

行政院及所屬各機關出國報告  
(出國類別：考察)

## 考察「日本電信編碼管理之規劃及推動情形」 出國報告書

行政院研考會/省(市)研考會 編號欄

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## 一、前言

本計畫之考察目的，主要在瞭解日本寬頻無線通信及有線通信網路的技術發展狀況，期由對日本網路技術之發展，了解新技術及新業務未來趨勢及對號碼的需求及對編碼架構可能產生之異動等情形。透過與 NTT 研究人員的討論，以及實地參訪 NTT、NTT Multimedia Center、NTT Do Co Mo 等展示中心，更進一步掌握電信科技之發展趨勢，俾做為我國相關政策、法規研擬及監督管理市場之參考，並及早規劃修正我國電信中長期編碼計畫，以因應未來市場所需。

本次考察係經日方建議將「日本電信編碼管理之規劃及推動情形」及「電信設備審驗認證及射頻設備管理之現況及實施」合併舉行，並邀請電信總局電波管理處吳副處長日田任考察團團長及團員五人共赴日本參訪，考察期間自民國 89 年 12 月 16 日至 89 年 12 月 22 日止共 7 天。透過日本東亞科學技術協力協會安排分別參訪 NTT Multimedia Center、郵政省通信總和研究所（CRL）、Tokin Co Ltd.、JQA 財團法人日本品質保證機構、Telecom Engineering Center、NTT Do Co Mo 等機構。

## 二、拜訪行程

十二月十六日（六）啟程赴日本東京

十二月十七日（日）行前事務協調、資料整理

十二月十八日（一）參訪 NTT Multimedia Center

參訪 CRL

十二月十九日（二）參訪 Tokin Co Ltd.

參訪 JQA 財團法人日本品質保證機構

十二月二十日（三）參訪 TELEC（Shinagawa-ku）

參訪 TELEC(Matsudo city,Chiba)

十二月二十一日（四）參訪 NTT(Minato-ku)

參訪 NTT Do Co Mo

十二月二十二日（五）返國

## 三、考察心得

（一）由於日本郵政省（Ministry of posts and Telecommunications , MPT）即將於西元二〇〇一年一月起全面改組，納入總務省內，日本東亞科學技術協力協會電氣通信無法安排對其參訪，故經洽商後，原參訪郵政省部分調整為參訪日本寬頻無線通信及有線通信網路的技術發展狀況，因此對於電信編碼方面之相關政策及規劃無法完整地了解，諮詢有限，甚感惋惜。

（二）NTT 多媒體中心現在位於東京都霞關，將於 2001 年遷至西新宿，日本 NTT 公司致力於佈建寬頻網路，目前是以

ISDN 為推廣之目標，鼓勵用戶使用 ISDN 作為快速上網之網路，未來計畫將光纖到家。參觀 NTT 多媒體中心讓我們了解到 NTT 公司現在及未來對寬頻網路建設的現況及規畫，也見識了其在寬頻網路上欲推展之多媒體服務，可充分感受到他們進步的情形。茲略述說明如下：

1. Mobil 及 ISDN 的用戶係透過不同號碼來擷取多媒體中心的資訊及服務。
2. 目前日本總人口約一億二千萬，而 Internet 用戶已有三千五百萬。
3. NTT 多媒體中心提供之透過不同網路之服務，費率如下：
  - (1) 「OCN-ISDN economic」服務的速度為 128kbps，其目前月租費(含通話費)為 32000 日圓，預期目標為 2005 年時速度增為 10Mbps，而月租費降為 10000 日圓。(日本民眾平均所得約為我國的三倍)
  - (2) 透過光纖網路服務的速度為 1.5Mbps，月租費為 328100 日圓，目前有 4 萬多用戶，動畫下載速度為 496kbps。
4. NTT 已研發出電腦下載音樂至磁片的新設施，其 IC 磁片依容量大小的不同，播放的時間長短也有差異，16MB 容量約可播放 25 分鐘，32MB 容量約可播放 50 分鐘，64MB 容量約可播放 100 分鐘。所使用之音樂壓縮技術為 Twin VQ，壓縮能力 1/18。自 1999 年推出至今已有 5 萬用戶，其售價為下載機及收音機(重 50 克)一組為 300 美元，32MB 的 IC 磁片為一片 3 萬日圓。

5. NTT 與 Sky Perfect TV 合作提供之廣播服務，傳送速度為 384kbps。其接收方式為透過 Sky Perfect 衛星傳送至 NTT 的衛星地面站 NTT-ME，再透過 ATM 網路傳送至用戶。其付帳方式為用戶付費給 NTT，NTT 再拆帳給 Sky。
6. NTT 有鑑於電子銀行盛行，亦發展供電子錢包應用之金資網路及相關應用，可節省現金交易之麻煩及風險，促進電子商務之發展。
7. 發展 Infoket 系統，利用 scramble 技術達到防止盜拷網路資料之目的。日本網路安全目前並沒有統一的專職管理機構，乃由各公司自行負責。
8. 另外在 NTT 多媒體中心還參觀了其研發出之語音辨識之手錶型行動手機，有兩種模式，分別為特定語者(speaker dependent)及不特定語者(speaker independent) 兩型。
9. ATM 網路係以專線方式提供企業用戶使用，因此不須配號碼。
10. NTT 推展多媒體服務的基礎網路因為考慮兩衰因素所以不擬採無線用戶迴路(WLL)方式，而是採 FTTH(Fiber To The Home) 光纖到家的方式。目前普及率約 30%，預估 2010 年時能達 100%。

(三) 由於本次考察與「電信設備審驗認證及射頻設備管理之現況及實施」考察案合併舉行，因此也讓我們額外獲取了日本電信設備審驗認證及射頻設備的相關知識，並參訪了郵政省通訊總合研究所 (CRL)、日本東金公司 (Tokin Co Ltd.)、日本品質保證機構 JQA 財團法人及 TELEC 等。茲

簡述如下：

- 拜訪郵政省通訊總合研究所時，由其企劃部室長大內智晴為我們簡報 CRL 設立之法規依據、願景、組織架構、研究方向等。有鑑於本局正擬籌設技術中心，故摘錄一些相關資料，俾供參考。其經費來源係由政府撥給，其提供之服務及研究詳圖一、圖二，員工人數及分配情形詳圖三、圖四。

除聽取簡報外並參觀其電波暗室，供作本局建置相關設施之參考。

- 拜訪東金公司時，見識了電波暗室的各種規格和各種不同吸收體及所能吸收之電波頻率，並參觀多種電波暗室。請參看圖五、圖六。
- 參訪日本品質保證組織 JQA 時，瞭解了該組織之架構及任務，及其認證的相關產品內容與工作性質。JQA 也對產品做電磁相容測試，但是只限於家電產品，通信產品並未包含在內，和我國標準檢驗局之部份工作相似。
- 參訪 TELEC 時，瞭解了 TELEC 是日本郵政省唯一指定之型式認定發證組織，所有電波法規定須要做型式認定之產品，均要獲得 TELEC 發給型式認定證明才可銷售或使用。該公司的經費非由政府編列預算，而是以收取客戶測試服務費做為其營運資金。當天下午並至松戶市參觀 TELEC 之電波暗室、室外開放場及行動電話機之 SAR 測試。

(四) NTT Do Co Mo 現在是日本最大的行動電話服務公司，參觀 NTT Do Co Mo 產品展示中心，不論其展示室之設計或

展示的研發產品均帶給我們相當大的震撼，首先是多媒體簡報該公司對 2010 年寬頻多媒體行動通訊的研發願景，幻想未來世界人們的生活方式，透過各式各樣的影像電話及通訊器材不但使我們的生活更便利也真正實現了天涯若比鄰的境界，其中一些富有創意的幻想產品如：單頁式的電子書籍、小圖示觸控式的電腦螢幕輸入及平面式鍵盤、柺杖型多媒體通訊設備、高品質的視訊會議、以及各式聲控的影音傳訊器材等，讓未來成為無疆界的全方位通訊時代。看完多媒體簡報後，大螢幕牆緩緩翻起，出現一條宛如時光隧道的走道，我們魚貫穿過來至一間寬敞的展示室，迎面就見一面玻璃牆在導引人員的控制下出現了之前多媒體簡報中的一些畫面，令人不禁震驚幻想已實現了嗎？陸續又參觀了現階段行動電話各種應用、各種造型的手機、聲控的手機等，以及為第三代行動通信多媒體應用準備的各式手機，遠端家庭設施遙控技術、配合指紋辨認之個人付款機等先進產品雛型、無線通信的電子商務、具有多媒體通訊設備的賽車及可與其連線的各項賽車相關資訊登錄設施等，這些雛形成品皆已研發成功，將適時量產以擴展其市場競爭力，這些展示在在顯示日本在研發寬頻多媒體通信相關的技術及設備之成果，令我們既讚嘆又惶恐我國電信研發能力落後之程度。

(五) 關於日本電信編碼之相關訊息，僅於拜訪 NTT 研究人員時所獲得之有限資訊，茲列於下：

1. 日本電信編碼單位為郵政省的通信政策局。當新技術、新業務需使用電信編碼時，則由政府相關人員、專家、



學者及電信業者等適時組成編碼小組研擬因應，而非定時開會。

2. 日本政府核配電信號碼給業者時並未收取任何費用，業者核發給用戶時亦未收費，當同一號碼有多位用戶爭取時，則由業者判決由誰獲得。反觀台灣目前政府核配電信號碼給業者時亦未收費，但業者核配給用戶時，則會收取號碼設定費，另更因用戶選號或選用金號碼而額外收取更多費用，如前陣子中華電信即因行動電話的一個號碼 0912345678 就額外得到 88,800 元暴利。由於我國民眾願意為了某些特殊號碼支付額外費用致使業者憑空獲得許多收入，就號碼資源稀少且為政府所有之角度來考量，我國政府應可實施電信號碼收費制，避免業者從中獲取暴利。
3. 對於電信號碼收回方式，日本政府目前並未強制制訂相關收回機制，僅以勸告方式，業者即會配合歸還。反觀近年來我國因電信自由化，開放多家業者公平競爭，考量號碼規劃之原則，須收回相關號碼時，總會因某些因素而無法如期迅速收回；又為促進新業務之發展，本局往往在初始核配時會核配較多號碼區塊，但若用戶需求量未如理想時，多餘的區塊就因此浪費了。有鑑於此，我國仍應訂定一套收回機制，俾利執行。
4. 1997 年 7 月日本內閣批准一項電信自由化計畫，其中允許 NTT 及其他新進業者進入國際電話市場。日本政府目前只實施撥號選接功能，預定於 2000 年 5 月起實施指定選接功能。而目前核予國際既有業者 KDD

業者國際接取碼碼長為三碼(001)，核予新進固網業者則核予4碼及五碼長；四碼長之編碼格式為00X1X2，其中X1不為0,0,9，譬如0033(NTT)、0041(JT)、0075(JTCS)等；五碼長之編碼格式為002Y1Y2。至於1997年12月22日正式開放之國際單純語音轉售業務(International Simple Resale,ISR)則核予六碼碼長(0091N1N2)，例如009130(Do Co Mo)。

雖然日本政府核准第二種電氣通信事業者可申請0091N1N2事業者識別番碼，但據平成12年4月電氣通信番號內記載該組號碼只被申請了三組，分別為009122、009123及009130。據NTT研究人員告知，日本民眾較喜好以另一種方式接取ISR業者，其方式為：先撥一免付費電話，再輸入個人識別號碼(Personal Identifier Number, PIN)，最後輸入目的地號碼。此方法雖然較冗長，但卻可節省以0091N1N2+目的地號碼方式接取時所需額外支付之local access charge。

因費用及撥號冗長之緣故，日本的ISR業者較缺乏競爭力。由此可知，雖有有利的資費方案，仍須搭配一套完善的編碼規劃，才有利市場的競爭，方可增進人民福祉。

5. 日本因行動電話費率降低，用戶數劇增，原規劃之行動電話號碼不敷使用，故於1999年1月1日起行動

電話號碼升碼，以前之編碼格式為 10 碼長，升碼為 11 碼長。分為兩大類，一為行動攜帶式與汽車電話，另一為低功率行動電話（PHS），其編碼格式如下：

升碼前之編碼格式	升碼後之編碼格式
行動攜帶式與汽車電話：  0A0-CD-XXXXX  PHS：  0A0-CD-XXXXX	行動攜帶式與自動車電話：  090-ACD-XXXXX  PHS：  070-ACD-XXXXX

其中 ACD (A=0 保留) 為業者識別碼，共計 900 個區塊；XXXXX 為用戶碼。

日本並於 2000 年 6 月研擬一份有關電信號碼的研究報告，其中調查出行動電話號碼雖然已於 1999 年 1 月 1 日起升碼為 11 碼長，但至 2000 年 3 月時其 ACD 碼（業者識別碼）已核配至 900 號（即已核配 800 個區塊）了，僅剩餘 100 個區塊，而日本已預訂於 2001 年開放第三代行動電話，因此將面臨不敷使用的情況，因此對於第三代行動電話的編碼格式做了深入探討，並提出兩方案：(1) 增闢一新的 0X0 字頭，使得行動號碼總容量增為 2 億號 (2) 將現有 11 碼升碼為 12 碼長。其中 (2) 方案需既有的行動電話號碼配合升碼，

造成社會成本的浪費，且與固定網路號碼（10碼長）的碼長相差了 2 碼等因素，最後建議採（1）方案。

6. 日本網際網路於 1999 年時已達二千七百萬戶，近三年來更有五倍的成長率。大型企業的普及率為 88.6%，商業辦公室的普及率為 31.8，一般家庭的普及率為 19.1%。日本對於網址及網域名稱是由 JPNIC 來核配，該機構為非營利單位，且並不受政府管理。此點與我國不同，我國目前正進行增修電信法第二十條之一，欲將目前核發網址及網域名稱之機構 TWNIC 授權為電信總局之受託機構，並授與辦理核准及管理時，管理費得歸受託機構，然其必要管理費之收費標準，由電信總局訂定之。
7. 日本固定通信網路號碼為 10 碼等碼長，其編碼格式為 0+區域碼+局碼+用戶號碼；其中區域碼為 1~3 碼長，局碼為 4~2 碼長，用戶號碼為 4 碼長。此與我國中長程編碼之規劃相似。
8. 日本 IN 之編碼格式為 0AB0，其中 0120 字頭為免付費電話、0990 為情報服務、0170 為語音錄放服務等。因 0120 字頭號碼已不敷使用，因此於 1999 年 7 月增加 0800 字頭做為免付費電話使用。

9. 日本 ATM 網路目前尚未與 PSTN 連結，屬於封閉型的網路，故政府尚未編訂 ATM 的編碼格式。

(六) 據 NTT 研究人員所言，日本 PHS 業務因行動電話費率降低的影響，導致於用戶數萎縮，但由於其數據傳輸的功能較強，拜網際網路盛行之故，其用戶成長率又增加了。本國 1900 兆赫低功率行動電話將於 2001 年開始營運，希望亦能有不錯的績效。

(七) KDD 已於 1995 年 4 月獲准經營國際網際網路開道，其意義在於經營國際服務之第一類電信業者得以將網際網路服務與網路電話 (I-Phone) 服務納入服務範圍。1997 年 8 月 26 日 MPT 開放了網路電話，任何第二類電信業者均可利用第一類電信業者的國際網際網路開道服務經營網路電話。我國目前第一類電信業者亦可經營 I-Phone，惟仍未開放第二類業者經營此服務。

#### 四、考察建議

(一) 此行參觀日本 NTT Multimedia Center、NTT Do Co Mo 等展示中心，見其對未來展望極為豐富並充滿競爭力，對通信科技之發展更大膽假設且付諸行動，致力於研發並模擬，反觀國內各家電信業者在研發方面的進度緩

慢，成果亦非常有限，此點值得國內各家電信業者效法及省思。建議國內業者能多觀摩其他電信科技發展先進之國家，提昇研發技能，期能提供更高品質的電信服務。

- (二) 日本在電信技術及應用方面之書籍甚多，但據瞭解電信總局員工對日文熟悉者甚少，且日本公布於網站之英文資料不多，一般員工無法研讀日本相關訊息，是一大損失。建議本局鼓勵員工進修日文，並鼓勵對日文有研究之員工，翻譯值得閱讀之電信科技資料供員工參考。
- (三) 此行因故無法安排參訪日本郵政省實是一大憾事，對電信編碼相關資料獲取相當有限，盼未來能有機會拜訪該單位，俾利全盤瞭解日本的電信編碼。
- (四) 此次考察本案乃是與「考察電信設備審驗認證及射頻設備管理之現況及實施」一案合併辦理，不但可精簡一名翻譯人員的人力，亦使我們加深電波監理方面的知識，對提升綜合規劃業務之能力有所助益，且一週的共處下來也增進了不同部門同仁間相互的瞭解與情誼，有助往後事務之合作、分工。此次考察承蒙李嘯河先生不辭辛勞每天陪著我們東奔西跑，為我們擔任翻譯；更感謝長官准予考察的機會，能赴日拜訪業務相關單位，增


廣見聞不少，在此由衷感謝。

## 五、附件

## Three Regular Services

### Determination & Supply of the Standard Time and Frequency

Highly Precise Japan Standard Time (Error rate: one second per 1.7 million years)



Optically pumped cesium frequency standard


- ★ Transmission Freq: 40 kHz
- ★ Transmission Output: 50 kW
- ★ Location: Fukushima Pref.

A new standard radio wave transmission center was established in Mt. Otakadoya in June 1999.

### Type Approval & Calibration of Wireless Equipments

(In Fiscal Year 1999)


- ★ Type Approval: 153
- ★ Calibration: 155



Standard site for type approval and calibration

### Regular Observation of Ionosphere & Space Environment Info. Service

- ★ Regular Observation of Ionosphere by four radio-wave observatories in Japan and the Showa Base in the Antarctic for about 60 years.
- ★ Space Environment Info. Service



COMMUNICATIONS RESEARCH LABORATORY

圖 一

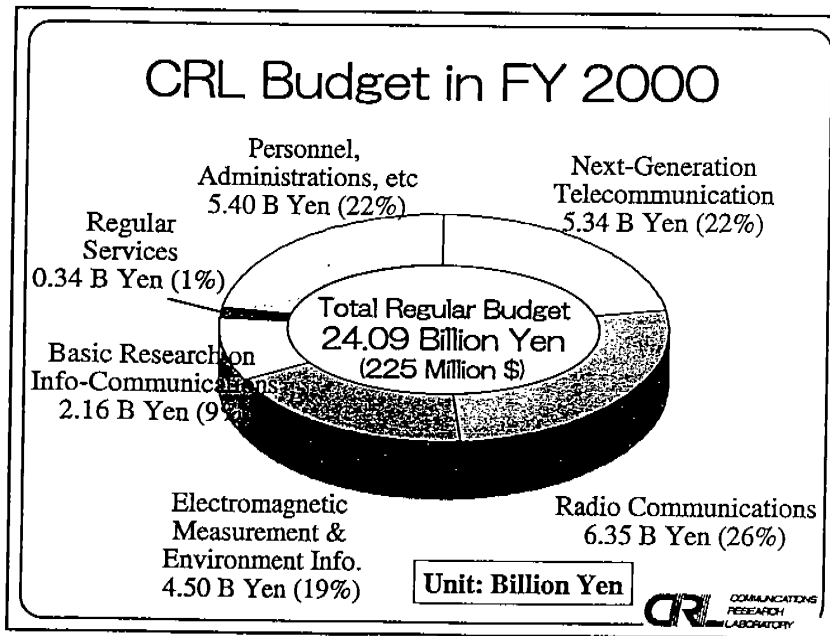


圖 二



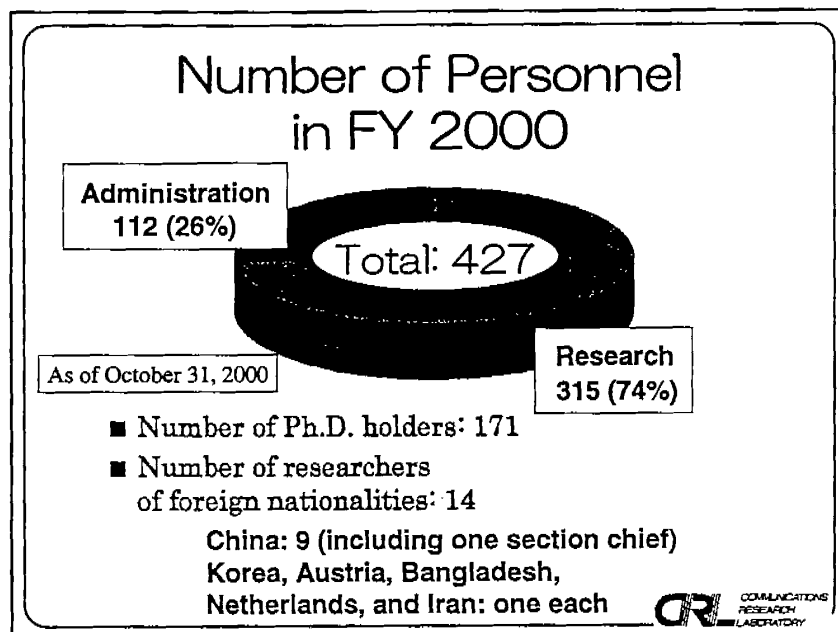


圖 三

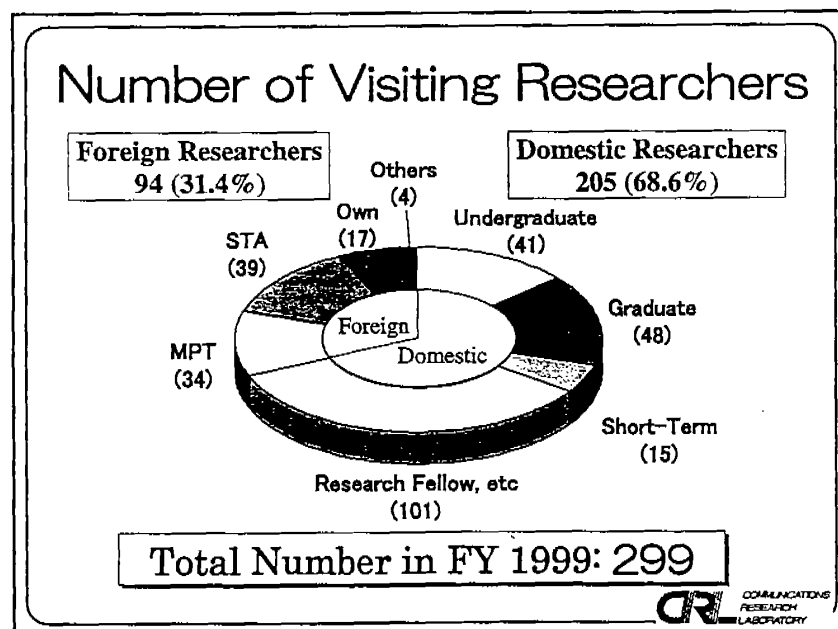
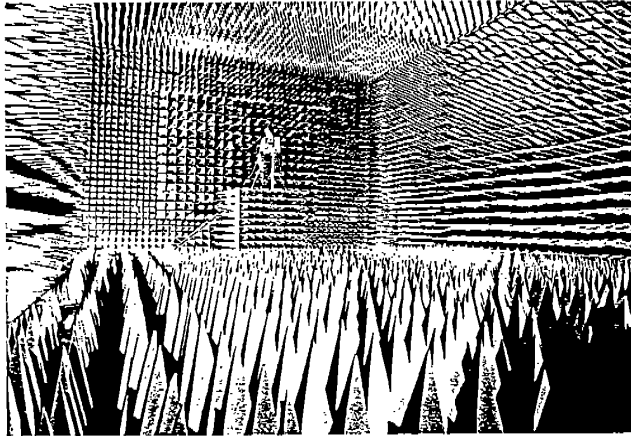


圖 四

# マイクロ波共用電波暗室／マイクロ波電波暗室

## ●マイクロ波共用電波暗室 (ALC-ME)

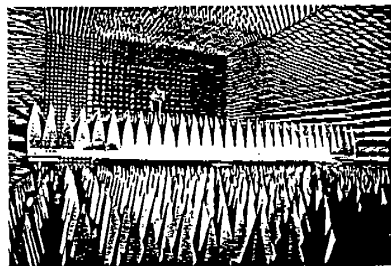


(写真提供：日本電気株式会社)

## 特 長

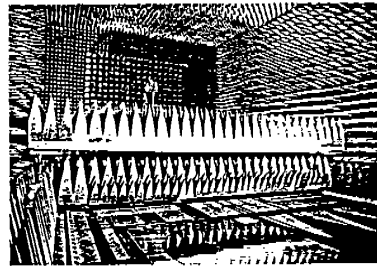
- 床の電波吸収体を、自動走行により移動させることで、マイクロ波帯での疑似自由空間をつくる完全電波暗室と、EMI測定(3m法)が可能な半電波暗室の両方の特性を兼備える。
- 使用する電波吸収体は、フェライト電波吸収体とピラミッド型ウレタン電波整合器の整合技術と電波暗室の設計技術により、非常に広範囲(30MHz~100GHz)な吸収性能の実現。
- 短時間での自動計測を可能にするために、付帯設備はGP-IB制御対応。

## 圖 五



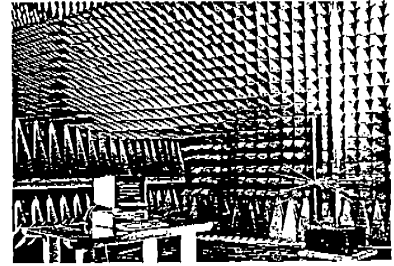
床面上昇

(写真提供：日本電気株式会社)



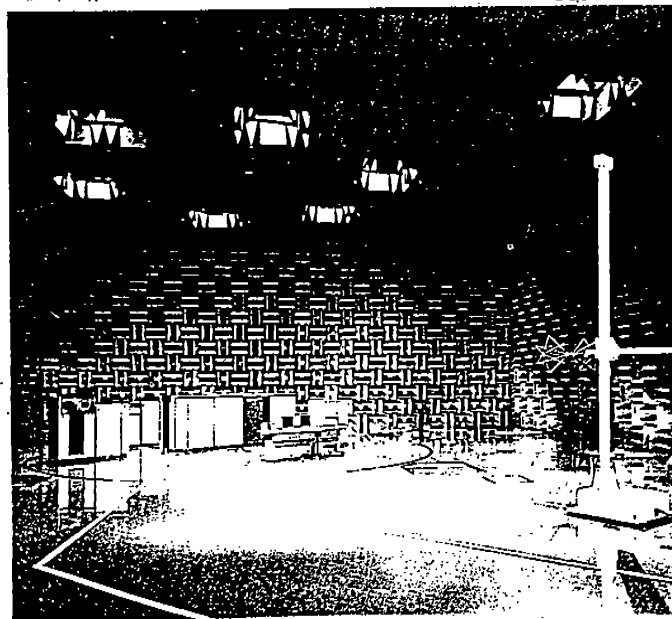
床面移動

(写真提供：日本電気株式会社)



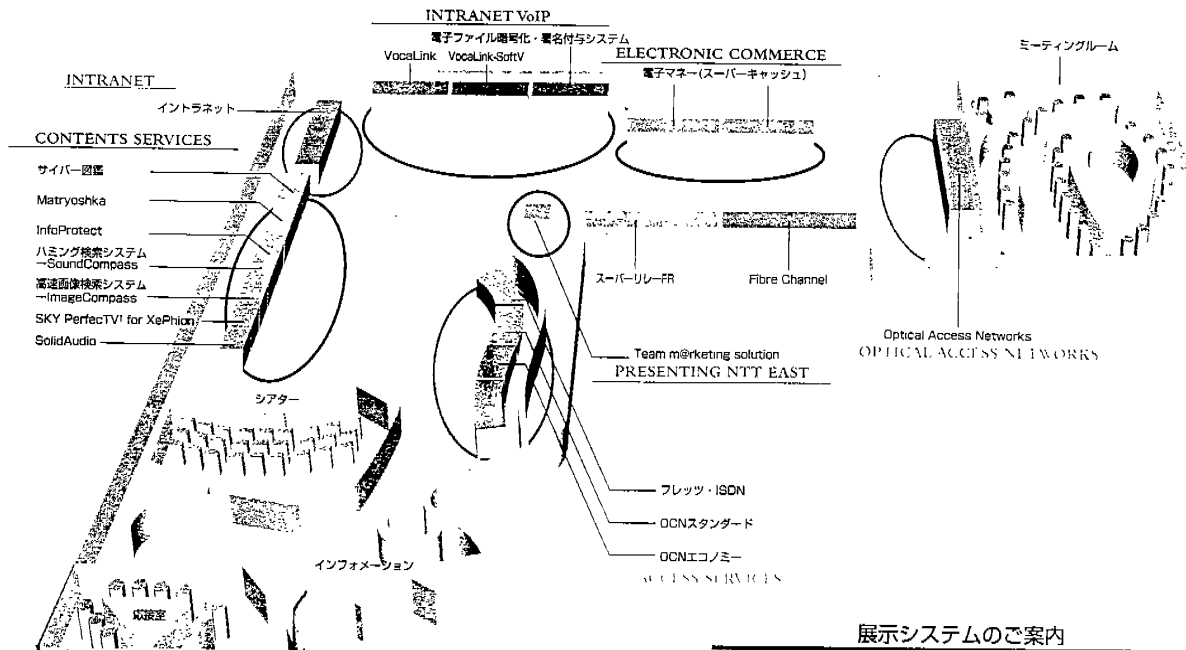
EMI計測状況

(写真提供：日本電気株式会社)



## 圖 六

# NTT MULTIMEDIA CENTER in TOKYO



## 展示システムのご案内

### IP ACCESS SERVICES

フレッツ・ISDN  
OCNエコノミー  
OCNスタンダード

### CONTENTS SERVICES

SolidAudio  
SKY PerfectTV! for XePhion  
高速画像検索システム—ImageCompass  
ハミング検索システム—SoundCompass  
InfoProtect  
Matryoshka  
サイバー図鑑

### INTRANET

イントラネット

### INTRANET VoIP

VocaLink  
VocaLink-SoftV  
電子ファイル暗号化・署名付与システム

### ELECTRONIC COMMERCE

電子マネー(スーパーキャッシュ)

### NETWORK SERVICES

スーパーリレーFR  
Fibre Channel

### OPTICAL ACCESS NETWORKS

Optical Access Networks

### PRESENTING NTT EAST

Team m@rketing solution



- シアター  
最新のNTTグループの事業概要をご覧頂けます。
- 展示システム  
8つのゾーンの中からご関心のあるシステムをご覧頂けます。

※ システムは変更になることもありますので予めご了承ください。



# NTT MULTIMEDIA CENTER in TOKYO

(旧称 NTT霞が関コミュニケーションセンター)

センターご案内時間 9:30 ~ 17:00  
休館日 土・日曜日、祝日

Open from 9:30 a.m. to 5:00 p.m.  
Closed on weekends and holidays

予約方法 (ご見学は予約制となっております)  
予約およびお問い合わせ番号 ☎ 0120-191921  
予約受付時間 9:00 ~ 17:00

For reservations and information,  
Tel. 0120-191921 (Toll free)  
Reservations accepted from 9:00 a.m. to 5:00 p.m.

〒100-6030  
東京都千代田区霞が関3-2-5 霞が関ビル30F

Kasumigaseki Bldg., 30th Fl.,  
2-5, Kasumigaseki 3-chome, Chiyoda-ku,  
Tokyo 100-6030 Japan

### 交通機関

- 地下鉄銀座線 虎ノ門駅 (5出口) 徒歩3分
- 地下鉄日比谷線・千代田線 霞が関駅 (A13出口) 徒歩7分
- 地下鉄丸ノ内線 霞が関駅 (A4出口) 徒歩8分
- 都営地下鉄三田線 内幸町駅 徒歩13分
- J R新橋駅 徒歩15分

### Nearest Stations:

- Three minutes' walk from Exit 5 of Toranomon Station on the Ginza Subway Line
- Seven minutes' walk from Exit A13 of Kasumigaseki Station on the Hibiya and Chiyoda Subway Lines
- Eight minutes' walk from Exit A4 of Kasumigaseki Station on the Marunouchi Subway Line
- Thirteen minutes' walk from Uchisaiwai-cho Station on the Mita Subway Line
- Fifteen minutes' walk from Shimbashi Station on the JR Line



**NTT**  
**Research and Development**  
*2000 Review of Activities*  
*(For the Fiscal Year Ending March 31, 2000)*



## ***Contents***

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### **Research and Development 2000 Review of Activities**

■ R&D in Review .....	1
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# R&D in Review

Fiscal 1999 was a year that saw major transformations in the field of information communications, in Japan and throughout the world. In March 2000, the number of mobile phone subscribers in Japan exceeded the number of fixed analog phone subscribers. NTT DoCoMo's "i-mode" service—which allows users to connect to the Internet via a cellular phone—was initiated in February 1999, and within just over a year, by March 2000, it had recorded over 5.6 million users. ISDN subscribers, meanwhile, had exceeded 7.4 million by this time. As these and other trends indicate, the "Internet population" in Japan, which is already estimated at over 27 million, is even now increasing at a rapid pace. These changes have made fiscal 1999 a year that will go down in the history of NTT, because income from mobile telephone and data communication services exceeded income from fixed analog telephones for the first time. In addition, amid the momentous changes that characterize the IT revolution, emerging Net businesses are enjoying rapid growth—particularly in the United States—and there is a growing trend in Japan as well toward mergers and tie-ups between such new Internet businesses and major media corporations.

In terms of NTT itself, a reorganization was performed in July 1999, and a new system was instituted under a pure holding company. Targeting a transformation from traditional telephone-oriented companies to a "Global Information Sharing Corporate Group," the NTT Group Three-Year Business plan, announced in April 2000, expresses the Group's determination to actively promote the IT revolution in Japan, by improving the speed, economy, and diversity of networks and IP-based services. Given this background, the Holding Company fulfills an extremely important role in terms of carrying responsibility for the strategies of the entire NTT Group and conducting its own research and development activities. While the R&D divisions in the operating companies of NTT Group conduct R&D related to services and applications that are close to the customer, the Laboratories of the Holding Company are responsible for R&D related to basic, elemental, common technologies, and other areas that will become the foundation for future activities.

Let us review briefly the R&D activities that have taken place over the past year. First of all, in the field of communication networks, NTT developed the world's first multi-chip module for ATM\* switches—allowing direct input and output of optical ATM cell signals—and made significant progress toward the establishment of a super high-speed optical network exceeding speeds in the terabit class. In October 1999, we began tests of an "adaptable network"—a network that can adapt itself flexibly to increasingly diverse and complex user needs and network services, and to ever-changing communication-related demand.

In the field of information sharing platforms, we have developed a number of security technologies that are essential to both e-commerce and "e-government." Among these are Provably Secure Elliptic Curve encryption (PSEC), the Optimal Extension Field operation method (OEF; the world's fastest Elliptic Curve encryption method), and the next-generation common-key encryption method "Camellia". Camellia, which was developed jointly with Mitsubishi Electric Corp., achieves high efficiency and the highest level of security in the world. In terms of efforts related to the next-generation Internet, NTT was certified in September 1999 as a "sub Top Level Aggregator (subTLA)," the highest-level of backbone provider using IPv6 protocol, and has made progress toward the establishment of the IPv6 network.



立花 佑介

Senior Executive Vice President  
Yusuke Tachibana

In the field of content applications, terminals, and software, we have promoted the creation of a foundation for easy generating, processing, and sharing of video contents. For example, we developed "CyberCoaster," which allows the user to interactively manipulate objects within an image, and created a PC card version of the real-time MPEG-2 encoder. In addition, NTT is participating in the Content ID Forum, which is drafting a framework to protect copyrights while promoting secondary applications of digital contents.

In the area of fundamental research, NTT conducted high-gain, low-noise optical amplification tests that redefine the quantum limits of traditional optical amplifiers through the use of coherent optical amplification technologies. We were the first in the world to succeed in developing semiconductor optical integrated circuits that integrate high-performance semiconductor optical filters and multiple optical detectors into a single chip, thus promoting the development of optical communication technologies as well as reductions in both the cost and the size of related devices. NTT has also promoted research and development into fundamental and elemental technologies aimed at raising the level of information sharing services, for example by developing technologies to integrate single-electron transistors whose power consumption is around 1/100,000th of conventional units, and by developing Dialog Understanding and Generation-1 (DUG-1), a computer that responds adaptively to human speech.

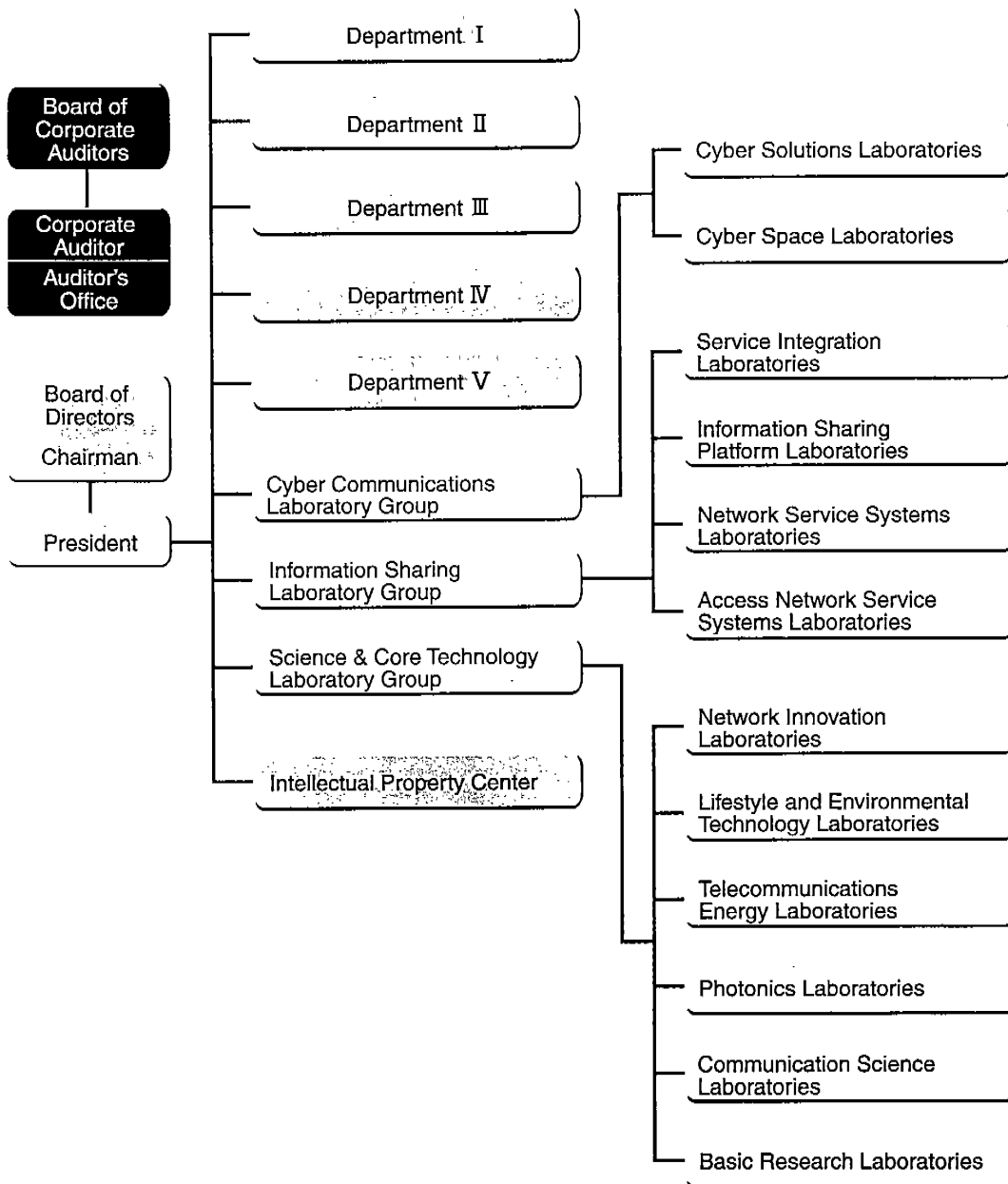
The year 2000 will see the beginning of optical fiber access services with maximum speeds of 10Mbit/s, as well as major advances for the NTT Group as a Global Information Sharing Corporation. We will create information sharing services for the 21st century incorporating information sharing platforms, contents, and terminals over the networks, and actively promote R&D activities aimed at making NTT the Center of Excellence for the NTT Group and for the world, to ensure that the fruits of our R&D efforts can be put to use at all levels of society.

We look forward to your continued guidance and support.

\* ATM: Asynchronous Transfer Mode

# R&D at NTT

## Organization Chart of Nippon Telegraph and Telephone Corporation (NTT-The Holding Company)



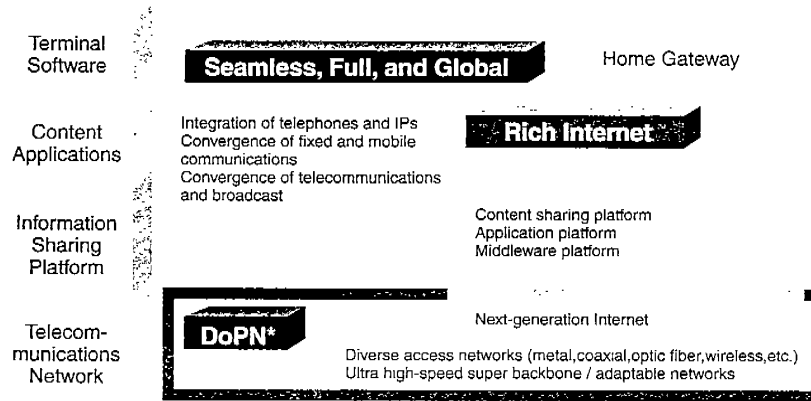
(As of March 31, 2000)



# NTT R&D Vision

Aiming to achieve information sharing service

## The Three Key Concepts for R&D



\* DoPN: Data over Photonic Network

In aiming to achieve and develop information sharing services, NTT is carrying out R&D activities based on three principal concepts:

### (1) Data over Photonic Network (DoPN)

Provide flexible network services based on photonic technologies to respond to a wide variety of needs, both present and future.

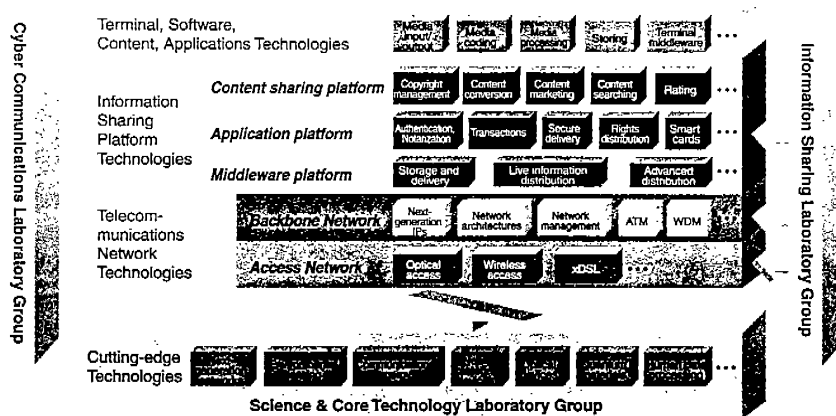
### (2) Rich Internet

Provide safe, secure, convenient and comfortable service solutions for content and applications businesses via an enriched Internet.

### (3) Seamless, full, and global

Provide integrated seamless services such as convergence of telecommunications and broadcast, and convergence of fixed and mobile services; unified full services from networks to applications; and increasingly globalized services.

## R&D Technology Fields



# Content, Application Technologies

Technologies for advancing and supporting the sharing of mass-media contents, including broadcasts, advertisements, music and games, over networks.

## CONTENTS

■ An Interactive Image Interface (CyberCoaster) .....	5
■ Image Cataloging System for Browsing and Searching a Large Volume of Images .....	5
■ Live Broadcasts that Notify Users of their Preferred Scenes (LiveWatch) .....	6
■ Knowledge Portal System (TITAN/KP) Using Company-Wide Information .....	6
■ Atmospheric Environment Monitoring System Using a Network .....	7
■ Pollen Information System for Use of Detailed Pollen Reports in Networks .....	7

## An Interactive Image Interface (CyberCoaster)

In conventional video systems, it is necessary to use the slow and cumbersome fast-forward or reverse functions to search for scenes one wants to see. Using these functions can be rather irritating to users; if they wish to closely study a golfer's swing, for example, they have to keep manipulating the buttons on the remote controller, now running past the scene in one direction, now rewinding past it in the other.

The CyberCoaster interface we have developed provides a welcome contrast in usage. It enables users to reproduce video images intuitively, by allowing them to feel just as if they could take hold of the things portrayed in the video and move them about themselves. In the golf swing example, they can feel like they are the one grasping the club and swinging it.

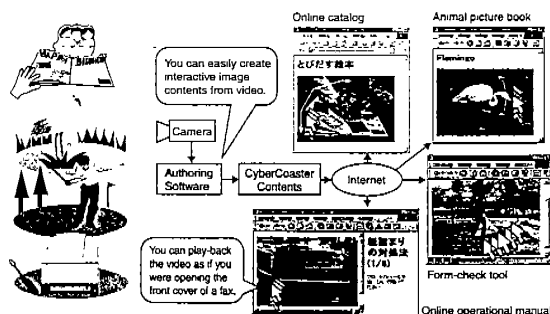
The CyberCoaster mechanism involves a broken-line slider buried in the video that allows users to move video frames forward and backward by inputting commands with a mouse or push-button panel. Furthermore, sound can be reproduced and relevant Web pages can be displayed along with the video. With its combination of the features of a clickable map and slider, the interface has an extremely wide field of application.

One example application is the creation of "moveable" automobile catalogs, i.e. one in which the doors, hood, etc. of the cars can be opened and closed. Other possible applications, all of them based on realistic interactive image contents, include the making of teaching tools like animal picture books or scientific experiments, operational manuals for equipment, form-check tools for sports usage, and games that allow them to participate in adventures like treasure hunts.

Because the interface runs on general Web browsers that drive Java, it can be made available to a great many users to easily provide them with services such as the ability to make payments electronically. Furthermore, its specialized editing software supports linked operations from video incorporation to Web page creation, making it possible for any user to create interactive image contents and put them on the Internet.

(Cyber Solutions Laboratories)

Contents creation and distribution with CyberCoaster



## Image Cataloging System for Browsing and Searching a Large Volume of Images

As a result of the decreasing cost of digital cameras and image scanners, more and more a large volume of digital images are being created, and how to easily organize and search large numbers of image files is becoming an important problem. Conventionally, text tags are attached to individual images manually after the images are acquired and search is done on the basis of key words. That requires considerable trouble to be taken to register images and also results in cases where the desired image cannot be found because of the different personal methods and standards for tagging images. Search technology based on image content, such as using the color blue as a picture feature to retrieve images containing views of the sea, has been proposed as a solution to these problems.

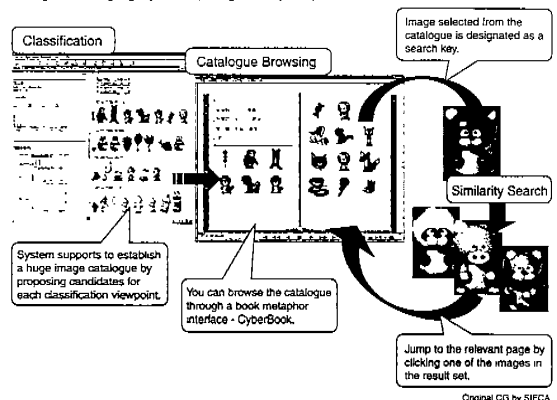
To achieve more accurate search results, this system performs searches on the basis of objects that appear in the images, such as "human face", dominant lines such as "horizontal line", and terms that express feelings, such as "elegant." These image features are extracted automatically by the system when the image is registered. In addition, the system employs a search engine that has a high-dimensional database indexing function built in to allow high-speed retrieval.

This system also makes it possible to construct an image catalog for efficient browsing of large-volume image databases by means of image features. The image catalog can be browsed with a Web browser, digital book, or other such means. By therefore treating this image catalog and image search function as a book's table of contents and index, respectively, and using them in a linked manner, we have implemented an efficient large-volume image cataloging system.

The overall image coloring and horizontal line features are suitable for scenic photographs, pattern direction and coarseness features are suitable for textile or cloth catalog photographs, and color and shape features of the photographic subject are suitable for commercial product photograph catalogs, sample photographs, and ordinary snapshots. This system has a wide area of application, including the selling of images by electronic commerce, electronic catalogs, distance education, digital museums and so on.

(Cyber Space Laboratories)

Image cataloging system (ImageCompass)



## Live Broadcasts that Notify Users of their Preferred Scenes (LiveWatch)

Research and development is presently being conducted on interactive video for next generation digital and Internet broadcasts.

With conventional live broadcasts, there is no way of knowing what and when events will occur. Viewers must therefore watch the broadcast until the scene they want to see is shown. NTT Laboratories have developed "LiveWatch", an interactive live broadcast system with a function that notifies viewers of their preferred scenes. With LiveWatch, each user can be notified when the scene they have designated, such as a home run or the play of a favorite player during baseball broadcasts, is imminent. Users will never again miss their desired scenes.

During Internet live broadcasts using LiveWatch, semantic information describing the live situation related to constantly changing conditions is transmitted from the server to the client in addition to streaming live video. In the case of baseball broadcasts, these constantly changing conditions refer to the count (strike, ball, out), innings and the player in the batter's box. The client application determines which scenes the user has pre-selected based on semantic information sent from the server. The user is then notified when these scenes are imminent. Users can select the notification method, either a sound or twinkling of the application, and it is possible to have the video to start up automatically at the same time notification is given. In addition, by changing the semantic information for relayed into a visual format displayed as an icon, live situations can be represented in an easy-to-understand manner on the client screen.

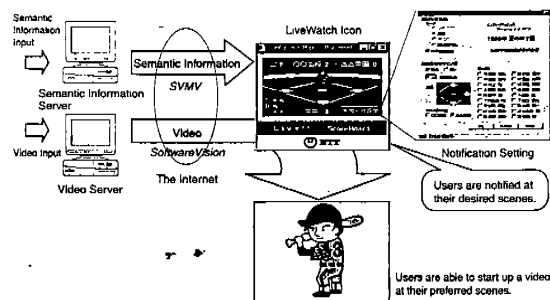
At the 81st All Japan High School Baseball Tournament in the summer of 1999, we used baseball games to test a LiveWatch Internet live broadcast with Asahi Broadcasting Corporation. For this broadcast, a prototype system was constructed using SoftwareVision, NTT's video distribution technology, and SVMV\*, scenario distribution technology for the distribution of semantic information, with the client application created in Java.

In the future, a variety of live broadcasts will be targeted for LiveWatch application.

(Cyber Solutions Laboratories)

\* SVMV: SoftwareVision Multi-Vision

LiveWatch service image



## Knowledge Portal System (TITAN/KP) Using Company-Wide Information

With the advances and spread of personal computers, in business, it has become easy to create and store materials electronically. This material can therefore be practically used on a daily basis by anyone in the department in which it was made. However, it is not yet possible for other branches or the whole company to access this material.

TITAN/KP\* is a "knowledge portal" that enables users to transcend the barriers between departments so that they can share information. It has the following technical features.

(1) Information disclosure by means of a simple template (upload server)

Proposals, manuals, and other business documents can be posted on the WWW by a simple operation. And the author's name and the document classification are added so that the document can be retrieved at a later date.

(2) Comprehensive information retrieval (portalization)

A "web robot" automatically gathers and retrieves information from the upload server and the WWW servers for intranets and the Internet. The robot uses the attributes added at the upload server or the document contents in order to retrieve the document file. As a result, any existing documents in the whole company can, in effect, be "seamlessly retrieved".

(3) Flexible control of access

Access to document information and document files posted at the upload server can be restricted. The restrictions can apply to whole documents or bibliographies of documents. This means that restricted document files can still be retrieved even though they cannot be accessed. In other words, disclosure of documents on the portal system can be flexibly restricted.

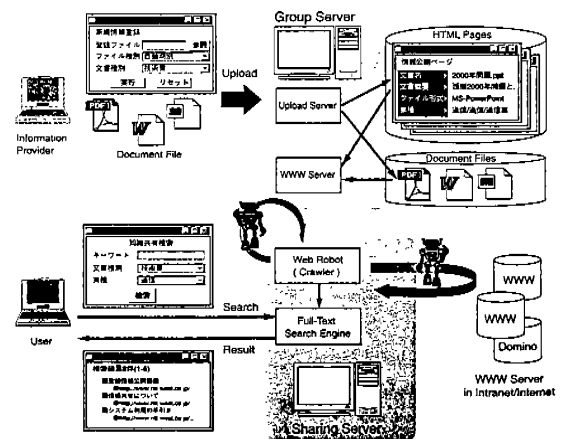
The above three features of TITAN/KP ensure that knowledge and information is systematically organized and therefore shared efficiently.

In the future, it is planned to expand, for example, the access control and to provide individually customized screens in order to create a so-called "company-wide knowledge portal".

(Cyber Space Laboratories)

\* TITAN/KP: Total Information Traverse Agent/Knowledge Portal

Structure of TITAN/KP



## Atmospheric Environment Monitoring System Using a Network

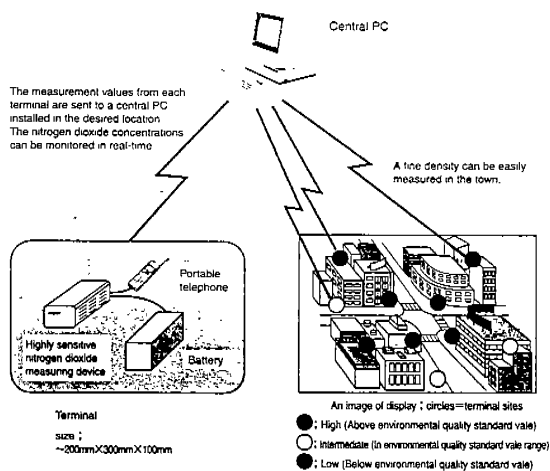
NTT continues to tackle environmental challenges. The present Basic Environmental Act targets seven environmental categories – (1) air pollution, (2) water pollution, (3) contamination, (4) noise pollution, (5) vibration, (6) land subsidence, and (7) offensive odors. Air pollution is identified as the most important category, and the act sets environmental standards for five pollutant substances –sulfur dioxide, carbon monoxide, suspended particulate materials, nitrogen dioxide and photochemical oxidants– and expects these standards to be maintained. Of these five substances, nitrogen dioxide is the most difficult to curtail as its major emission source is motor vehicles, and many areas have not as yet met the required numerical standard (65% achievement rate as of 1997). Moreover, as the emission source is mobile, there are indications that nitrogen dioxide concentrations are highly location dependent. However, existing measuring systems are problematic in reducing nitrogen dioxide as they are large and expensive, and can not be installed freely nor detect detailed conditions.

NTT has proposed and developed an atmospheric environment monitoring system that measures nitrogen dioxide concentrations using simple, miniature sensors linked by a network that simultaneously provides information on multiple locations. This monitoring system has been achieved through the use of nitrogen dioxide concentration detection elements and measuring devices developed by NTT. A detection element and measuring device form the network terminal, which can be easily installed wherever the users wants to measure nitrogen dioxide levels. The terminal is considered one system and up to 100 systems can be installed to provide detailed concentrate information. The measurement values from each terminal are sent via wire or radio circuits to a center PC installed in the desired location. The nitrogen dioxide concentrates at each measurement site can be monitored in real-time for changes over time.

This system has been employed by a joint project conducted by Iwate Prefecture, United Nations University and NTT, and its operation throughout the year is checked. Results are reported and updated whenever necessary on the project's homepage. (<http://www.ias.unu.edu/ecology/>)

(Lifestyle and Environmental Technology Laboratories)

Atmospheric environment monitoring system; an image of installation and display



## Pollen Information System for Use of Detailed Pollen Reports in Networks

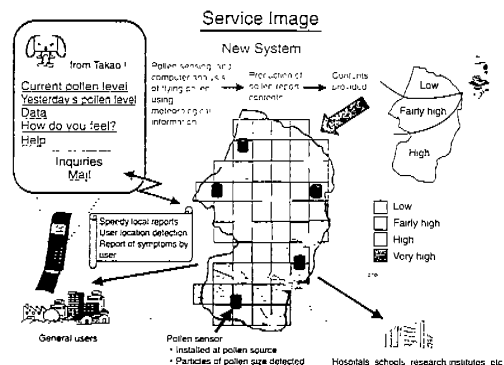
NTT Laboratories are moving forward with the development of an interactive, network-based service that will allow applications of the latest pollen reports and other living environment information, anytime, anywhere. For the prototype system, we will install a laser-light scattering particle counter –modified for pollen counting– in a clean environment near a cedar forest, which is a source of cedar pollen. This device will conduct periodic, real-time tabulation of the number of pollen particles floating in the air under low-noise conditions. Measured values will be transmitted to a remote server via a network, using which we will create a pollen database. Based on meteorological data such as wind direction, wind strength, and temperature, the remote server will conduct a computer analysis of how the pollen released from the cedar forest will be borne by air currents, and to which metropolitan areas or other populated areas the pollen will be carried. The results of this analysis will be processed into "pollen reports" and other information contents, which users will be able to access interactively via portable phones or the Internet.

Along with the changes in living environments and lifestyle patterns in recent years, cases of hay fever and other allergies have been increasing with each passing year. The number of persons suffering from hay fever is said to be about one in ten on a national average, or an estimated 15 million people. Air pollution is one inducing factor –the number of sufferers in the Kanto and Kansai regions exceeds the national average– and there is also a trend toward a widening age range of these sufferers nationwide. According to medical institutions, the most advisable means of preventing hay fever symptoms is to avoid allowing pollen to enter the body. The pollen reports included in current weather reports use very basic data measured from visual observation under a microscope, and as a result numerous problems arise, including the accuracy of the data and the speed with which this data is distributed.

We are working toward the development of technologies that will allow users to access the latest pollen-related information interactively through various types of media. We will apply sensor measurement technologies, computer analysis technologies, and Internet technologies to provide information that is even more detailed, both in terms of time and location, as part of our efforts to develop systems that are useful to society and that contribute to improved quality of life.

(Lifestyle and Environmental Technology Laboratories)

The pollen report system of the future



Example of an i-mode display



# Information Sharing Platform Technologies

Technologies for achieving common functions essential to content sharing business and electronic commerce such as copyright management, electronic settlement, and information delivery.

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## Development and Introduction of GMN-CL (IP-VPN Service)

With the approaching advanced information society, there is growing demand for high-speed transfer of voice, video, and other types of data for corporate networks and personal communication. That demand has created the need to provide broadband, highly-secure, and high-quality communication for various types of information at low cost.

GMN-CL<sup>1</sup> responds to that need by using the Internet protocol (IP) to construct corporate intranets and other such private networks (IP-VPN<sup>2</sup>). The features of GMN-CL are listed below.

(1) When an ATM<sup>3</sup> is used for the infrastructure network, the guaranteed quality of service and high-speed data transfer functions provided by the ATM can be used at the IP level.

(2) In the Core Network, communication is conducted by a Core Protocol that incorporates MPLS<sup>4</sup> technology, so high-speed packet transmission processing in which labels are used is possible, and additional services that feature high quality and reliability are possible as well. In case that an ATM is used for the infrastructure network, interworking between the Core Protocol and the ATM enables elaborate QoS<sup>5</sup> control.

(3) The Core Network is managed by the carrier using Core Addresses, which are different from the IP addresses, so from the outside it appears as a single virtual router. In this way, a high degree of security is ensured.

GMN-CL comprises a transmission control system, which transmits IP packets at high speed and with high quality, an advanced service system that makes it possible to provide sophisticated services, and an integrated management system that manages the GMN-CL network as a whole. Development is done within that framework. The transmission control system specifications are for Track II procurement to make full use of on-the-market technology. The advanced service system and integrated management system were developed in-house as differentiated items. This year, the system was introduced into NTT Communications' Arcstar21 and is being used in various industries, including the automobile industry, insurance industry, and distribution industry. Moreover, the introduction to NTT East and NTT West and the Information Highway in municipal corporations is also being planned. NTT Laboratories will continue in the future to add various functions and to strive to improve reliability, quality, and service content in response to the needs of NTT Group corporations while also contributing to standardization activities such as IETF<sup>6</sup>.

(Information Sharing Platform Laboratories)

<sup>1</sup> GMN-CL: Connectionless Networking Technologies for Global Mega-media Networks

<sup>2</sup> IP-VPN: Internet Protocol-Virtual Private Network

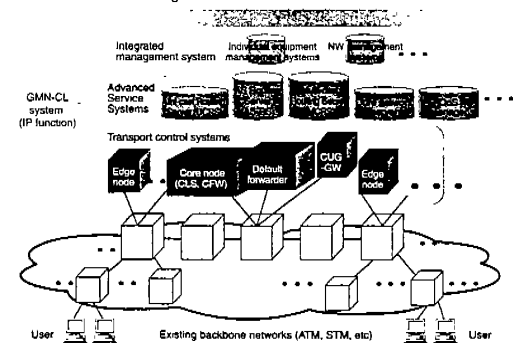
<sup>3</sup> ATM: Asynchronous Transfer Mode

<sup>4</sup> MPLS: Multi-Protocol Label Switching

<sup>5</sup> QoS: Quality of Service

<sup>6</sup> IETF: Internet Engineering Task Force

GMN-CL network configuration



## Scalable Information Collection/Retrieval Server for SOHO to Portal Site Needs (InfoBee/Evangelist)

With the increasing use of computers and the Internet in recent years, the amount of information stored in electronic form has expanded rapidly. As a result, data collecting and searching technologies are becoming increasingly important for helping network users locate the information they need from the vast amounts of data on the network. One particularly hoped-for development is that of technologies with enough scalability to keep up with the rapidly expanding scale on which data is being stored.

To help address these needs, we have used PC cluster technology to develop "InfoBee/Evangelist", an information collection and search server that comprises multiple computers working together to form a single large computer system. InfoBee/Evangelist is composed of crawlers that collect data from the Internet, intranets and other networks, and search engines that conduct fast and accurate searches by creating word indexes from compiled data.

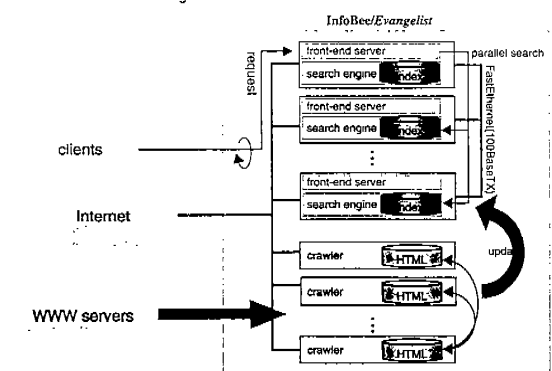
Multiple computers working together enable the system's crawlers to search out WWW data links with a high degree of efficiency; the result is that an extremely large volume of document data is collected within a short period of time. Collected document data is divided into multiple blocks, each of which is then sent to a search engine that will handle it. When the search engines receive the conditions for making a search, they start operating in parallel and the search results they obtain are merged so that a final search result is created and output.

Since both crawlers and search engines have distributed and co-operative architecture, InfoBee/Evangelist achieves superior scalability both in terms of throughput and the scale of document data to be processed. It provides users with a wide data search solution range, from in-house databases like SOHO\* and other small- and middle-scale databases to the large-scale search services available through Internet portal sites. The InfoBee/Evangelist system is now being used at the OCNnavi (NTT Communications) and goo (NTT-ME Information Xing) Internet portal sites.

(Cyber Solutions Laboratories)

\* SOHO: Small Office Home Office

Outline of InfoBee/Evangelist



## Yokosuka City Service Card System

The Yokosuka City Service Card System aims to allow users easy access to government and private services through the use of a special multipurpose IC card (provisionally named the "Yokosuka City Service Card"). The card will be able to be used to obtain services in such diverse areas as transportation, medicine, finance, insurance, and social welfare. Developed with the objective of making city life easier, the system was test-demonstrated in Yokosuka during the period of July-December 1999. Specific services provided in the test were (1) managing a personnel database and automating contacts for the support of NPO<sup>1</sup> activities and (2) making reservations at public facilities through the use of the Internet and kiosk terminals.

The system, jointly developed by NTT Laboratories, NTT Communications, and NTT East, is an electronic society base system with public key infrastructure and IC card. It combines an IC card (Elwise Card), a coding library (ISEC<sup>2</sup>), and an electronic certification authority (CANP<sup>3</sup>) previously developed by NTT Laboratories.

The multipurpose IC card used in the system has a high-capacity 512-Kbyte memory, and it is possible to make additions or substitutions to the card's program content. In the demonstration test of the system, an ESIGN<sup>4</sup> secret key for the user was housed in the card to enable users to be authenticated. This card was also used for individual usage data storage, and the data compiled during the six-month test verified the system's practicality. Additionally, we used on trial a local government's homepage search engine which categorizes pages in a search result by using the search engine TITAN<sup>5</sup> and a data classification system.

In future work, we will use the results obtained so far to develop an information system for community use and to make the government system electronic.

(Service Integration Laboratories, Lifestyle and Environmental Technology Laboratories, Information Sharing Platform Laboratories, Cyber Space Laboratories)

<sup>1</sup> NPO: Non-Profit Organization

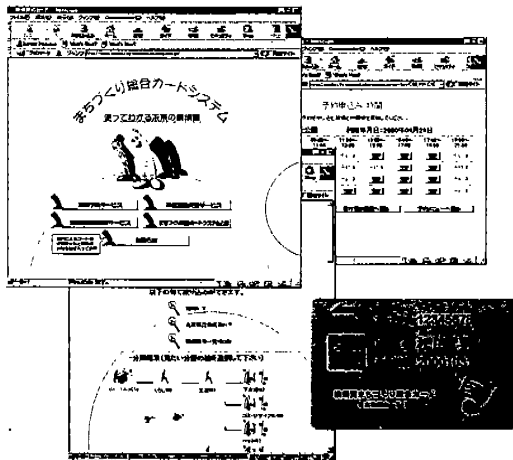
<sup>2</sup> ISEC: Cryptography and Information Security Library

<sup>3</sup> CANP: Certification Authority for Network Policy

<sup>4</sup> ESIGN: Efficient Digital SIGNature Scheme

<sup>5</sup> TITAN: Total Information Traverse Agent

The City Service Card System's website top page and IC card



## Content Distribution Using Content ID and Digital Watermark Technologies

As a result of the popularization of the Internet and improvements in digital encoding technologies for image and sound data, there has been a trend toward laying out the conditions for easy distribution of digital content via networks. Despite this situation, however, there are a number of problems that are resulting in a tendency to avoid content distribution, including the inability to send copyrighted materials over networks without anxiety due to digital media being characteristically "easy to copy without loss of quality."

In order to respond to this situation, we have proposed a distribution framework, through the activities of the Content ID Forum (Chairman: Professor H. Yasuda, Tokyo University; established in August 1999 to promote standardization and defacto standardization of content ID), to protect copyrights while promoting the reuse of digital content. This can be accomplished by using digital watermark technologies to allot a unique copyright code (content ID) to each item of digital content. A first-stage prototype system based on this framework has already been completed.

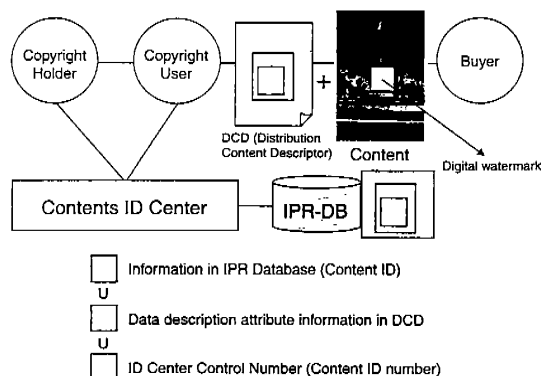
In this system—as illustrated in the distribution model (Content ID Forum compliant) diagram—the copyright holder registers the content in the IPR-DB<sup>\*</sup> of the Content ID Center, and a unique ID is embedded in the content using digital watermark technology. The copyright holder gives the copyright user a license for use with regard to rights and distribution by way of a Distributed Content Descriptor (DCD). The copyright user combines the DCD and the content with embedded ID, and provides (or sells) the content to the buyer. Because the ID is embedded in the content, it is easy to detect the ID and conduct an illegal use check in the event that the content is used illegally.

In the future, we will combine this technology with usage limitation technologies and payment/accounting technologies, as part of continuing efforts geared toward developments into content distribution platform operations. A number of tests related to content applications—in cooperation with image and music creators as well as content providers—are scheduled to be conducted from June 2000 in order to verify the effectiveness of this system.

(Cyber Solutions Laboratories)

\* IPR-DB: Intellectual Property Rights Database

A distribution model that promotes the re-use of digital contents while protecting copyrights, through the use of digital watermark technology





## The CANP Certification Authority System

To allow safe conduct of EC<sup>1</sup> and EDI<sup>2</sup> over a network, it is necessary to protect important data from wiretapping or tampering by using cryptography. Generally, digital signatures based on the public-key cryptosystem are being used, but they are subject to attack by spoofing, so it is necessary that the owner of a public key be certified by a trusted third party. This mechanism is implemented as a certification organization that is called a CA<sup>3</sup>, which issues and manages certificates that serve to authenticate the identity of the certificate owner over the network and distributes certificates upon retrieval requests from the other party in a communication.

NTT Laboratories have developed the CANP<sup>4</sup> Certification Authority system, aiming at a highly reliable CA that can be applied to a large-scale intranet or extranet.

CANP uses the domestic encryption method ESIGN in addition to the world-standard RSA<sup>5</sup> encryption, so this CA system can be used to construct a highly reliable communication environment that is not governed by the encryption policies of other countries. Furthermore, because the system supports the world's fastest tamper-free dedicated digital signature equipment and has a function for the batch issuing of certificates, it is capable of safe, high-speed processing of large volumes of applications. Moreover, because the system implements a real-time certificate validation checking function by means of an HTTP<sup>6</sup> interface, it can also be applied to systems that require authentication that is both large in scale and strict, such as electronic administration. CANP has so far already been applied in the On-line Application and Electronic Content Identification System, the Yokosuka City Universal Card System, and other systems.

In future, with the objective of expanding the application areas of CANP, we plan to proceed with research and development of technology for operating multiple different CAs on a single CA server and technology for the hierarchical certification and cross-certification among multiple CAs that is required for electronic administration applications.

(Information Sharing Platform Laboratories)

<sup>1</sup> EC: Electronic Commerce

<sup>2</sup> EDI: Electronic Data Interchange

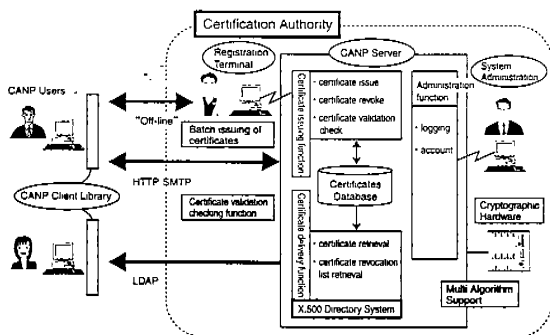
<sup>3</sup> CA: Certification Authority

<sup>4</sup> CANP: Certification Authority for Network Policy

<sup>5</sup> RSA: Rivest-Shamir-Adleman Scheme

<sup>6</sup> HTTP: Hypertext Transfer Protocol

CANP system



## Development of the Right Commerce Platform "Infoket/InfoBind Ver1.0"

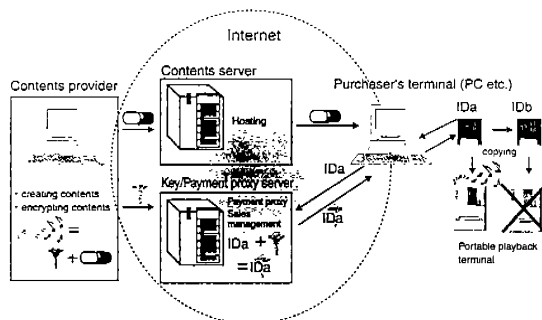
In order to allow content owners to distribute contents without fear of their being misused, we have developed the right commerce platform "Infoket/InfoBind Ver1.0". The platform prevents misuse of contents by encrypting them and providing a key that allows them to be decrypted. The contents are sent in encrypted form to users, who can then have the decrypting key sent to them by using an unalterable ID they have on a memory medium such as SmartMedia. The user must have such an ID to decrypt the contents, and this makes it impossible to copy contents onto another personal computer or memory medium after purchasing them. Since providers are able to encrypt the contents themselves, they can provide the contents to users without any plain contents flowing over the network. Eavesdropping and forging of contents during distribution is also prevented, and thus a high degree of content security is achieved.

The platform is already in service, and is currently being used to protect the security of distributed music contents. In July 1999 it was put into commercial use for the first time, as part of the SolidAudio music playback terminal. It is also being used in the BaySide contents distribution mail.

For the future, we envision increasingly diversified usage of the platform, not only with music distribution systems, but also for distributing a wide range of digital-content items such as document-reading services, English-language teaching materials and moving images.

(Information Sharing Platform Laboratories)

Overview of right commerce platform ver1.0



## A Highly Reliable, Low-Cost, High-Efficiency Content Transfer System for Industrial Extranets

Accompanying the acceleration in business activity and increasing importance of information in those activities, there is a growing demand for a system that can deliver large-volume digital data quickly, safely, and surely. Conventionally, Internet file transfer services or specialized systems that employ file transfer middle-ware have been used, but it has been difficult to fully satisfy requirements such as abundant delivery functions, safe and certain delivery, easy interworking with application programs, and the efficient use of networks.

In response to such requirements, NTT Laboratories have developed a system that efficiently transfers digital content over a network via a transfer server. This system implements safe, certain and efficient delivery by providing a function for reporting the status of the information content to the sender, a function for restarting a transmission at the point where it was interrupted, a multicasting function in which the same data is sent to multiple receiving points simultaneously, an on-the-fly transfer function in which data is transmitted on immediately after it is received, and other such functions. In addition, functions for compression of multiple files or directories for transfer together in a single transmission, encryption, and the attachment of 'job tickets' that specify automatic execution of processing are also available. By providing an open API<sup>1</sup> and well-equipped SDK<sup>2</sup> for these numerous data delivery functions, this system facilitates use in cooperation with user application programs.

A highly efficient digital content transfer system that has the kinds of functions described above can be used to construct an advanced extranet service through the interworking of application programs for a variety of industries that involve the delivery of large-volume data, such as the printing industry, the construction industry, and the broadcasting industry. A commercial service in which this system applied in a platform for the printing, advertising and publishing industry will begin in the year 2000.

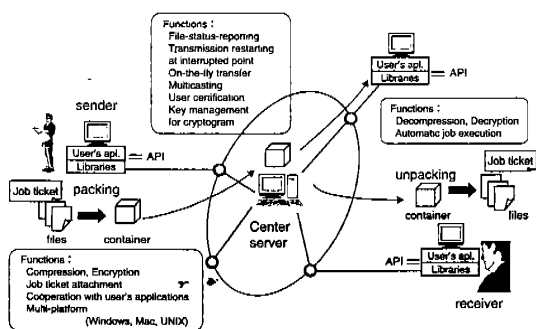
In future, we plan to implement a digital content transfer services that offer a variety of quality classes by increasing the number of installed transfer servers in the network and management of the bandwidth of the communication lines that connect the servers.

(Information Sharing Platform Laboratories)

<sup>1</sup> API: Application Program Interface

<sup>2</sup> SDK: Software Development Kit

Outline of high-efficiency content transfer service



## UPT Services Based on Advanced Intelligent Network (AIN) Technologies

We are seeing the arrival of an era of personal communications marked by a rapid popularization of portable telephones. Persons on the receiving end of calls, meanwhile, are finding it desirable to have a choice of connecting calls to the registered destination, or of accepting or rejecting calls depending on the conditions at the time. We have thus developed a UPT<sup>1</sup> service that allots a personal number to each customer, extending across multiple networks (fixed and portable telephones, PHS, etc.) to allow customers to select call destinations, or to have the choice of either rejecting—or storing at a message center—calls that they do not wish to take at that particular time.

This service successfully combines the following three functions: (1) a function that bills the customer for the calling charge; (2) a function that advises the customer that a message has been stored at the message center; and (3) a customer control function that allows the customer to register the call destination via a telephone network or the Internet.

Among the AIN components, a service control node (MHN-SCP<sup>2</sup>) and a service management node (SMS<sup>3</sup> (MG/OP)) operates based on a tie-up between platform functions common to various services and service-specific programs (SLP<sup>4</sup>/MLP<sup>5</sup>/OLP<sup>6</sup>).

The SLP is located in the MHN-SCP to achieve service-specific connection control functions. We have applied the INAP<sup>7</sup> signaling scheme, which has been accepted as a standard by both ITU-T<sup>8</sup> and TTC<sup>9</sup>, as the signaling scheme between the switch and the MHN-SCP. The MLP and OLP are located in the SMS (MG/OP). These allows contract information management functions and service operation condition management functions such as traffic data collection. By developing these service-specific programs, we have made it possible to develop these services more quickly.

Regarding an MHN-SCP facility operation system (MHN-SCP-OpS) as well, we have improved test call functions for those output format that are no longer required in the development of service-specific functions.

In the future, we plan to continue development of services that link together IP networks and public networks, based on AIN technologies as described above.

(Information Sharing Platform Laboratories)

<sup>1</sup> UPT: Universal Personal Telecommunications

<sup>2</sup> MHN-SCP: Multimedia Handling Node-Service Control Point

<sup>3</sup> SMS: Service Management System

<sup>4</sup> SLP: Service Logic Program

<sup>5</sup> MLP: Management Logic Program

<sup>6</sup> OLP: Operation Logic Program

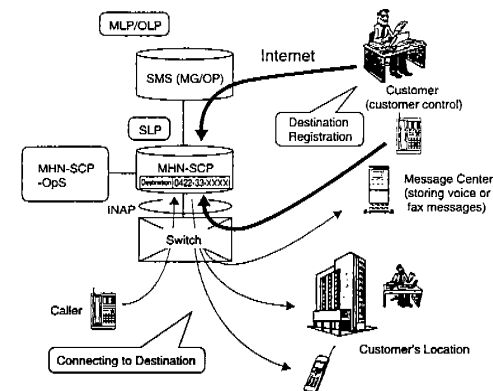
<sup>7</sup> INAP: Intelligent Network Application Protocol

<sup>8</sup> ITU-T: International Telecommunication Union-Telecommunication

Standardization Sector

<sup>9</sup> TTC: Telecommunication Technology Committee

UPT services based on AIN technologies



## Multilayer Traffic Monitor (ATM Probe)

Asynchronous transfer mode (ATM) networks are being applied more and more to the Internet backbone and to intra/extranets. Companies using an ATM network typically charge each department for its usage of the network. It is thus important to measure and monitor the traffic in layers such as ATM, IP<sup>1</sup>, and TCP<sup>2</sup>/UDP<sup>3</sup>. The products that have been developed to do this run on a dedicated computer and their functions are implemented in hardware, so they are expensive and difficult to upgrade.

We have developed a multilayer traffic monitor called "ATM Probe" that runs on a personal computer and whose functions are implemented in software. It is thus economical and easy to upgrade. ATM Probe can not only measure many kinds of traffic, it can also evaluate a network. It simulates network performance with actual traffic, but the actual traffic is not affected because ATM Probe uses passive measurement. The network can then be tuned based on the results of the simulation so that it will run more efficiently. ATM Probe also provides security and traffic forecast functions.

ATM Probe measures L2TP<sup>4</sup> traffic and has OC-3<sup>5</sup> and OC-12<sup>6</sup> interfaces. It is the first tool to enable traffic monitoring with an OC-12 interface. ATM Probe provides measurement reports and traffic forecasts automatically. The reports are useful for providing solutions to problems with a customer's network.

TAO<sup>7</sup> and NACSIS<sup>8</sup> have been using ATM Probe for over a year. NTT East and NTT West have selected ATM Probe for their local IP networks. NTT Communications has selected ATM Probe for its ATM leased lines.

We plan to develop an ATM probe for the Core protocol, to develop a function for estimating the bandwidth of a virtual path, and to upgrade the security and simulation capabilities.

(Service Integration Laboratories)

<sup>1</sup> IP: Internet Protocol

<sup>2</sup> TCP: Transmission Control Protocol

<sup>3</sup> UDP: User Datagram Protocol

<sup>4</sup> L2TP: Layer 2 Tunneling Protocol

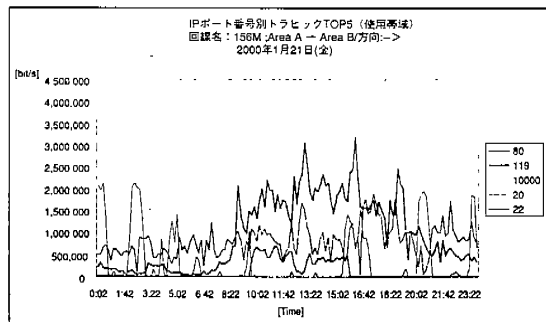
<sup>5</sup> OC-3: Optical Carrier level 3

<sup>6</sup> OC-12: Optical Carrier level 12

<sup>7</sup> TAO: Telecommunication Advancement Organization of Japan

<sup>8</sup> NACSIS: National Center for Science Information Systems

Sample of output



## New Satellite Communication Services that Combine Communications and Broadcasts

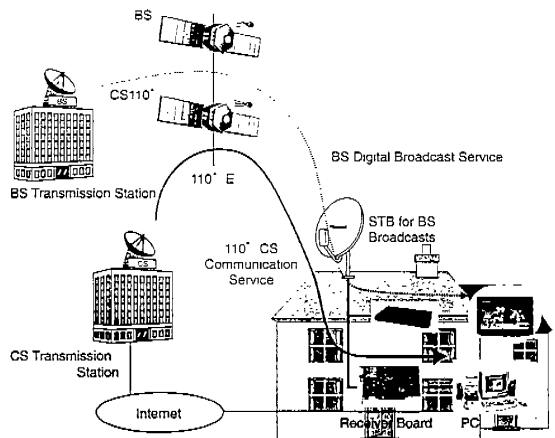
With the advent of BS Digital Broadcasts, service for which is expected to begin at the end of 2000, High Definition TV (HDTV) will become possible through the adoption of adaptive modulation schemes. As a result, not only video distribution but also interactive services and a diverse range of other data distribution services will be offered. The CS110<sup>°</sup> communications satellite (N-SAT-110), which is scheduled for launch in August 2000, will have the same orbit as the BS-4 satellite that provides BS digital broadcasts. It will thus be possible to provide satellite communication services that place less of a burden on users that are using the same reception antenna as for BS broadcasts. Through this project, we are developing an adaptive modulation satellite communication system for applications in satellite communications, using an adaptive modulation scheme (a BS digital broadcast technology). The goal of this system is to provide video image transfers, data broadcasts, and data communication services via the same terminal.

Another characteristic of this system is that it conducts circuit quality control that dynamically switches the modulation scheme in accordance with weather conditions and the reception conditions at the user's station. This is accomplished by applying the same adaptive modulation scheme as that used in BS digital broadcasts. In this way, it becomes possible to optimize transmission speeds and transmission quality based on user applications, allowing faster and higher-quality services to be provided. At the present stage, we have succeeded in developing two types of user terminals: a board type that conducts satellite communications via an independent PC unit, and a router type that conducts satellite communications via multiple PCs.

Future plans call for the development of a set-top box type that conducts Internet communications via a TV.

(Service Integration Laboratories)

Adaptive modulation satellite communication system



# Telecommunications Network Technologies

Technologies for establishing a base network infrastructure including satellite, wireless, and optical networks, all of which are essential to guaranteed bandwidth and broadband telecommunication.

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## Practical Applications of Systems for ATM Backbone Network

NTT Laboratories have been promoting development of various types of systems (model A/B/C, NE-OpS<sup>1</sup>) for ATM<sup>2</sup> backbone network, in order to respond flexibly to the rapidly increasing demand for multimedia, and on purpose to reduce costs by integrating networks that in the past had been created individually for each service. Files were released as at the end of June 1999, and the system was applied in Megalink and other services from October of the same year.

In order to allow the system for ATM backbone network to be applied in a number of different services, for this system consist of three types of equipment and equipment operation systems –Model A (node system), Model B (link system), and Model C (access system)– and have as basic functions the ability to support various types of QoS<sup>3</sup> class as well as to support various types of reliability measures, including section and VP<sup>4</sup> protection. Model A, which has a function that controls and manages ATM-related services, controls the PVC/SVC<sup>5</sup>. Model B has a VP cross-connect function to ensure efficient path accommodation in the optic fibers. Model C has a function that efficiently accommodates ATM-related services. Concentration between Model C and Model A is carried out using SNI<sup>6</sup> technology, so it is also possible to provide SVCs economically.

At the same time, a network operation system (ANIMA<sup>7</sup>) was developed (at the current NTT East and NTT West Research and Development Center) to allow us to operate these three types of equipment as a single unit. In this way, it is possible for us to uniformly carry out such functions as circuit monitoring and control, circuit opening, and receipt of failure notifications.

ATM backbone network can be developed as the backbone network offering, from existing ATM-related services to future SVC services, various types of multi-QoS that support diverse QoS levels, and for IP<sup>8</sup> services.

In the future, we will continue to increase the performance of this system, adding new functions including support for new services, and improving maintenance and operation functions even further than before.

(Network Service Systems Laboratories, Access Network Service Systems Laboratories)

<sup>1</sup> NE-OpS: Network Element Operation System

<sup>2</sup> ATM: Asynchronous Transfer Mode

<sup>3</sup> QoS: Quality of Service

<sup>4</sup> VP: Virtual Path

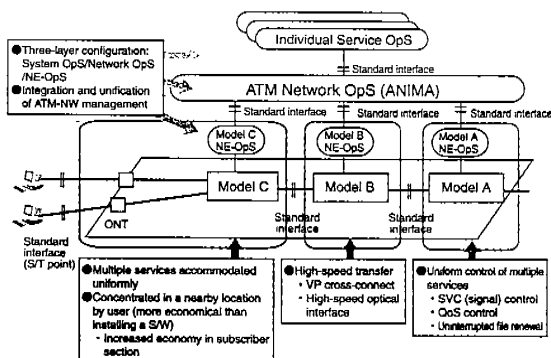
<sup>5</sup> PVC/SVC: Permanent Virtual Channel/Switched Virtual Channel

<sup>6</sup> SNI: Service Node Interface

<sup>7</sup> ANIMA: ATM Network Integration Manager

<sup>8</sup> IP: Internet Protocol

Configuration of systems for ATM backbone network



## Economically Upgrading Submarine Transmission Systems to 10 Gbit/s × 4 ch Using WDM Technologies

The communication capacity of backbone networks has increased dramatically in keeping with the growing demand for the Internet and other forms of multimedia communication. As a result, there have been considerable efforts made to find economical ways to increase the capacity of submarine optical fiber transmission systems, which are an important method of achieving high-capacity communications on submarine cable routes.

NTT Laboratories have developed a system that economically achieves high-capacity transmission in the FSA<sup>1</sup> submarine optical fiber transmission system, originally intended for single wavelength channel transmissions, which is installed between Kagoshima and Okinawa. This has been accomplished by making only the land-based equipment compatible with the shift to WDM<sup>2</sup>, while using the Submarine facilities (optical fiber cables and optical repeaters), which account for most of the capital investment, in their original form. This system was developed based on the results of field tests carried out by NTT Laboratories on the route targeted for the new application. It features a flexible and economical system configuration that makes it possible to increase the capacity of the existing transmission system, from 10 G × 1 wavelength per fiber to a maximum of 10 G × 4 wavelengths. In order to make this substantial capacity increase possible, we have applied the following: (1) a high-speed forward error correction technology for 10-Gbit/s systems; (2) a pre-emphasis technology for optical transmission; and (3) PRZ<sup>3</sup> transmission pulse and wavelength dispersion compensation technologies that can suppress the waveform distortion caused by fiber nonlinearity and dispersion. The system's monitoring and control carries over the supervisory methods used by the existing optical repeaters, and so allows the same ease of operation as the existing single wavelength channel transmission system, while at the same time offering independent monitoring and control for each separate wavelength. In addition, we have achieved single fiber-pair 4-wavelength channel transmission using a two-bay mount with a compact equipment design.

In the future, we will promote increases in the communication capacity and the economy of submarine optical fiber transmission systems and networks.

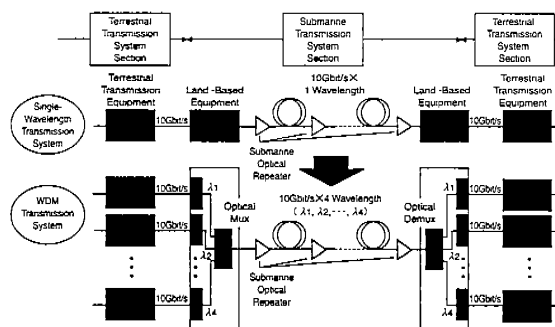
(Network Service Systems Laboratories)

<sup>1</sup> FSA: Fiber Submarine Transmission using in-line Optical Amplifier

<sup>2</sup> WDM: Wavelength Division Multiplexing

<sup>3</sup> PRZ: Partial-Return-to-Zero

Increasing capacity of submarine transmission systems using WDM Technologies



## Unidirectional Optical ADM Ring System for Multi-Point Broadband Communications

Backbone networks and regional networks in the information age will need to have the capability of transmitting an exceedingly large signal volume of several hundred Gbit/s with low cost and minimal delay. To handle signal volume of this magnitude with conventional electric-signal processing systems, however, hardware size would need to be excessively large and this would not be efficient from the standpoints of cost and delay time. By using the optical ADM<sup>1</sup> ring system, low-cost and small-delay operation can be achieved by optical signal processing of DWDM<sup>2</sup> signals.

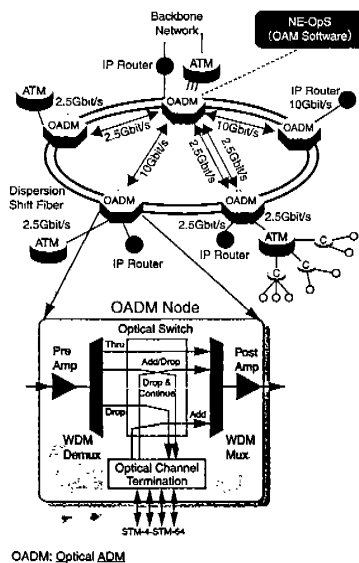
In this system, signals with different destinations are allocated by their respective wavelengths, and optical ADM nodes can easily be connected freely at the maximum signal capacity of 10 Gbit/s, since add/drop operations are executed for each separate wavelength in the nodes. Because the system employs long wavelength band transmission technology centering around 1.58 μm, wavelength for as many as 32 (optical) channels can be utilized regardless of the type of fiber used. In addition, the setting of optical switches in the optical ADM nodes makes it possible to distribute signals in their original light form without optoelectric conversion, giving the system a efficient 1-to-N multicast function. Making changes in these optical ADM functions enables optical channel connections to be changed while they are in service without affecting any other optical channels, resulting in flexible network operation. The system has a unidirectional path (optical channel) switched ring structure that uses two optical fibers and allows identical signals to be transmitted in their respective opposite directions simultaneously. This ensures high operational reliability, since even in the event of a fiber break or a malfunctioning node equipment, 1+1 optical channel protection makes it possible to instantly switch transmission to an alternate route.

(Network Innovation Laboratories)

<sup>1</sup> ADM: Add Drop Multiplexer

<sup>2</sup> DWDM: Dense Wavelength Division Multiplexing

Unidirectional optical ADM ring system



OADM: Optical ADM

## MAPOS Networking – Supercharge the Internet

Existing protocols for super high-speed communications still have many problems such as fragmentation of data, which results in poor efficiency and the effort required for management and operation. MAPOS<sup>1</sup> is a super-high-speed data-communication protocol, a technology that resolves these problems by combining standard optical transmission schemes (SONET<sup>2</sup>/SDH<sup>3</sup>) with Internet technologies. New protocols for the Internet are released by the IETF<sup>4</sup>, a committee that defines global standards, in the form of documents referred to as RFCs<sup>5</sup>. MAPOS, which was proposed by NTT Laboratories, was approved as a series of RFCs in June 1997 and was released in the same month. MAPOS has the following features:

- (1) Sends Internet data (IP packets) "as is" (without the need for data division).
- (2) Achieves super-high-speed communications that can be scaled up from 155 Mbit/s to 10 Gbit/s.
- (3) Can be used seamlessly from LANs<sup>6</sup> to WANs<sup>7</sup>.
- (4) Facilitates construction of freely configured networks with plug-and-play functions.
- (5) Allows the use of SONET/SDH technologies for the maintenance and operation of WANs.

NTT Laboratories have developed the following types of equipment for 155-Mbit/s to 2.4-Gbit/s MAPOS networks.

- (1) COREswitch: High-speed communication switch with a built-in compact DWDM that can handle up to 16 MAPOS lines.
- (2) MAPOS cards: PC/WS interfaces that can be used under either UNIX or Windows 95/98.
- (3) IP Router with MAPOS interfaces: MAPOS software has been ported into a commercial router (CISCO 12000) through collaboration with Cisco Systems.

In addition, we have constructed a MAPOS Tokyo metropolitan network on optical fibers connecting several metropolitan locations, as shown in the attached figure. Experimental operations began in March 1999 using 622-Mbit/s equipment, and a shift is gradually progressing toward the use of 2.4-Gbit/s equipment. The speed and convenience of MAPOS on actual networks have been demonstrated in evaluations up to now. Using this network, we will expand the range of our research into areas such as analysis of Internet dynamics in super-high-speed networks, automatic diagnostic systems in WANs, and global parallel processing systems.

(Network Innovation Laboratories)

<sup>1</sup> MAPOS: Multiple Access Protocol Over SONET/SDH

<sup>2</sup> SONET: Synchronous Optical Network

<sup>3</sup> SDH: Synchronous Digital Hierarchy

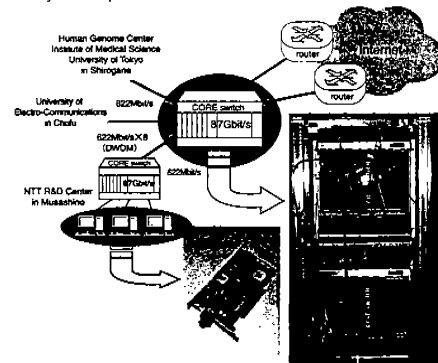
<sup>4</sup> IETF: Internet Engineering Task Force

<sup>5</sup> RFC: Request For Comments

<sup>6</sup> LAN: Local Area Network

<sup>7</sup> WAN: Wide Area Network

MAPOS Tokyo metropolitan network



## Planning Tool for Estimating Costs of Transport Networks

Network planners must estimate the costs of establishing transport networks whenever they introduce new technologies. They also have to repeatedly estimate the costs and compare among them if they have several alternative candidate technologies, products, or network topologies. Obviously, such cost estimation should be done efficiently.

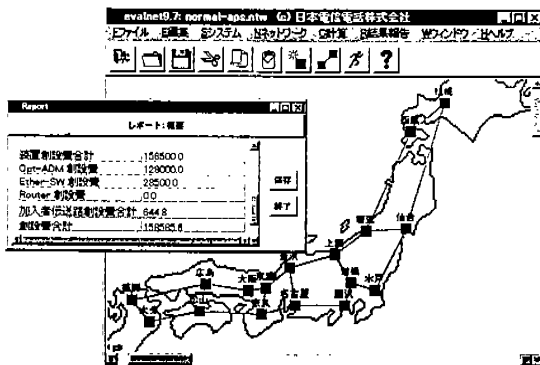
Conventionally, the costs of transport networks are calculated using generic spreadsheet programs. However, spreadsheet calculation is disadvantageous because human errors are very likely to happen during data input. Also, the sheets or macros made for one network model may be hard to reuse for other network models.

NTT Laboratories have developed a software tool for estimating transport network costs more efficiently than with spreadsheet calculation. The developed tool works on commonly used personal computers and workstations. Once it has been fed the traffic demand and information on the cable duct network and system architecture, it automatically computes the configuration of transmission paths and fibers. It then calculates the amount of equipment required and the cost of the network on the basis of the configuration. Of the procedures involved in this process, that computing the path configuration is the hardest to design. We have established a new algorithm to do this. In building the algorithm, quickness was given priority over strictness. As a result, one can evaluate many alternative models during a relatively short time period. A difficult problem occurs when a variety of path bandwidths coexist in a link, as seen in ATM networks. Namely, we need to identify a combination of paths to be multiplexed in the link so as to minimize link cost. A fast algorithm was developed to find an efficient combination of link paths. An additional feature of the tool is the capability of defining the system architecture and unit prices of network resources. This feature makes the tool very versatile, so it can be applied to various technologies.

We are planning to enhance the functions of the tool so that it can handle a wider range of technologies and network configurations.

(Network Innovation Laboratories)

Screenshot of developed transport network planning tool



## The World's First Field Test of a 40-Gbit/s/channel WDM Signal Transmission over an Installed Dispersion-Shifted Fiber

The 40-Gbit/s/channel WDM transmission system transmits a large-capacity WDM signal that has a 40-Gbit/s capacity per wavelength over a single optical fiber. Because of its large channel capacity of 40 Gbit/s, it is possible to reduce the number of wavelengths (devices) in achieving a large-capacity system. Moreover, it is expected that large-scale integration technology will make possible increased system economy, reliability, and advanced functionality. In the NTT Laboratories, we pushed forward with world-leading research toward the realization of this system.

We succeeded in accomplishing the world's first stable transmission of a 320-Gbit/s (8-channel 40-Gbit/s) WDM signal over an installed fiber (a 1.5- $\mu$ m DSF<sup>1</sup>, 281 km). In that test, the new carrier-suppressed RZ optical modulation (CS-RZ<sup>2</sup>) format was used to greatly improve the optical fiber transmission performance in comparison with the conventional NRZ<sup>3</sup> format. Moreover, we constructed in the lab a 40-Gbit/s system prototype using ultra-high-speed InP-based integrated circuits, a low-driving-voltage LiNbO<sub>3</sub> external modulator, and a high-power uni-traveling-carrier photodiode, all of which are original technologies that were newly developed in the NTT Laboratories. The prototype system is capable of stable transmission and reception of a 40-Gbit/s optical signal.

The result of this work demonstrates the prospect of increasing the capacity of NTT's installed optical fiber lines by means of the 40-Gbit/s/channel WDM transmission system. In future, we will promote this WDM system as an international standard and aim at providing a high-capacity data trunk network that can realize advanced network functions and economy.

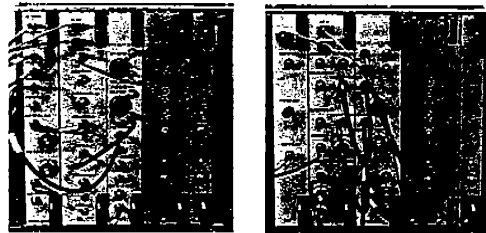
(Network Innovation Laboratories)

<sup>1</sup> DSF: Dispersion Shifted Fiber

<sup>2</sup> CS-RZ: Carrier-Suppressed Return-to-Zero

<sup>3</sup> NRZ: Non-Return-to-Zero

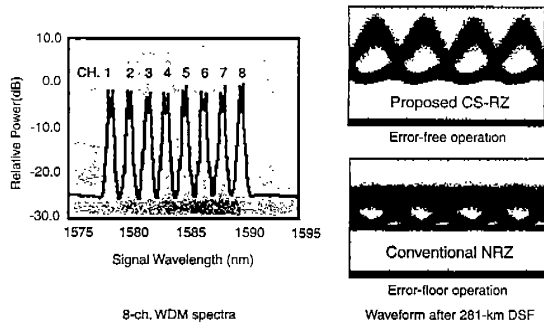
40-Gbit/s system prototype



40-Gbit/s Transmitter

40-Gbit/s Receiver

40 Gbit/s × 8 ch WDM field experiment



8-ch. WDM spectra

Waveform after 281-km DSF

## Support for Introduction of WDM-Phase I

This is a long-distance point-to-point transmission system that economically and efficiently accommodates IP traffic and high-speed leased lines. The WDM transmission system (Phase- I ) consists of a WDM multiplexer, a WDM repeater, and NE-OpS. This equipment is specifically for use with single-mode fiber (SMF<sup>1)</sup> and can multiplex up to 32 STM<sup>2</sup>-4 (622 Mbit/s) and STM-16 (2.4 Gbit/s) signals per 1.3- $\mu$ m zero-dispersion fiber (SMF) in the 1550-nm band and transmit the multiplexed signal up to approximately 320 km without electrical regeneration. Because service can be started quickly by increasing the number of wavelengths in response to demand, it is possible to construct a long-distance transmission system that is both flexible and economical.

In the WDM multiplexer, the received STM-4 and STM-16 signals are first converted to the signal optical wavelengths that are suitable for wavelength multiplexing by each transponder, wavelength multiplexed, and subjected to common amplification. The signal is then transmitted over an inter-office fiber cable. The received wavelength multiplexed signal is split into up to 32 optical signals for transmission over intra-office or inter-office fiber cable.

The WDM repeater receives a multiplexed signal of up to 32 wavelengths from one inter-office fiber cable, subjects it to optical common amplification, and transmits it over another inter-office fiber cable.

The NE-OpS includes a NE-OpS server, NE-OpS clients, craft interface terminals and other components. It allows administration of the WDM transmission system and WDM repeaters via a data communication network.

NTT Laboratories received a request for technical support from the NTT West Kyoto Office and provided support that contributed to the successful start of service on October 1, 1999. This support included evaluation of this system used as an infrastructure system for the JGN<sup>3</sup> experimental circuit in the Kyoto-Osaka-Nara area, start-of-service support, and explanation sessions for operation of NE-OpS.

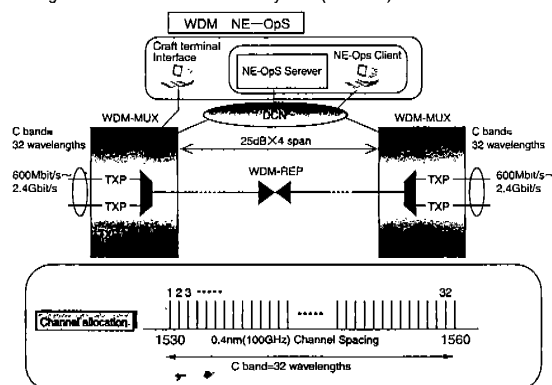
(Network Service Systems Laboratories)

<sup>1</sup> SMF: Single Mode Fiber

<sup>2</sup> STM: Synchronous Transfer Mode

<sup>3</sup> JGN: Japan Gigabit Network

Configuration of WDM transmission system (Phase I)



DCN: Data Communication Network

## Development of Coded OFDM Technologies

With the recent spread of mobile telephone services, the need for wireless access has been increasing very rapidly. At the same time, the research and development of broadband mobile wireless access systems has been attracting a great deal of attentions to support the Internet and multimedia services which are also growing dramatically all over the world. To meet these demand, standardization bodies in Japan, USA, and Europe have been actively working towards establishing a broadband wireless access system in the 5-GHz band. In association with these activities, NTT has been developing an advanced wireless access (AWA) system for broadband mobile/nomadic multimedia services.

Severe frequency-selective fading caused by multipath delays is a major problem to be solved in mobile communication environments. The key to successful deployment of a broadband wireless access system is to establish a novel transmission technique that achieves a low packet-error rate (PER) over such channels. We have been conducting research and development of coded Orthogonal Frequency Division Multiplexing (OFDM) for broadband mobile wireless access. Coded OFDM is a multicarrier modulation method using Fast Fourier Transform (FFT) in combination with powerful forward error correction (FEC). A guard interval (GI), cyclical extension of OFDM symbol, makes coded OFDM robust to the inter-symbol interference caused by delayed multipath waves. In addition, the OFDM can achieve high FEC coding gain even in severe frequency selective fading environments. Thus, coded OFDM realizes high quality transmission in mobile environments without a complex adaptive equalizer. We have contributed to accomplish the unification of physical layer specifications by standardization bodies such as EP-BRAN<sup>1</sup>, IEEE<sup>2</sup> (with its 802.11 standard) and MMAC<sup>3</sup>. In addition, we have developed new techniques to improve the PER performance, for example space-combining transmission diversity. Based on the standard that the standardization bodies agreed upon, NTT has successfully developed a coded OFDM-LSI incorporating the above-mentioned new techniques. The developed coded OFDM-LSI conforming to the unified standard is a world-leading achievement. We have experimented the coded OFDM-LSI and confirmed its high-speed operation at an input clock frequency of 40 MHz, i.e. an operating clock frequency of 20 MHz.

We will continue to carry out the research and development of coded OFDM technologies to further improve its performance. We will also apply the developed coded OFDM technologies to the AWA system under development in NTT.

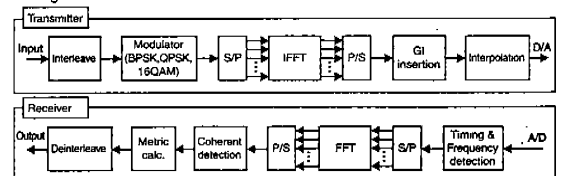
(Network Service Systems Laboratories)

<sup>1</sup> EP-BRAN: ETSI (European Telecommunications Standards Institute) Project-Broadband Radio Access Networks

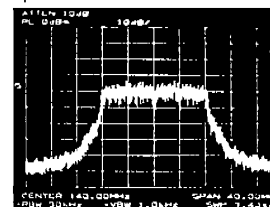
<sup>2</sup> IEEE: The Institute of Electrical and Electronics Engineers Inc.

<sup>3</sup> MMAC: Multimedia Mobile Access Communication Systems

Configuration of OFDM-LSI



Spectrum wave of OFDM





## Development of Wideband FWA (Occupied Band) Using Sub-Millimeter-Wave and Millimeter-Wave Bands

Wideband FWA<sup>1</sup> which uses wireless frequencies in the sub-millimeter-wave (22/26 GHz) and millimeter-wave (38 GHz) bands, was developed with the goal of constructing an access network for leased lines mainly in metropolitan areas in a short time and at low costs. The main characteristics of this system are as follows: (1) Low cost of construction, because construction of the access line is not required; (2) short open-circuit period; and (3) resistant to earthquakes and other disasters.

The system can be divided into two main categories: a P-P<sup>2</sup> system, and a P-MP<sup>3</sup> system.

The P-P system connects customer buildings and wireless base stations on a one-to-one basis. There are two types of P-P system: Type 1 has a capacity of 1.5 Mbit/s × 4 for each wireless channel, while Type 2 has a capacity of 45 Mbit/s. The radio propagation distance is expected to be roughly 2 km (depending on conditions).

The P-MP system, on the other hand, can accommodate multiple customer buildings at a single wireless base station. It has a capacity of up to 1.5 Mbit/s × 4 for each customer building, and a single wireless base station can accommodate a maximum of 32 customer buildings. The radio propagation distance is expected to be roughly 1 km (depending on conditions).

In addition to improving circuit quality in comparison to existing subscriber wireless systems, through the addition of such features as an error correction function, we have also achieved a substantial reduction in costs by actively incorporating commercial technologies.

In reference to the P-P system, NTT Communications has already acquired a radio license for the 26-GHz band, and provision of services began in March 2000. Meanwhile, in reference to the P-MP system, NTT Communications is planning to apply for a radio license for the same 26-GHz band, with provision of services scheduled to begin in the fall of 2000.

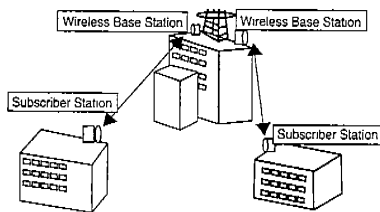
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<sup>1</sup> FWA: Fixed Wireless Access

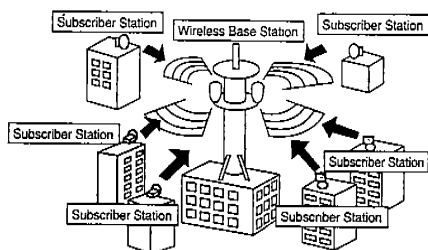
<sup>2</sup> P-P: Point-to-Point

<sup>3</sup> P-MP: Point-to-Multipoint

P-P system application diagram



P-MP system application diagram



## Software Radio System Featuring Service/System Reconfiguration Through Software Changes

In recent years, a wide variety of cellular communication modes such as PDC<sup>1</sup> and PHS and wireless schemes such as LAN and ITS<sup>2</sup> have become available to the public, and users almost inevitably take their hand-held terminals with them wherever they go. At the same time, the life spans of offered services have become quite short, and businesses in the field have been forced to make major investments in new equipment. As a consequence, wireless devices that formerly comprised specialized hardware such as transistors and ICs now comprise programmable devices such as DSPs<sup>3</sup> and FPGAs<sup>4</sup>, and technology that enables wireless devices to be reconfigured merely by modifying software has become a major focus of attention. A single portable terminal can now accommodate all types of cellular communication schemes and serve as a wireless LAN terminal, and the reappearance of tuners that receive broadcast signals has made it possible to access a large variety of service media. Radio base stations are now able to offer multiple wireless schemes with a single device, and system versions can be upgraded simply and flexibly merely by modifying software. Work is also being done on the development of wireless schemes that can be suitably reconfigured to accommodate changes in propagation and communication environments, enabling high levels of transmission quality and subscriber capacity unattainable in today's existing systems.

Devices based on general-purpose DSP boards with unprecedented operational capacity (6,400 MIPS<sup>5</sup>) have been developed and are now in the trial production stage, and they have demonstrated excellent transmitting/receiving performance surpassing that of conventional hardware-based radio devices. They feature a microprocessor for high-layer control, DSPs for low-layer signal processing, and a PHS scheme enabled through use of C language.

It is anticipated that future devices will offer higher programmability, wider bandwidth to accommodate wide-band radio modes such as W-CDMA<sup>6</sup>, low power consumption, and reduced size. It is also expected that utilizing the features of the new software radio technology will enable in the development of new networks, and new services such as the use of over-the-air downloads to upgraded system versions.

(Network Innovation Laboratories)

<sup>1</sup> PDC: Personal Digital Cellular

<sup>2</sup> ITS: Intelligent Transport Systems

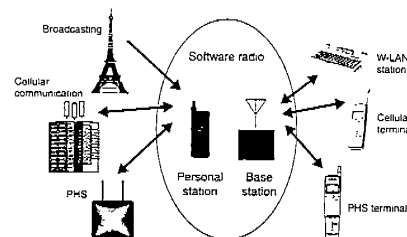
<sup>3</sup> DSP: Digital Signal Processor

<sup>4</sup> FPGA: Field Programmable Gate Array

<sup>5</sup> MIPS: Million Instructions Per Second

<sup>6</sup> W-CDMA: Wideband Code Division Multiple Access

Image of software radio services



Prototype of software radio station



## Wide-LAN Service

As companies and local governments continue to build Intranet systems, high-speed computer communication between multiple points at low cost is increasingly being demanded. LANs are currently connected by leased lines that provide data transmission rates in the range of 64 kbit/s to 1.5 Mbit/s. However, if the number of connections increases, customers' costs will also rise; moreover, if data transmission speed is in the lower end of this range, a connection using this low speed will become a bottleneck that drastically reduces data throughput.

In response to these problems, NTT Laboratories have developed the "STM shared-access system," through STM-PDS<sup>1</sup>, which provides a maximum transmission speed of 10 Mbit/s (minimum: 300 kbit/s). Instead of allocating a bandwidth to each individual phone line, this system provides one high-speed bandwidth to be fairly shared between multiple users. For example, when multiple ONUs<sup>2</sup> are connected to an OSU<sup>3</sup> via a star coupler, if there is only one user, the maximum bandwidth is allocated to that user. But when the system is used by multiple users at the same time, an equal share of the bandwidth is allotted to each user. And when the 10BASE-T is used at the terminal interface, personal computers and LAN equipment can be connected directly to ONUs.

NTT East and NTT West have been offering "Wide LAN Services" –providing LAN connections between multiple locations– since May 2000. Then it is planned to utilize this Wide LAN system to provide general users with medium-to-high-speed Internet access.

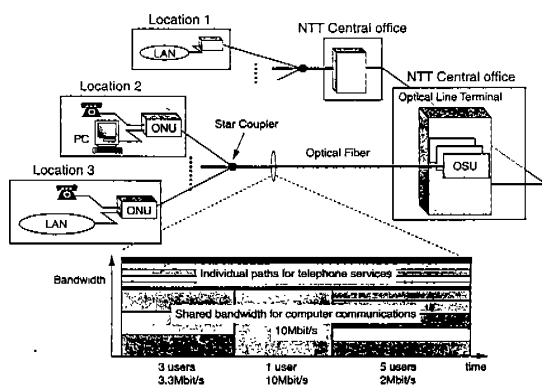
(Access Network Service Systems Laboratories)

<sup>1</sup> STM-PDS: Synchronous Transmission Mode-Passive Double Star

<sup>2</sup> ONU: Optical Network Unit

<sup>3</sup> OSU: Optical Subscriber Unit

Overview of the STM-shared access system



## Asymmetric Digital Subscriber Line

Existing metallic cables in conjunction with digital-subscriber-line technology (xDSL<sup>1</sup>) can provide digital transmission rates of up to several megabits per second. This technology includes ADSL<sup>2</sup>, whose uplink (i.e., from customer to central office) and downlink (i.e., from central office to customer) transmission speeds are asymmetric; HDSL<sup>3</sup> and SDSL<sup>4</sup>, whose transmission speeds are symmetric; and VDSL<sup>5</sup> for high-speed digital transmission over short distances. Of these DSL technologies, ADSL is receiving considerable attention because it is the most suitable for Internet access and the standardization of its specifications is well advanced.

The ITU-T<sup>6</sup> is standardizing two transmission specifications for ADSL: G.922.1 (G.dmt), which provides an uplink maximum transmission speed of 640 kbit/s and a downlink speed of 6 Mbit/s; and G.922.2 (G.lite), which provides an uplink speed of 512 kbit/s and a downlink speed of 1.5 Mbit/s.

NTT Laboratories have conducted tests to evaluate the mutual interference between ADSL and ISDN<sup>7</sup> circuits and to determine the transmission characteristics of NTT's metallic access network. The ADSL equipment was specified according to the results of these tests; that is, based on specification G.922.2 (G.lite) Annex C, which reduces the influence of the noise coming from TCM-ISDN<sup>8</sup>, the specified ADSL equipment can provide an uplink maximum transmission speed of 224 kbit/s and a downlink speed of 512 kbit/s.

NTT East and NTT West have been providing the connection service for the IP routing network that utilizes the ADSL equipment since December 1999. This service is now provided on a trial basis (limited area and period) in order to verify the ADSL technology, to confirm its maintainability, and to evaluate market demand. Following this trial period, lasting about one year, NTT is planning to launch the full ADSL service.

(Access Network Service Systems Laboratories)

<sup>1</sup> xDSL: X-Digital Subscriber Line

<sup>2</sup> ADSL: Asymmetric DSL

<sup>3</sup> HDSL: High bit rate DSL

<sup>4</sup> SDSL: Symmetric DSL

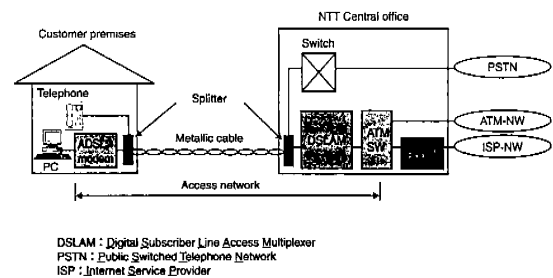
<sup>5</sup> VDSL: Very-high-speed DSL

<sup>6</sup> ITU-T: International Telecommunication Union-Telecommunication Standardization Sector

<sup>7</sup> ISDN: Integrated Services Digital Network

<sup>8</sup> TCM-ISDN: Time Compression Multiplexing ISDN

Overview of the ADSL system



## Dedicated Service Handling Modules (DSM) for Constructing Economical Leased Line Networks

The use of digital leased lines is increasing rapidly in keeping with the sharp growth in demand for intranets and the Internet in recent years. The use of analog leased lines, on the other hand, is experiencing a gradual downward trend, as a changeover in the era of leased line services continues.

NTT Laboratories developed a Dedicated Service handling Module (DSM) that can integrate analog and digital leased lines, accommodating these lines efficiently and economically. Operation of DSM began in August 1998.

DSM facilitates functions such as service terminating functions (for subscriber lines) and external connection functions (for connections to network equipment) on interface boards. The TSW<sup>1</sup> segment of the DSM has the configuration of a general-purpose cross-connect module, which executes only cross-connects in 64-kbit/s units, making it possible to support new services expected to appear in the future, and to create flexible connections to new systems. Furthermore, making the circuit accommodation segment slot-free allows mounting of either analog or digital leased lines depending on the demand, which will in turn bring about increased circuit accommodation efficiency in comparison to traditional modules.

In terms of providing services, it is possible to accommodate all existing services by mounting various types of subscriber packages used in traditional systems. In addition, it is possible to mount connection interfaces to new optical access system ( $\pi$ -system), as well as diverse trunk interface boards that also take international connections into consideration, thus allowing the flexible configuration of a variety of circuits.

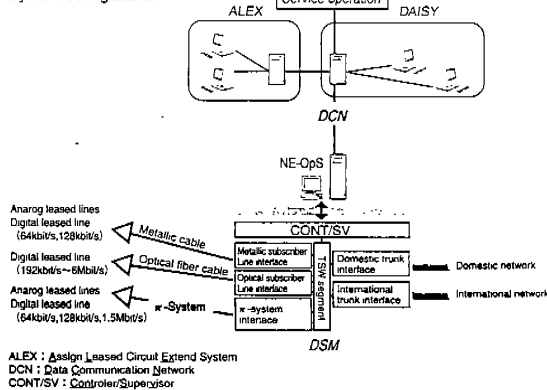
In the DSM system, we have adopted a method in which the existing OpS is divided into two segments—one (DAISY<sup>2</sup>) that relies on carrier services and networks, and another (NE-OpS) that relies on hardware—and the differences resulting from hardware changes and additional functions in the NE-OpS are concealed from the DAISY. In this way, independent improvements in DAISY functions and DSM functions are possible, allowing efficiency in development.

(Network Service Systems Laboratories)

<sup>1</sup> TSW: Time Switch

<sup>2</sup> DAISY: Digital Leased Line Administration System

System configuration



## Development of a Software Tool for Evaluating Network Reliability

The role of private networks in telecommunications is increasing. Many companies and governmental organizations have come to depend on private networks. Reliability is the essential factor in the success of private networks. To construct a highly reliable private network at reasonable cost, design for reliability is important. For instance, the process of listing possible network configurations, evaluating the reliability of the possible configurations, and selecting the optimal configuration from an overall view of reliability, cost and other factors is crucial.

Software tools which support the design of private network in terms of network connectivity or cost have already appeared on the market. However there is no tool that is appropriate for evaluating reliability. Therefore, in the NTT Laboratories, we have been developing a method for evaluating the reliability of private networks, and have implemented the method as a software tool. This tool evaluates the reliability of private networks, in which distributed customer sites are connected via NTT's leased circuits. The protection of routes, and the degree of redundancy and failure rate of transmission facilities are considered. This tool can answer the following questions, which may arise when networks are designed.

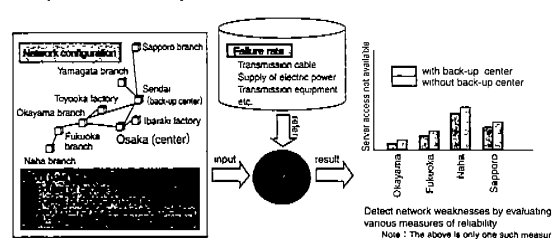
- (1) How does a leased circuit as a protected route improve the network's reliability?
- (2) What is the best site for the back-up server or servers from the viewpoint of network reliability?
- (3) Can reliability be improved more by using a leased circuit from NTT as a protected route, or by placing a stand-by router at the customer's site?

The tool runs in the Windows environment that is so popular with many customers.

This tool is planned so that it can be applied to a wide range of business solutions to do with private networks, and especially for networks that require extremely high reliability, such as disaster information networks constructed by local government.

(Service Integration Laboratories)

The process of reliability evaluation



## Cost Reduction Technologies for MU Fiber Optic Connectors

The MU<sup>1</sup> fiber optic connector is the smallest single-fiber connector in the world, and also exhibits the highest level of performance. The MU connector was developed in 1993 based on SC<sup>2</sup> connector technology. We have now developed new MU connector technologies to reduce both parts and assembly costs.

The newly developed low-cost MU plug is shown in the left figure. The structure of the conventional MU plug was re-designed for further cost reduction by developing pre-assembled parts suitable for automatic and field assembly. The number of plug parts has been reduced from 7 to 5. We developed a new polishing machine, as shown in the right figure, to reduce the cost of ferrule polishing. The ferrule area to be polished for the MU connector is roughly one tenth that for conventional connectors. We optimized this machine to take advantage of the smaller polishing area of the MU ferrule. The polishing process has been reduced from three steps to two. In addition, expensive abrasives such as diamond slurry are no longer required. As a result, the polishing cost with the new polishing method can be reduced to less than one third that with conventional methods. Moreover, the introduction of plastic MU adapters and MU simplified receptacles helps to reduce the cost further.

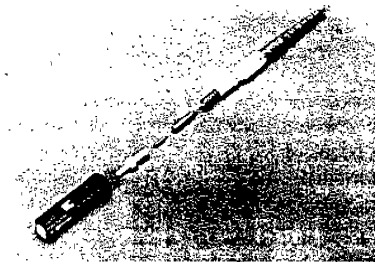
NTT plans to carry out a full-scale introduction of these new MU technologies into commercial networks to cope with the explosive increase in demand for fiber optic network traffic, and accelerate the economical and efficient construction of next-generation fiber optic networks.

(Photonics Laboratories, Telecommunications Energy Laboratories)

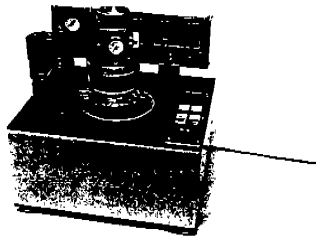
<sup>1</sup> MU: Miniature Unit-coupling

<sup>2</sup> SC: Single Coupling

Low-cost MU plug (before assembly)



Low-cost polishing machine for MU connectors



## Development of a 1300-nm-Band Optical Fiber Amplifier Module

Rare-earth ion-doped optical-fiber amplifiers can amplify optical signals without using electrical-to-optical conversion. They become key devices because of their low-noise and high-output characteristics. For 1550-nm-band optical transmission, erbium-doped fiber amplifiers have been installed in long-haul large-capacity transmission systems using wavelength division multiplexing. For 1300-nm-band systems, we have developed praseodymium-doped fluoride fiber amplifiers (PDFA) using zirconium-based fluoride glass. Although solid-state laser pumped PDFAs are commercially available from an NTT Group company, they need to be made highly efficient and reliable to expand their application area.

To meet the need for high efficiency, we have developed praseodymium-doped indium-based fluoride fiber with a super-high numerical-aperture NA<sup>1</sup> structure. Its power conversion efficiency is 50% better than that of zirconium-based PDFAs, enables us to construct LD<sup>2</sup>-pumped PDFAs. For booster-type applications, these LD-pumped PDFAs have an amplifier-output power of more than 10 dBm at a signal wavelength from 1280 to 1335 nm. To meet the need for high reliability, we have developed a low-cost semi-hermetic case for the praseodymium-doped fluoride fibers, making the PDFAs reliable enough for practical applications.

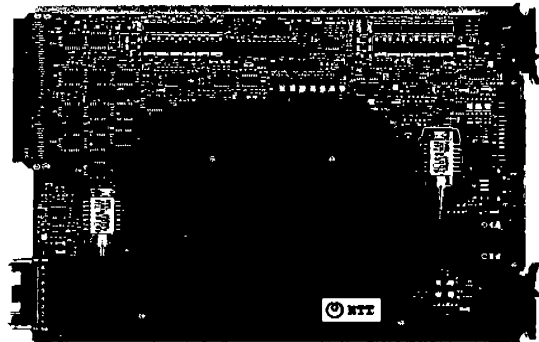
We plan to expand the gain-bandwidth of rare-earth ion-doped optical-fiber amplifiers to enable exploitation of a much larger fraction of the intrinsic capacity of optical fibers.

(Photonics Laboratories)

<sup>1</sup> NA: Numerical Aperture

<sup>2</sup> LD: Laser Diode

1300-nm-band optical fiber amplifier module



## Guidelines for Preventing Accidents in Power-Supply Systems

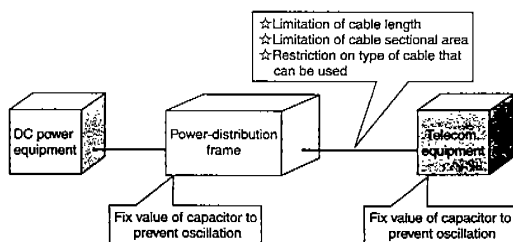
To offer highly reliable telecommunications services, the underlying systems must be reliable. The mean time between failures (MTBF) of equipment such as engine generators and DC power equipment was established by NTT to meet this need for reliability. However, the interface conditions of power-supply lines from power equipment to telecommunications equipment have not been established yet. A mismatch between the interface of DC power equipment and that of telecommunications equipment can lead to failure. For example, oscillation in the DC power-supply system in NTT's Higashi Yodogawa telecommunications building caused a system failure.

Guidelines were thus established in October 1999 for power-supply systems. They cover the requirements for developing telecommunications and power-supply equipment used in NTT Group and for designing and implementing power-supply systems for telecommunications. They set the conditions for the interface and functions of systems that supply DC power to telecommunications equipment and of systems that supply AC power to computers, servers, and routers. They specify the essential conditions for preventing the failure of a telecommunications system and for not affecting other equipment connected to the power-supply lines if the system does fail. They also specify the recommended conditions for achieving high reliability. Development, design, and implementation of telecommunications power-supply systems following these guidelines can prevent severe accidents.

In the near future, we will investigate power-supply systems in data centers, where there are many servers and routers, and will expand the guidelines accordingly.

(Telecommunications Energy Laboratories)

Main guidelines for preventing oscillation



## Free Space Aperture Line Technologies for Simplified Line Routing

One of the important requirements for the information age is to lower the cost of constructing cables and other underground communications equipment, while at the same time preserving stable cable-housing space. Free space aperture line technology is one of the means of meeting these requirements.

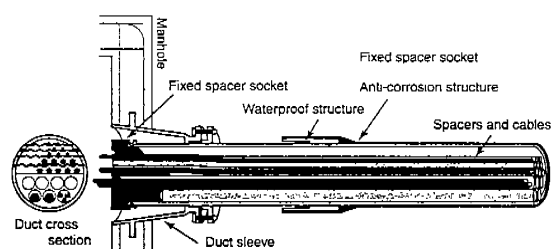
Compared with the conventional underground communication line system, the free space aperture line system offers superior stability, reliability and durability. It also allows cables to be housed in more compact space, and the cables can be very densely packed inside the housing in response to cable demand by using the inner housing space step by step. The use of free space aperture lines for important networked routes can significantly contribute to route simplification and lowered equipment costs.

We have developed a number of new technologies which will help lead to increasingly widespread use of the free space aperture line system. These include the development of a waterproof structure for line junctions to resist external water pressure, an anti-corrosion structure to increase durability and reduce wear during non-excavation work, and an open-air technology for improving the stability of the space within the cable housing. Also developed were construction and rodding technologies that allow spacers to be built inside cable housings any time they are required, thus achieving more efficient use of space within the housing by allowing cables to be packed more densely in the space. Another development was that of fixed spacer sockets that help to prevent spacers in the manhole duct from moving, expanding or contracting. The use of these technologies has made it possible to make equipment that is more compact in size and costs less to build.

Finally, to achieve greater economy in line construction we have developed four separate line types: one for installation in areas where the danger of foundation liquefaction is high, one for areas where the danger is low (general areas), one for excavation construction, and one for non-excavation construction.

(Access Network Service Systems Laboratories)

Free space aperture line cross section



# Terminal, Software Technologies

Technologies for achieving home gateways and home information appliances and software technologies related to solution businesses.

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## Plural Zone Sound Segregation Technology for Picking up Sounds in a Desired Area –A Virtual Acoustic Curtain

NTT Laboratories have developed a method for separating an acoustic space into two zones and collecting the sound waves from each zone in real time. A directional microphone is generally used to pick up sounds from a specific zone. It mainly picks up sounds from a fixed direction, but inevitably it also picks up unintended sounds from the opposite direction.

In our new method, we use two directional microphones. By measuring the differences in signal characteristics between the signals output by the two microphones, we can distinguish the sounds coming from each zone. This sound segregation is 100-fold better than with a single directional microphone.

Using this "virtual acoustic curtain", we can almost completely separate an acoustic space into two zones. For example, as illustrated in Fig. 1, we can establish a "communication zone" and a "privacy zone" in an ordinary room, enabling some people to participate in a hands-free videoconference, while others continue performing their regular activities. The voices of those not participating are suppressed by reducing the amount of undesired sound picked up in the videoconferencing.

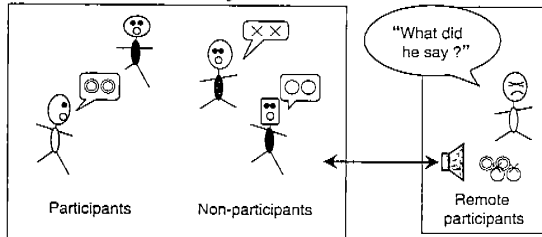
Other potential applications include voice guidance and control of vehicles, enabling a vehicle to be controlled by only the driver's voice, and monitoring of abnormal sounds within a particular area of a plant or factory, enabling managers to quickly respond to abnormal situations.

We are now working on extending this method to separate an acoustic space into three or more zones, which will make it possible to locate a particular sound source in a noisy environment.

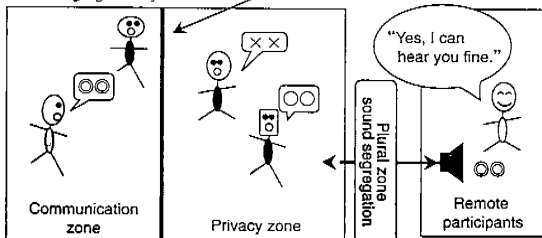
(Cyber Space Laboratories)

### Example usage of "virtual acoustic curtain" for videoconferencing

Conventional videoconferencing



Using plural zone sound segregation system



## 200-Inch Super-High-Resolution Display System

With the age of full-scale proliferation and diffusion of high-speed networks right in front of us, the appearance of new image communications applications is widely anticipated. NTT Laboratories are now offering applications featuring the concept of "high presence", through the development of such products as high-presence multimedia communication conferencing systems. This concept describes electronic communications that enable persons to feel that they are actually physically present and sharing space with other persons with them in electronic communication environments.

Display devices used in such applications are required to: (1) be sufficiently large in size for life-size displays to be shown; (2) display with sufficient brightness for easy viewing under ordinary room lighting conditions; and (3) have sufficient resolution such that images do not become noticeably rough as one gets nearer them. The display device we have developed features a 200-inch screen that covers an entire wall, enabling life-size displays of such objects as persons or automobiles. It also features an interleaved projection mode in which images provided by four HDTV-class projectors are composed and displayed on the screen. This makes the brightness and resolution (about 6 million picture elements) of the screen images four times brighter and sharper than those of conventional images.

The system also displays as many as four windows simultaneously for displaying PC or HDTV images, and the stereo images using polarized glasses enables the brilliant images that drive multimedia applications to be displayed. We also succeeded in developing a server for the system that can reproduce still and moving images with super-high resolution, and an interface that can directly link digital image outputs of graphic-use super computers.

In future work on the system, we anticipate being able to incorporate it into a variety of high-presence communication applications, including systems for transmitting digital cinema and events that cannot be attended by persons living in remote locations.

(Cyber Space Laboratories)

\* HDTV: High Definition Television

200-inch super-high-resolution display



## An MPEG-2 Encoding PC Card System

In recent years, MPEG-2<sup>1</sup> compliant digital imaging media has become increasingly popular in a wide range of fields, including broadcast, communications, education, and entertainment. Furthermore, the rise of mobile computing has led to a demand for the creation of a compact MPEG-2 encoding system that offers excellent mobility, and which can easily handle these types of digital video images in mobile environments.

In response to these demands, and with the intention of creating new mobile applications for MPEG-2, NTT Laboratories have been striving to achieve both reduced size and reduced power consumption in MPEG-2 encoders. As the key system for these encoders, we have developed the world's smallest and lightest MPEG-2 encoding PC card: one that allows storage and transmission of high-quality images—on a par with standard TV picture quality—in a mobile environment, using notebook PCs. Because this card requires no external power source, it can display its powerful potential in mobile environments.

This MPEG-2 encoding PC card combines both hardware and software elements. The hardware is comprised of a previously developed single-chip MPEG-2 video encoder LSI and a newly developed encoder control LSI, which are mounted on a PC card about the size of a business card (Type II: 5mm thick). The PC software executes real-time processing of audio encoding and AV multiplexing (MUX). Through the cooperative operation of this hardware and software, we have created an all-in-one encoder that offers real-time processing of all encoded material, including MPEG-2 video, audio, and multiplexing. This card is also compatible with various types of stream outputs, allowing such output to be stored to files on the notebook PC's internal disk, or to be transmitted in real-time to IP<sup>2</sup> networks.

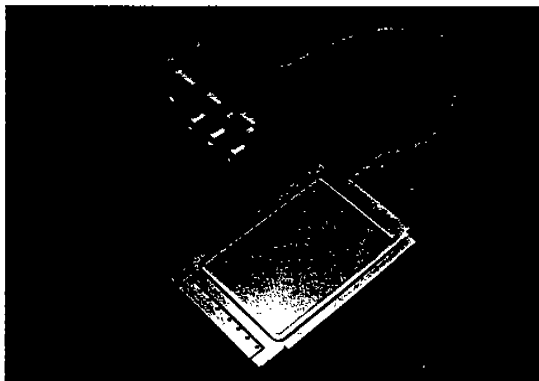
In order to encourage practical mobile applications using this newly developed PC card, we have proposed various types of systems; for example, image sets for news coverage, monitoring, remote lectures, TV conferencing, and personal transmissions. At the same time, we are continuing our efforts in research related to the composite technologies of next-generation encoder systems.

In the future, we will work toward the creation of new digital imaging communication services that apply these proposals and technologies. (Cyber Space Laboratories)

<sup>1</sup> MPEG-2: Moving Picture Experts Group Phase2

<sup>2</sup> IP: Internet Protocol

MPEG-2 encoding PC card



## Development of Systems for "Portrait Greeting Card" Services

Recently, Internet services have started up across the United States and Europe in which greeting cards for birthdays, Christmas, weddings, births, and other events are created and sent electronically. These services have become increasingly popular, in part because the cultural practice of exchanging greeting cards with considerable frequency has been in place for some time. The demand for Internet greeting card services is expected to gain popularity in the future in Japan as well, due to the increasing "Internet population" and the growing trend toward sending greeting cards on occasions other than the New Year's season.

In current Internet greeting card services, the sender simply selects from among a group of prepared drawings or photographs, or perhaps adds a prepared message, before sending the card electronically to the receiver. In fact, this was no more than a recycled version of the traditional services for posting greeting cards. At NTT Laboratories, we have applied the special features offered by the Internet to propose a fun new service that we call the "Portrait Greeting Card." This service has been made possible with a combination of an automatic portrait creation system (Chara-face) and simultaneous CG animation/speech synthesis technology (WebMessenger).

Chara-face is a system that allows anyone to easily create a cute portrait from a single photograph. The system automatically generates a variety of emotional expressions, making it possible to easily develop a portrait animation with a wide range of facial expressions.

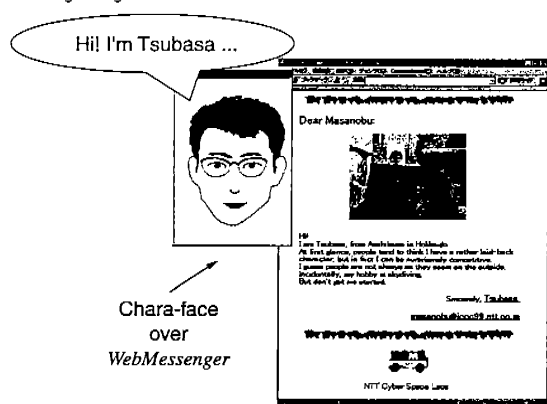
WebMessenger is an application system for speech synthesis technologies, which can convert any form of text into speech. This system allows the user to send voice messages by linking speech synthesis and animations with a timing that seems almost natural.

With these two technologies, we have created a fun new greeting card service: an animated portrait created by the sender reads out the message, while abundant facial expressions help to communicate the sender's feelings more clearly.

In the future, through continued service testing, we will make more improvements to the system as we approach the practical application stage, in order to create a service that is more fun, and which communicates feelings clearly for both the sender and the receiver.

(Cyber Solutions Laboratories, Cyber Space Laboratories)

Portrait greeting card





## Development of CT Image Reading Systems for Lung Cancer Screening

In vital statistics for 1998, death from lung cancer was the most common among cancer-related death, and as a result early detection has become a critical issue. In order to achieve this early detection, the use of spiral CT<sup>1)</sup> has been considered for applications in group examinations, but because CT involves a large number of images, the process of reading these images would entail an enormous amount of work. NTT Laboratories have thus been developing a system that can efficiently read these spiral CT images. This reading system has the following characteristics:

### (1) Comparable reading

If examinations are conducted annually, it is possible to compare images on a year-to-year basis. The film previously used for examinations was roll film, however, so it was difficult to create side-by-side displays of past and current film. Because CT images are digital, the creation of a database allows easy searches and reference. In this system, we have developed a comparable reading function that allows (1) searches using a DICOM<sup>2)</sup> function; (2) slice position automatic positioning of past and present images; and (3) simultaneous handling of both images. Using these functions, it is possible to conduct efficient reading examinations while comparing images year-to-year.

### (2) MIDI Operating device

Aiming for efficient operations, we have adopted a MIDI<sup>3)</sup> device as the reading operation device, and incorporated long-stroke sliders, dials, and a variety of buttons. With this device, the operator can easily change the axial orientation of the cross-sectional image from the upper segment to the lower segment of the lung with a slider operation or easily change the conditions of the image display with the press of a button, all without the use of a keyboard.

This system has already been supplied to Group companies of NTT East and NTT West, and there are plans for sales of the system to local governments and other organizations conducting CT examinations. In the future, NTT Laboratories will begin investigations into a network-based reading system based on the principles of the current system. Future plans also call for connections to the gigabit network operated by the Telecommunications Advanced Organization of Japan (TAO), image transmissions between Tokyo, Nagoya and Osaka, and verification tests of network-based reading.

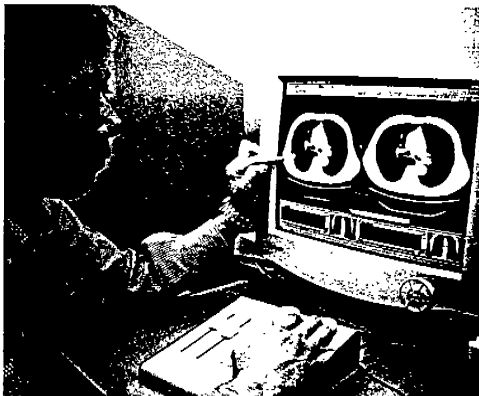
(Cyber Solutions Laboratories)

<sup>1)</sup> CT: Computed Tomography

<sup>2)</sup> DICOM: Digital Imaging and Communications in Medicine

<sup>3)</sup> MIDI: Musical Instrument Digital Interface

Example of comparative screening using proposed system



## Finger Print Recognition System Developed; Verification Tests Underway

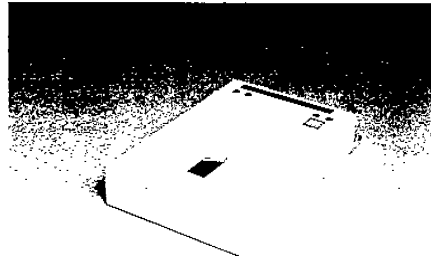
In our advanced information/network society, there is a strong drive toward research and development of security technologies aimed at protecting private information and allowing people to live in comfort and with peace of mind. In this backdrop, the development of technologies that prevent an individual from assuming the identity of another—that is, technologies to verify a person's true identity—are becoming increasingly important. This is particularly true in the case of access to information processing systems, as well as business transactions such as electronic payments via networks and electronic commerce. Up to now, user IDs and passwords have been widely used to differentiate between individuals. The problem with this method, is that because the system relies on the individual's memory, it is very common for users to select easily remembered numbers or simple words for their password, making that password easy to steal.

NTT Laboratories have developed an identification system that uses information from each individual person's fingerprint—that is to say, "biometric information"—to take the place of the current user IDs and passwords. This system requires no changes to society's existing password-based information systems; all that is required for its application is a connection to the user terminal. In addition, as part of the development of this fingerprint recognition system, we have at the same time developed a semiconductor-type fingerprint sensor chip that offers both high reliability (withstand electrostatic voltage of over 2 kV) and high sensitivity (pixel density of 500 dots per inch (dpi)) compared to traditional systems.

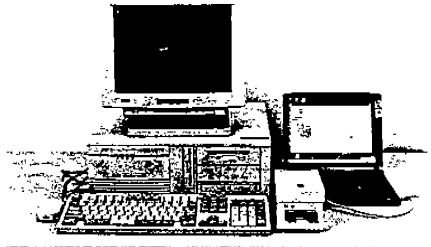
Verification tests were initiated in February 2000 in cooperation with NTT East to evaluate the performance of the fingerprint recognition system. The tests were carried out on a scale of 100 subjects, using in-house information processing systems. Through such verification tests, we will conduct various activities including performance evaluations at application sites and the resolution of issues leading toward practical applications of this system.

(Lifestyle and Environmental Technology Laboratories,  
Telecommunications Energy Laboratories)

Fingerprint image capture device



User terminal with a fingerprint recognition system



# Cutting-edge Technologies

Technologies in fields such as optical devices, material science, and information science, at the true cutting edge of a new era.

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### Single-Chip 3.5-Gbit/s CMOS/SIMOX Optical Transceivers with On-Chip Analog Control Circuit

In WDM<sup>1</sup> technology, as the number of multiplexed wavelengths increases, so too does the number of optical transmitters and receivers used. Reduced power consumption, miniaturization, and decreased costs for optical transceivers are thus essential to WDM technology.

Existing optical transceivers are comprised of transmitting and receiving modules, and incorporate multiple analog ICs and digital ICs. In order to accomplish "reduced power consumption" and "miniaturization," it would be effective to integrate these multiple ICs into a single IC. This creates a problem, however, in that the noise generated from the digital circuits is transmitted through the semiconductor substrate, causing a deterioration in the characteristics of the analog circuits, which handle a weak signal.

In the NTT Laboratories, we have resolved this problem through developing two technologies. The first is a "half-rate PLL<sup>2</sup> circuit." We focused on the fact that the amplitude of the propagated noise is proportionate to the frequency, and devised an oscillation circuit that facilitates accurate half-rate operation. With half-rate operation, the applied clock frequency is reduced by half, and a noise reduction effect is obtained. The second technology is a "depletion-layer guard ring." This applies NTT's original technologies "CMOS<sup>3</sup>/SIMOX<sup>4</sup>," which are high-integration transistor fabrication technologies that operate with extremely low levels of power consumption. By forming a depletion layer on the path that has been targeted for noise interception, it is possible to bring the propagation of noise down to roughly 1/6 of previous levels.

Using the above noted technologies, we created a prototype of a single-chip CMOS optical transceiver IC, and confirmed that its operation satisfied LAN<sup>5</sup> standards at speeds up to 3.5 Gbit/s. We also created a prototype of an optical transceiver module using this IC, achieving twice the speed (2.125 Gbit/s) at 1/4 of the power consumption (650 mW) and 1/2 the surface area of existing units.

In the future, we plan to continue moving forward with improvements to accommodate WDM, as well as further reductions in size using miniaturized optical connectors.

(Telecommunications Energy Laboratories)

<sup>1</sup> WDM: Wavelength Quision Multiplexing

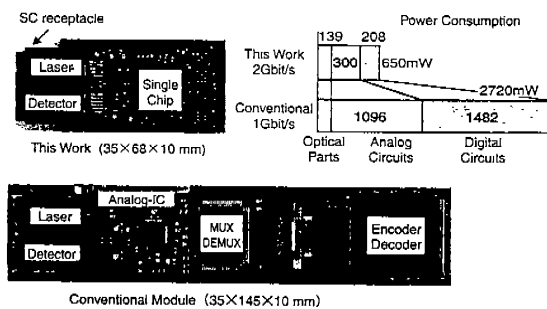
<sup>2</sup> PLL: Phase Locked Loop

<sup>3</sup> CMOS: Complementary Metal Oxide Semiconductor

<sup>4</sup> SIMOX: Separation by Implanted Oxygen

<sup>5</sup> LAN: Local Area Network

Low-power compact optical transceiver module



### Transistors Operating at High Temperatures

Semiconductors such as silicon and gallium arsenide are currently used for electron devices that support our modern information society. However, fundamental limits on device performance are being approached because the minimization of devices is reaching high levels. The limits on device performance are increasingly determined by the toughness of the material against high electric fields and high temperatures under device operation.

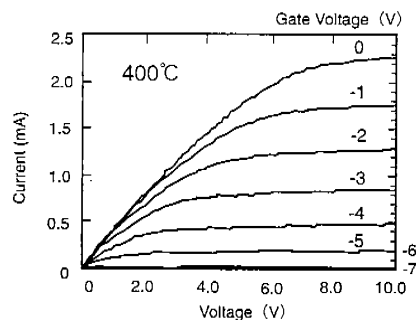
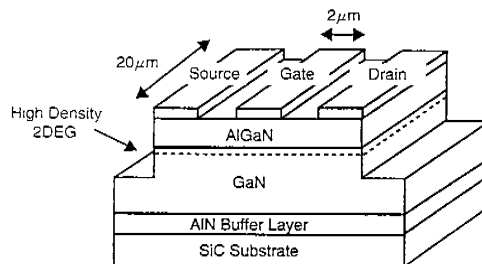
Wide band-gap semiconductors such as gallium nitride (III-V nitride semiconductors) are promising as next-generation semiconductors, because they effectively resist both high electric fields and high temperatures, then can be used in further minimized devices. We have grown high quality III-V nitride semiconductors, in the NTT Laboratories, and have successfully used the material to fabricate transistors that were able to operate at up to 400°C as stably as at room temperature.

The figure shows the structure of one of the transistors and its current-voltage characteristics at 400°C. A high electron velocity and density are obtained by using a heterostructure which consists of gallium nitride and aluminum gallium nitride. By using optimized crystal growth conditions and an improved device fabrication process to reduce crystal defects and surface damage, we have successfully obtained transistor operation with excellent current saturation and without leak currents at high temperatures up to 400°C. We are especially interested in the application of these transistors to satellite microwave communications.

The wide band-gap electron devices are attractive also from the environmental point of view, because they only consist of harmless elements. In our laboratories, we are further investigating crystal growth, electron transport properties, and device operation for these next-generation semiconductors.

(Basic Research Laboratories)

Heterostructure field effect transistor operating at high-temperatures



## Silicon Single-Electron Inverter

The already-high and ever-improving performance of data processing devices like personal computers and portable terminals has brought about an unfortunate side-effect: rapidly expanding electric power consumption. In this age of concern for the earth's environment, one of the major problems to overcome in realizing a full-fledged multimedia society is that of achieving both lower power consumption and higher performance in such devices.

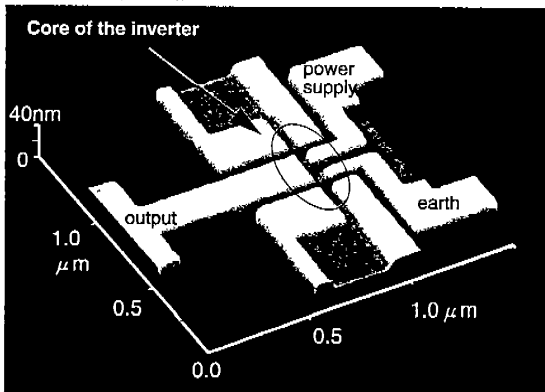
Single-electron devices with their ultra-low power consumption are one means of addressing this issue. Since control in these devices is obtained literally by utilizing the behavior of a single electron, device size and power consumption are but a fraction of those in conventional devices. As a result, they are attracting considerable attention as devices for use in the ultra-large-scale, ultra-low-power-consumption integrated circuits of the future.

NTT in 1994 developed a silicon single-electron transistor, in which the power of a single electron is harnessed for controlling, the device current comprising electrons flowing one after the other in succession. This device proved that such transistors could be operated at room temperature, instead of in the near-absolute zero (-273°C) conditions that had previously been required. Moving a step beyond manufacturing transistors one by one, research since then has been moving ahead with the aims of achieving new, high-level, compounded functions and building a foundation for future integration. The first results of this research have been the successful development and operation of an inverter, an elemental logic circuit for computers. This single-electron inverter is only about 1/100th the size of conventional circuits and consumes only 1/100,000th as much power.

To achieve still further integration it will be necessary to develop process technologies that will enable nanometer-scale structures to be realized, and to improve the performance of devices and circuits by changing their structures. These are research issues we will need to challenge with vigor in our quest to achieve integrated circuits with ultra-low power consumption for the future.

(Basic Research Laboratories)

Microscope image of single-electron inverter circuit



Structure of the inverter before forming the input terminal.

## InP-Based Ultrahigh-Speed-IC Technology for over-40-Gbit/s Optical Transmission Systems

Demands for network infrastructures with high-speed and large capacity are increasing due to the explosive spread of the Internet and multimedia applications. Systems that can operate four times faster than commercial ones (10 Gbit/s) will enable us to send, for example, the data of a disk of DVD for a 100-minute movie in about one second and to open up various services. To achieve such high-speed systems, boosting the speed of the front-end transceivers is very important.

NTT Laboratories have fabricated the world's fastest transistors by using an InP-based crystal-growth technology, which results in high electron density and velocity in compound semiconductors, and a 0.1- $\mu\text{m}$ -process technology. We have also unified technologies that improve the uniformity of the transistors and makes it possible to fabricate interconnection lines suitable for high-speed signals on a 3-inch wafer. The focus is now on establishing technologies for fabricating over-40-Gbit/s ICs, which will contribute to the development of next-generation optical transmission systems.

The three features of the developed IC structure are (1) reliable process technology for a 0.1- $\mu\text{m}$ -gate electrode, (2) an InP-etch stopper with a thickness of only 20 atomic layers, which is inserted in InAlAs/InGaAs HFETs<sup>1</sup> grown by MOCVD<sup>2</sup> and sophisticated in uniformity and thickness controllability, resulting in a uniform transistor threshold voltage over a 3-inch wafer, (3) monolithic integration of diodes with a low parasitic resistance, which is indispensable for digital ICs. The result is a propagation delay time below 5 ps/gate in an inverter.

In such high-speed operations, transmission delay and distortion due to interconnection lines interfere with stable operation of the ICs. To maintain stable operation, we have established an interconnection process using an organic insulator with a low permittivity as a manufacturing technology. Using it, we have been able to reduce the capacitance between lines and to optimize the specific impedance of lines.

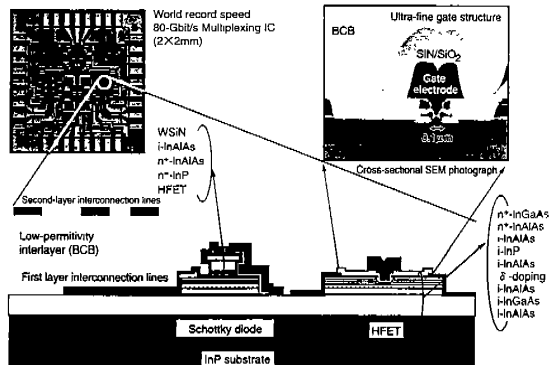
These achievements have enabled to reproducibly fabricate frequency dividers and multiplexers operating at 50 GHz and 80 Gbit/s, respectively, and to achieve an IC speed margin for 40-Gbit/s systems for the first time. This speed margin enabled us to introduce an error-correcting code to achieve high-quality and long-distance transmission systems. In the future, NTT Laboratories will contribute to the development of a small, low-power, high-speed transponder by introducing innovative technologies such as monolithic integration of optical devices and high-speed ICs.

(Photonics Laboratories)

<sup>1</sup> HFET: Heterostructure Field Effect Transistor

<sup>2</sup> MOCVD: Metal-Organic Chemical Vapor Deposition

InP-based HFET IC structure



## Very-Large-Scale 256-Channel WDM Filter for Future Photonic Networks

The rapid and global spread of the Internet is accelerating the growth in telecommunication networks in which photonic technologies based on optical WDM systems support the huge capacity in the backbone network. The demands for increased capacity in photonic networks will not slacken because the Internet is expanding more than expected. To construct large-scale and cost-effective networks, a narrow-band optical filter with a large scale is essential because it can effectively increase the number of wavelength channels in WDM systems.

In the NTT Laboratories, we have been developing silica-based planar lightwave circuits (PLCs) which can provide various practical devices for the photonic networks. Among such devices, an arrayed waveguide grating (AWG) multi/demultiplexer is a key component in the photonic networks. It consists of  $N$  input/output waveguides, two focusing slab waveguides, and arrayed-waveguides with a constant path length difference  $\Delta L$  between them. Input signals with different wavelengths can thus be demultiplexed into different output ports according to their wavelengths.

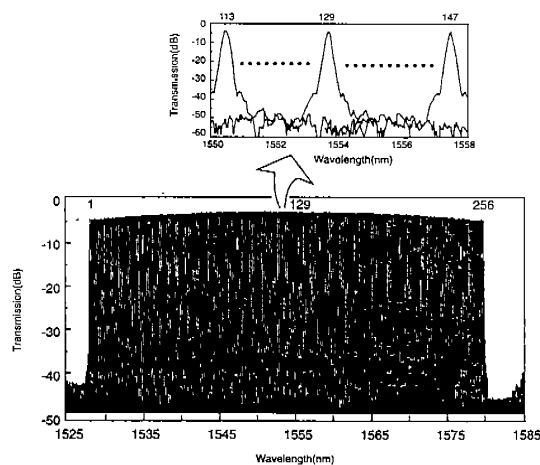
Using PLC technologies, we have fabricated a 25-GHz-spacing 256-channel AWG. The chip is  $55 \times 75$  mm, half the size of conventional AWGs. To construct this AWG, we improved the fabrication techniques to enable the bending radius of the PLC to be reduced 5 to 2 mm. The circuits can thus be integrated more densely.

The demultiplexing characteristics for all 256 output ports in the AWG are shown in Fig. 1. A background crosstalk of less than -40 dB and an on-chip loss of about 3.0 dB were attained. The transmission uniformity of the ports was excellent, indicating that the PLC devices are advantageous for very-large-scale devices.

We will continue to work on further advancing optical components and technologies, which should contribute greatly to the construction of future photonic networks.

(Photonics Laboratories)

Demultiplexing spectra of 256-channel AWG



## Integrated WDM Photo-Detector Consists of Semiconductor Wavelength Filter and Photo-Detectors

With the rapid expansion of the Internet, optical communication with WDM is attracting much attention, because it allows a large quantity of information to be transmitted at a reasonable cost. Applying WDM to optical communications significantly reduces the cost of transmissions, because many light signals can then share a single optical fiber and a single series of optical amplifiers. On the other hand, WDM systems need numerous optical transmitters and receivers, because each light signal needs its own transmitter and receiver. In this context, a reduction in the cost of transmitters and receivers is important in the realization of the practical ultra-high capacity WDM communication systems of the future, which will support the carriage of hundreds of optical channels by a single fiber. Photonic integrated circuits on InP substrates provide an attractive and practical technology for the effective reduction of the cost of the optical circuits which are used as transmitters and receivers. This is because such circuits can include most of the optical devices which are indispensable to optical communications, such as lasers, modulators, and photo-detectors, on a single substrate.

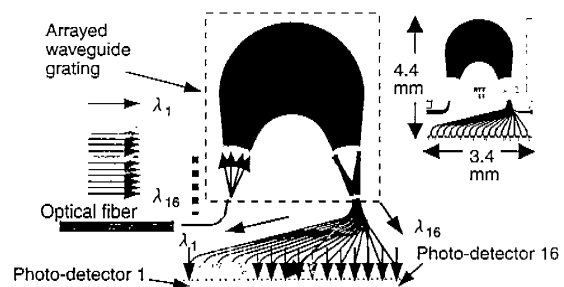
A prototype WDM photo-detector, as shown in Figure 1, consists of an arrayed-waveguide grating filter and sixteen photo-detectors, which can detect sixteen light signals at different wavelengths. NTT has developed the arrayed-waveguide grating as a high-resolution optical filter which is suitable for mass production. Making it on a semiconductor substrate enables us to make integrated device with semiconductor optical devices. The multiplexed light signal, which contains sixteen different light signals at different wavelengths, is injected by an optical fiber which is attached to the device. The arrayed-waveguide grating in the device divides the multiplexed signal into sixteen separate channels, according to their wavelengths. The light signals are then detected with one photo-detector for each wavelength channel.

A single grating can be used to demultiplex all 16 optical signals from the fiber. Such light circuits have in the past been fabricated by using a number of individual optical devices, and have thus been bulky, but the new device has the necessary optical components on a substrate that is only four-mm square and the area required for implementation has thus been reduced to 1/10 of the conventional optical circuits. This integrated circuit is currently used as a signal monitor in WDM test system that NTT has built between Yokosuka and Atsugi.

This technology will lead to the development of photonic integrated circuits with more complex functionality, and which will include lasers and modulators. Such integrated circuits will contribute greatly to reducing the cost of WDM optical communications in the future.

(Photonics Laboratories)

Operating principle of a WDM photo-detector



## High-Reliability, High-Efficiency Multi-Fuel Fuel Cell System

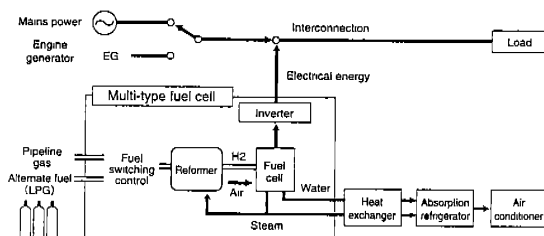
NTT Group will install low-power-consumption telecommunication systems and increase in-house electric power generation using clean-energy systems to meet the increasing need for power to support the expanding information-sharing society. A fuel cell generates power efficiently and does not release harmful gases because it produces electricity through the electrochemical reaction of hydrogen produced from fuel and oxygen in the air. It is especially promising for next generation clean-energy systems because its efficiency can be increased by using heat recovered from the system.

We have been researching and developing highly reliable and highly efficient fuel cell systems for use in telecommunication systems. To increase system reliability, we developed a multi-fuel system that can operate continuously by switching to liquefied propane gas (LPG) as an alternate fuel when the supply of city gas is interrupted by a natural disaster, such as an earthquake. Electric power generated from a multi-fuel fuel cell system is interconnected with mains power or power output from an engine generator, which starts operating when the mains power is interrupted. The system enables intensive maintenance, including remote diagnosis of fuel cell degradation and remote reconfiguration of fuel switching via telephone lines.

A room housing telecommunication equipment now requires air conditioning year round due to equipment downsizing and highly dense assembly of telecommunications equipment. For this air conditioning, we developed a direct contact heat exchanger that recovers heat efficiently from a fuel cell system with an efficiency of about 21%. When used in conjunction with a conventional heat exchanger, it boosts the recovery efficiency of the system to 38%. Thus, the overall efficiency of this multi-fuel fuel cell system is as high as 78%, including 40% electrical efficiency.

(Telecommunications Energy Laboratories)

Configuration of multi-fuel fuel cell system



Direct contact heat exchanger and photograph multi-fuel fuel cell



## SR Ring Technology for Fabricating LSIs with Very Low Power Consumption

To fabricate high-density integrated circuits with high performance and low power consumption, circuit structure patterns need to be made as small as possible. Our research has led to the development of a way of making extremely fine patterns through the use of synchrotron radiation (SR) lithography.

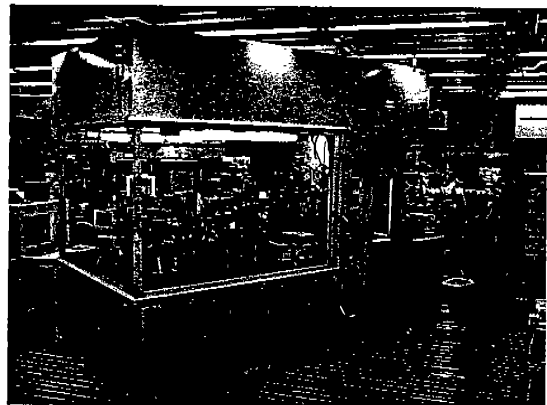
In this method, soft x-rays with less than 1-nm wavelengths are used to replicate mask patterns on wafers. As a result it can easily fabricate less than 100-nm patterns, which are very difficult to form with conventional lithography that makes use of ultraviolet rays with wavelengths of 100 nm or more. Based on the semiconductor roadmap, the power supply voltage of an integrated circuit with a 100-nm pattern would be a low 0.9 V.

In SR lithography, it is necessary to employ an SR ring for x-ray generation, a highly precise x-ray mask on which the original patterns of the integrated circuit are written, and an SR stepper which replicates the patterns on the mask onto a silicon wafer with very accurate alignment. In 1989 we developed a superconductive SR ring that generates very powerful x-rays. In our current work, we succeeded in developing a high-precision stepper with pattern alignment accuracy of 15 nm or less, and a high-precision electron beam writer for x-ray masks with writing accuracy of 10 nm or less. We also developed a x-ray mask fabrication process that achieves pattern placement accuracy of 20 nm or less. At present, we have all element technologies in SR lithography required for making highly fine 100-nm-class patterns. Through the use of these technologies, and with the cooperation of the Association of Super-Advanced Electronics Technologies, we fabricated high-density integrated circuits equivalent to a 1-Gbit DRAM and demonstrated SR lithography's usefulness.

(Telecommunications Energy Laboratories)

\* DRAM: Dynamic Random Access Memory

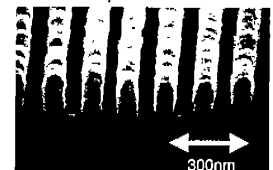
SR stepper



X-ray mask



70-nm resist pattern



## New Superconducting Lead Cuprates Prepared by Molecular Beam Epitaxy

High- $T_c$  superconductors offer solutions to urgent global problems, such as the need for new energy sources and the expanding greenhouse effect, due to their unique loss less property. Efforts are underway worldwide to develop still higher- $T_c$  superconductors. In the NTT Laboratories, we have been searching for new high- $T_c$  superconductors by using a novel synthetic technique that was molecular beam epitaxy (MBE). MBE has a great potential to produce entirely new materials, ones that cannot be obtained by bulk synthesis, due to its unique features –low-temperature synthesis, epitaxy effect, contamination-free environment, and atomic-layer control. Using these advantages, we have synthesized new superconducting Pb cuprates.

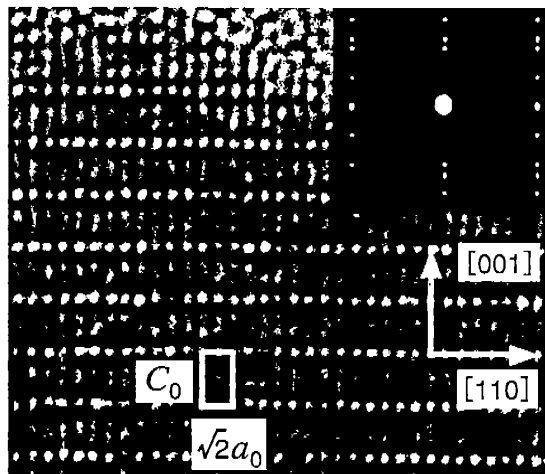
The crystal structure of superconducting copper oxides can be viewed as the stacking of two-dimensional  $\text{CuO}_2$  planes and charge reservoir blocks. Charge reservoir blocks containing heavy cation elements give the high  $T_c$ , as can be seen in Hg-, Tl-, and Bi-based superconductors. Unfortunately, however, the first two are toxic, and the last one has strong two-dimensionality, which is an obstacle to magnetic-wire application.

There is thus a desire to develop Pb-based superconductors, but there has been no real success by bulk synthesis. There are two problems in the synthesis of Pb cuprates: (1) the high-vapor pressure of Pb and  $\text{PbO}_x$  and (2) the predominant phase formation of thermodynamically stable  $\text{SrPbO}_3$ . To avoid the first problem, we grew films at temperatures as low as  $500^\circ\text{C}$ . To avoid the second problem, we found the choice of substrate material to be crucial. Using lattice-matched  $\text{LaAlO}_3$  substrates, we selectively formed superconducting  $\text{PbSr}_2\text{CuO}_{5+d}$  with no  $\text{SrPbO}_3$  phase formation. Figure 1 shows a cross-sectional lattice image, obtained with a transmission electron microscope, of  $\text{PbSr}_2\text{CuO}_{5+d}$  film. It shows a regular stacking of  $\text{CuO}_2$  planes and  $\text{PbO}$  charge reservoir blocks.

$\text{PbSr}_2\text{CuO}_{5+d}$  is the first member of the Pb-12 (n-1) n homologous series, and hence has  $T_c$  as low as 40 K. However, according to the empirical rule for  $T_c$ -versus-n, the third member of this series will give a  $T_c$  of more than 120 K, making this approach a promising one.

(Basic Research Laboratories)

A cross-sectional lattice image obtained with a transmission electron microscope for  $\text{PbSr}_2\text{CuO}_{5+d}$



## Imaging Atomic Step Dynamics

To the eye, a crystal surface appears smooth, flat, and mirror-like, but on a microscopic scale, it is covered in atomic steps, forming the edges of perfectly flat terraces. Crystal growth starts at these atomic steps, so they play a pivotal role in atomically controlled thin-film growth and nanostructure fabrication. We have developed unique methods for both observing and manipulating atomic steps and have analyzed the underlying mechanisms behind their behavior.

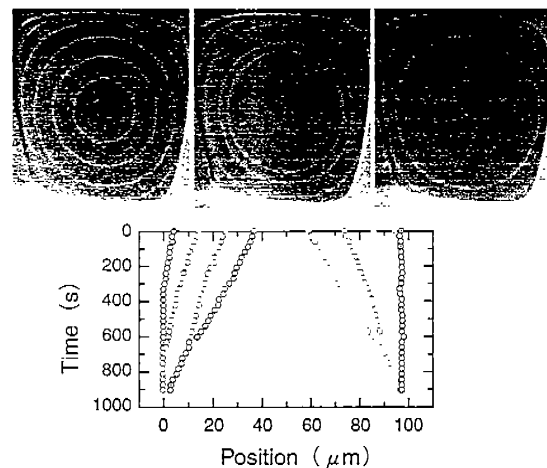
The arena for these atomic-step motion studies is an ultra-flat Si (111) surface, which is atomically flat over macroscopic areas –areas measuring  $100\ \mu\text{m}$  or more on a side. We discovered that ultra-flat terraces form at the bottom of craters in silicon surfaces when the surfaces are heated to a high temperature. The terraces form when the silicon is heated to sublimation, causing the atomic steps to retreat.

On an ultra-flat terrace, steps can be controllably introduced, one by one, and they can be tracked with an electron microscope, allowing atomic phenomena to be seen on a macroscopic scale. For example, studying the growth and erosion of atom-high islands and craters reveals the kinetics of attachment and detachment of surface atoms. By creating two craters or islands simultaneously, we can make atomic steps collide, enabling us to probe the interaction between steps. One such collision is shown below. The series of snapshots shows concentric atomic steps (crater edges) expanding during sublimation. The graph shows the time evolution of the step positions. The innermost step collides with its neighbor.

These studies are contributing to our understanding of the physics of crystal growth and sublimation. We plan to use this knowledge to precisely control step structures.

(Basic Research Laboratories)

The motion of atomic steps on an ultra-flat terraces



## Database of Japanese Lexical Properties

Modern science is exploring the language of the human brain. To do this, it is necessary to identify the properties of each word and characters because the brain works differently for each one. However, lack of a Japanese lexical database containing many properties of many words and characters has been a big obstacle to brain research on language.

To overcome this obstacle, we developed the largest and most reliable lexical database of properties of Japanese words and characters.

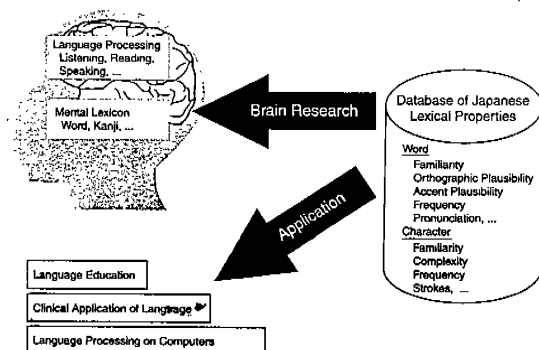
- It contains, for example,
- (1) the familiarity, orthographic plausibility, and accent plausibility for about 80,000 words,
  - (2) the frequency for about 340,000 words, and
  - (3) the familiarity, complexity, and frequency for about 7,000 characters.

A user-friendly search program is provided with the database.

This database should greatly contribute to basic research on language functions of the human brain. In addition, it can be applied in many areas such as education, medicine, and engineering. For example, we have already developed a vocabulary test (<http://www.bril.ntt.co.jp/cs/human/goi/>) and a check test for aphasia. And we have proposed a new front-end for a Japanese language processing system.

(Communication Science Laboratories)

Brain research and applications based on the Database of Japanese Lexical Properties



## Security Analysis of Elliptic Curve Cryptosystems

The focus in telecommunications has shifted from "communicating messages" to "communicating messages safely". Secure communication is a prerequisite for electronic commerce, electronic money, etc. Cryptography is a key technology of such security.

Elliptic curve cryptosystems (ECC) are expected to be the next generation standard for cryptography. An elliptic curve system can run about 10 times as fast as RSA's scheme (the current de facto standard). However, since elliptic curve cryptosystems have a short history, there may be unknown weak points or points which can easily be attacked. Hence, the cryptosystem needs to be analyzed more deeply in terms of security.

At NTT Laboratories, we have been analyzing the security of elliptic curve cryptosystems. As a result, we have mathematically proven that when a particular type of curve, which we call a super-anomalous elliptic curve, is used in encryption, ECC can easily be broken. We prove it as follows. Firstly, we define a mathematical problem whose difficulty is equivalent to ECC in using this curve to break. Secondly, we propose an algorithm by which the problem can easily be solved, and we mathematically prove that the algorithm always outputs the correct answer. As a result, we show that it is easy to break ECC when super-anomalous elliptic curves are used.

The result became one guideline for choosing a secure curve for ECC. Aside from proving that a particular cryptosystem can easily be broken, this work contributes to the mathematics of cryptography.

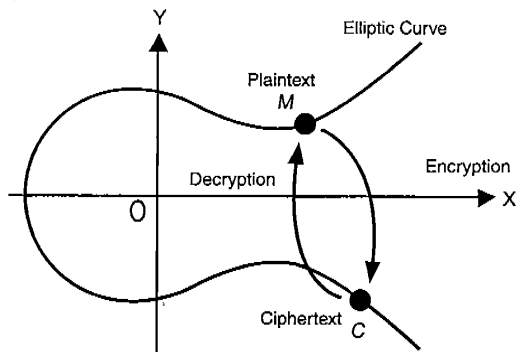
From now on, we plan to search for ways to attack other curves and analyze the efficiency of these attacks.

Furthermore, we plan to apply the results of this security analysis to the development of new, more efficient cryptosystems.

(Communication Science Laboratories)

\* RSA: Rivest-Shamir-Adleman Scheme

Encryption and decryption of elliptic curve cryptosystems





### Learning-Based Active Search Method for Instantaneous Searching of Reduced-Quality Sound and Video Images

In keeping with the growing popularity of the Internet, there is a growing need to quickly search for specified sounds or images from among huge amounts of information. In October 1998, NTT Laboratories developed a multimedia search technology –called the Time-series Active Search (TAS) method– which could seek out specified sounds and video images from among longer sound and image data some 600 times faster than with the conventional feature-matching method. There is an undesirable phenomenon with TAS method, however, in that the search accuracy decreases when searching for sounds or video images of which quality has been significantly altered as a result of such operations as compression or editing, a situation that is often encountered on the Internet.

The recently developed Learning-based Active Search method (LAS) has expanded on the concepts of the TAS method, resolving the above-mentioned problem by introducing a learning mechanism. First, in the learning stage, the system learns how the characteristics of sounds and images differ before and after compression or other processes. This learning takes place in the form of a probabilistic model, using sounds and images designed specifically for this purpose. Then, in the search stage, the system reflects the results of the learning process, matching data while taking into consideration a number of possible quality changes. We have introduced an original technique at this point: the system instantly identifies unnecessary matching calculations both in terms of time domain and feature domain, in order to increase the speed of the matching process.

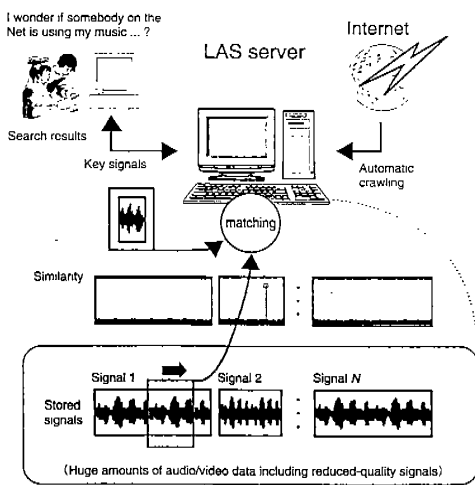
This technology maintains approximately the same speed as the TAS method, and can also correctly search for materials that could not be searched using conventional methods; for example, video images that have been repeatedly dubbed on home video recorders, or sounds from music CDs that have been transmitted through telephone lines. Of course, this technology is compatible with commonly used compression methods, including MPEG. This technology can be used in a number of applications, including monitoring systems for sounds and video images on the Internet and music search services using sound fragments transmitted over telephone lines.

In the future, we will continue to aim for even higher level technologies, centered around the current technology, to allow users to quickly search out information of interest from among huge amounts of multimedia information, including sound, images, and text.

(Communication Science Laboratories)

MPEG: Moving Picture Experts Group

An audio/video searching system for Internet using Learning-based Active Search (LAS)



### An Information Integration System Based on Geographical Information (GeoLink)

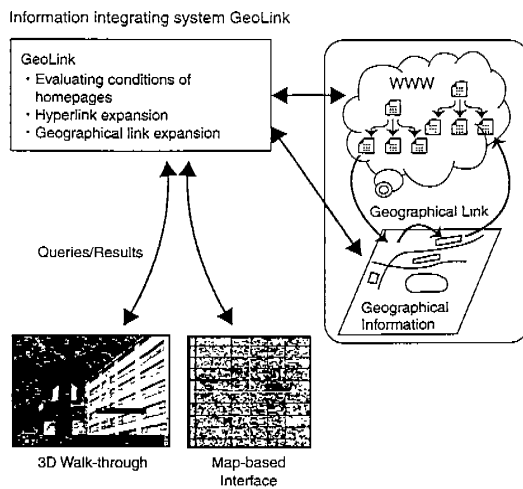
NTT Laboratories are conducting research and development on the GeoLink Information Integration System, the goal of which is to integrate geographical information and information on the Internet, as part of efforts to build a social information infrastructure that provides living city information. By handling the hyperlinks between homepages on the Internet and the geographical relationship among pieces of information relating to actual cities in an integrated way, we are aiming to construct an information system that will be useful in day-to-day lifestyles.

GeoLink enables the user to receive information on the network through an expanding series of links among homepages, and repeated evaluations of the conditions in relation to the homepages contacted. In addition to expanding on the hyperlinks listed on the homepages, this system also expands on links derived from newly created relationships, using geographical attributes extracted from the homepages. In this way, users can retrieve information based in part on geographical relationships, such as distance and positional relationships, in actual cities. Using GeoLink, it is possible to provide even more diverse information than ever before, beyond what can be accomplished by traditional information retrieval systems that target only the content of homepages. For example, the user can search out specific information from sites with unknown configurations by tracing back through a series of links, or search on a map for homepages located within a given distance from a user-specified location.

GeoLink can be used via a variety of interface types, including a 3D walkthrough and a map-based interface that searches for information relating to cities. It can also be used in conjunction with construction tools for regional information portal sites that gather such city-related information.

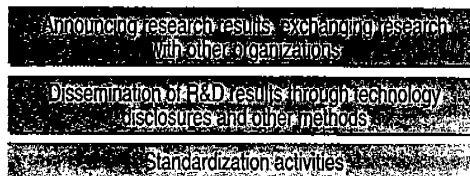
In the future, we will continue to develop our research themes as we work to construct an information retrieval system that can not only refer to Internet homepages and geographical information, but can also gather up-to-date information from the real world through tie-ups with sensors installed throughout the city and a variety of other communication tools.

(Communication Science Laboratories)



# Open R&D Environment

The role that information communications should play in the advancement of the society and economy is of great importance. In accordance with the Nippon Telegraph and Telephone Corporation Law, NTT believes its mission is to contribute to the development of information communications in Japan, and all around the world as well, by disseminating our research and development results. To achieve our mission, we are energetically developing the activities shown on the right.



## 1999 Symposia/Forums Schedule (arranged chronologically)

Event	Date	Location
The 10th NTT Science Forum	April 6, 1999	New Pier Hall
Communication Science Laboratoires Openhouse '99	June 3-4, 1999	NTT Keihan-na Building (Kyoto)
NTT Group R&D Forum 1999	October 19-20, 1999	NTT Musashino R&D Center
Photonic Network Forum PNF '99	October 27-28, 1999	KOKUYO Hall
Science & Core Technology Laboratory Group Forum	November 1, 1999	NTT Atsugi R&D Center
Tsukuba Forum '99	November 11-12, 1999	NTT Tsukuba R&D Center
Environment-Information- Education Forum 21	November 11, 1999	Iwate Medical Association Hall
NTT Open Lab Symposium	November 19, 1999	NTT Musashino R&D Center
2nd GEMnet Forum	March 1, 2000	NTT Musashino R&D Center
CmCC Symposium	1st : July 24, 1999	Tokyo International Forum
	2nd : September 11, 1999	Nara-Ken New Public Hall
	3rd : March 11, 2000	Tokyo International Forum

## Advanced Technologies Displayed at World Telecom '99

At the 8th World Telecommunications Exhibition (World Telecom '99), held in Geneva in October 1999, the exhibits of the NTT Group focused on the results of advanced research activities. World Telecom is a venue for the introduction of the latest accomplishments in telecommunications technologies by member countries of the International Telecommunication Union (ITU) introduce. It provides an opportunity for developing countries and other interested parties to learn about the possibilities for applications of these technologies.

World Telecom '99 was an extremely successful exhibition, with 1,146 participating companies, organizations, and agencies from 47 countries around the world. At the research display corner, NTT conducted demonstrations that showed detailed contents of a variety of services, and also gave visitors a chance to operate actual devices, thus emphasizing how each of the display systems is organically linked to make up the next generation in multimedia networks. Visitors to the exhibition showed very keen interest in all the displays. The details of each exhibit are outlined below.

### 1. Global Megamedia Network (GMN) -1 Corner

The first step in GMNs (a next-generation information communications infrastructure proposed by NTT Laboratories, which combines ATM<sup>1</sup> technologies and optical fiber networks.

- (1) IPM, an advanced-function IP<sup>2</sup> transfer system
- (2) MDS, a distributed storage network for contents distribution
- (3) ATM-PON, which allows the creation of economical FTTH<sup>3</sup>
- (4) ATM Shared, which allows the realization of low-cost services through shared network bandwidths
- (5) AWA<sup>4</sup>, which allows multimedia services to be used any time, anywhere
- (6) ATM Loss Less CODEC<sup>5</sup>, a realtime lossless compressed transfer method for digital video.

### 2. GMN-2 Corner

The second step in GMN, aimed at creating a next-generation IP network that offers such features as transfer speeds of 10 Mbit/s or more, as well as QoS<sup>6</sup> functions

- (1) Media Cruising, a next-generation internet architecture using advanced high-speed communication protocols.
- (2) Netwarp, an economical, PC-based, super-high-speed data transfer service
- (3) OPTIMA, a 640Gbit/s ATM switching system
- (4) Photonic Network, a network in the Tbit/s class that uses electronic and optical technologies.

### 3. E-commerce corner

Services that allows users to easily seek out and purchase their desired contents via networks.

- (1) A one-stop image shopping system comprised of such services as ExSight, DBSENA, and InfoProtect, which allow searches, purchase, and assured safety in transfer for digital images from multiple databases
- (2) Infoket/EA, an electronic transaction agent system for EC<sup>7</sup> platforms
- (3) TellTails, a detection system to detect pirated contents.

<sup>1</sup> ATM: Asynchronous Transfer Mode

<sup>5</sup> CODEC: COder/DECoder

<sup>2</sup> IP: Internetworking Protocol

<sup>6</sup> QoS: Quality of Service

<sup>3</sup> FTTH: Fiber To The Home

<sup>7</sup> EC: Electronic Commerce

<sup>4</sup> AWA: Advanced Wireless Access



NTT Group booth



Display area

## ■ NTT Group R&D Forum 1999; Commemorative Event Celebrates Opening of NTT Musashino R&D Center Main Building

The "NTT Group R&D Forum 1999" was held over two days, on October 19 and 20, at the main building of the NTT Musashino R&D Center. The goal of this forum, which was held to commemorate the completion of the R&D Center main building, was to introduce the R&D activities and future prospects for the NTT Group as a whole.

Jun-ichiro Miyazu, President of NTT, gave the keynote address to start off the special discussion meeting on the 19th. Hiroshi Inose, Director General of the National Center for Science Information Systems at the Ministry of Education, Science, and Culture, followed this address with a speech concerning expectations for NTT's R&D activities. On the 20th, a series of technical presentations was held by key personnel in charge of R&D at the various group companies.

A special exhibit by twelve NTT Group companies (featuring about 50 displays) and a separate exhibit of research achievements (about 70 displays) were held during the two days of the Forum, as a technical display of the R&D achievements at the various Group companies. Total attendance for the two days combined was around 3,000 visitors. The NTT Group, which is aiming to become a Global Information Sharing company, presented to visitors a clear vision of its R&D activities. The full capabilities of the Group are being invested in the promotion of these activities, as part of efforts to create a rich information society for the future.



NTT Musashino R&D Center main building



Technical presentations



Display corner

## ■ The 10th NTT Science Forum

The 10th NTT Science Forum was held on April 6, 1999, at the New Pier Hall in Minato Ward, Tokyo. The goal of this Forum, which has been held every year since 1990, is to contribute to the advancement of fundamental research and developments in science and technology. This year's Forum marked the tenth gathering since the Forum's inception. The Forum began with three keynote addresses—presented by Lawrence L. Rauch, Professor Emeritus, University of Michigan; Leslie J. Deutsch, Manager, Advanced Flight System Program of the Jet Propulsion Research Laboratory, NASA; and Haruto Hirotsawa, a Professor at the Institute of Space and Astronautical Science—based on the theme "Challenging the Mysteries of Space: Unraveling the Mysteries of Space with Advanced Technology." Later, panelist presentations were given by numerous scholars from throughout the country, and a panel discussion was held on "The challenges of space, both present and future." This discussion examined the mysteries of space from a number of different perspectives, and left a lasting impression on the roughly 800 visitors to the Forum.



Welcoming speech by Jun-ichiro Miyazu, President of NTT



Panel discussion

## ■ Promotion of Technology Support Activities by Means of Satellite Labs

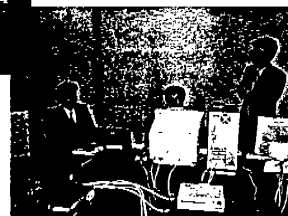
NTT Laboratories have established Satellite Labs nationwide for the purposes of encouraging fundamental R&D activities by directly grasping market needs and applying R&D results when and where needed in commercial enterprise and society. At the Satellite Labs thirty researchers cooperate with the R&D Centers of NTT East and NTT West to provide technological support to NTT East and NTT West business sectors. Satellite Labs aim to promote transfer of the latest research results to specific services and systems oriented to each region and customer.

The technical support activities conducted in 1999 include education application experiments using environment-sensing technology, and field experiments related to digital information content storage and distribution using digital watermarking technology. At the "NTT R&D Selections," an exhibition held in Naha city (February 17 to 18), the latest R&D results were demonstrated to about 500 visitors, including the Vice Governor of Okinawa prefecture, creating a very favorable impression of how NTT is taking on the challenges of information sharing technologies. Also, seminars took place in many cities, such as "Communication and Well-being" (May 8 in Fukuoka city), "Computers are Changing Daily Lives" (June 22 in Nanao city), and "Multimedia Technology is Changing the Information Sharing Society" (October 27 in Naha city) to explain NTT's vision of the "information sharing society" and research on the technology for realizing it.

In the future, as well, we will continue with technology support activities based on the advanced technology and knowledge possessed by NTT Laboratories to promote the early dissemination of R&D results.



"NTT R&D Selection" in Naha city



Technical demonstration at Hokuriku satellite laboratory

## ■ Publishing of Technical Magazines

NTT publishes the following three technical magazines with the aim of disseminating research and development results.

### (1) NTT Gijutsu Journal (monthly magazine in Japanese)

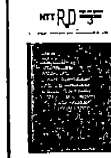


Explains research and development results and business trends.

(1999 Feature Articles)  
Construction of ATM Backbone Network, Construction of Information Sharing Platforms, Multimedia

Communication Devices Becoming Pervasive in Households, Technical Developments for the 21st Century, Future Telephone Services of the NTT Group, Efforts to Improve the Quality of Service, The Future Opened Up through Fundamental Research into Physical Properties, Electronic Business Solutions for the EC marketplace, Voice Recognition/Voice Synthesis Technologies, etc.

### (2) NTT R&D (monthly magazine in Japanese)



Consists of research and scientific papers written for specialists.

(1999 Feature Articles)  
JoiNet Information Sharing System Technologies, Development of ATM Backbone Network Equipment,

Network-based Technologies that Support NTT Group Activities, Next-generation On-board Satellite Equipment Technologies, Wireless LAN Systems for 5GHz Band Ethernet, IC Card Public Phone Systems, Information Communications and Micromechanics, Encoding, Clean Energy System Technologies, Developments in Technologies for Next-generation Map Applications, Experimental Results from Global Test Beds (GEMnet), Media Processing Technologies, etc.

### (3) NTT REVIEW (published every odd-numbered month in English)



Explains research and development results and business trends for overseas readers.

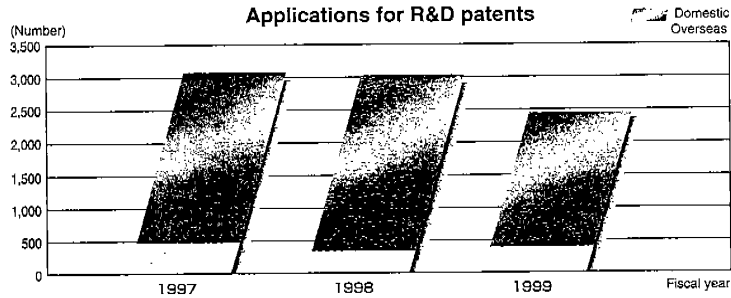
(1999 Feature Articles)  
Information Sharing Business in the 21st Century, Challenges for

Terabit Communications Technologies, New Technologies and Developments for the 21st Century, Development of ATM Backbone Network Equipment, Basic Research towards the Future Information Sharing Society, GEMnet, Optical Access Network System Technologies, etc.

## ■ Patents and Technology Disclosures

In addition to enthusiastically obtaining patents, technology resulting from research and development across a wide range of fields is provided at a reasonable cost so that it can be utilized in the industrial world when required.

Applications for R&D patents

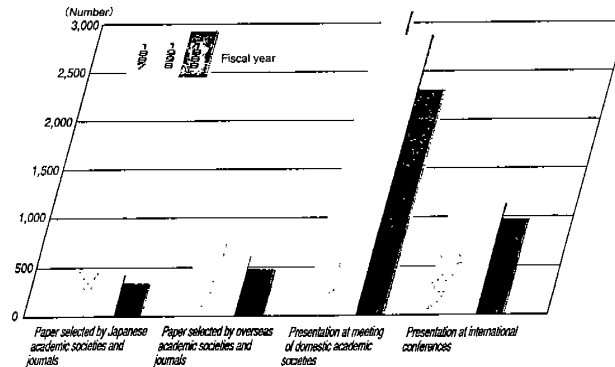


### Major technology disclosure

- |                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>1997</b></p> <ul style="list-style-type: none"> <li>● Multifuel-Type Fuel Cell Technology</li> <li>● Polyimide Optical Waveguide Fabrication Technology</li> <li>● Microwave over Optical Fiber Subcarrier Transmission (MOST) Design Technology</li> </ul> | <p><b>1998</b></p> <ul style="list-style-type: none"> <li>● 5GHz Band Wireless LAN Technology</li> <li>● Process and Design Technologies on 0.5 μm CMOS/BiCMOS</li> <li>● Lightning Protection Testing Technology for Terminal Equipment</li> </ul> | <p><b>1999</b></p> <ul style="list-style-type: none"> <li>● Transform Domain Weighted Interleave Vector Quantization (TwinVQ)</li> <li>● MU Fiber Optic Connectors</li> <li>● 10-Gbit/s ADM Ring System</li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## ■ Scientific Papers and External Announcements

The results of research and development activities carried out at our research laboratories are frequently announced at domestic and international conferences and in specialized scientific journals. These activities inspire more research and development into the field of information communications and contribute greatly to the development of science and technology.



## Standardization Activities

Based on its comprehensive range of research and development on information communications, NTT has been active in fora and consortia, which are recently playing leading roles, as well as in standardization organizations such as ITU-T, ISO. These activities also contribute to the orderly development of worldwide information communications.

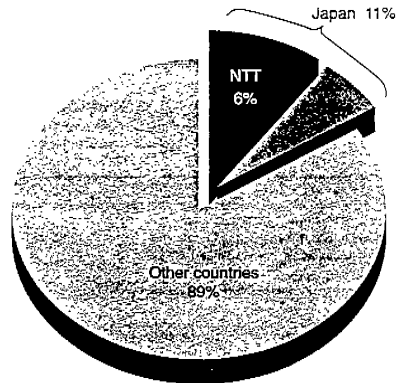
Participation in standardization organizations such as ITU and TTC (fiscal 1999)

International : Chairperson and other appointees	total	80
International : Participants	total	340
Domestic : Participants	total	380

Number of participation in international standardization meetings (fiscal 1999)

About 2,900 man-days  
(Excluding preparatory studies)

Percentage of contributions submitted to ITU-T (1993-1996 study period)

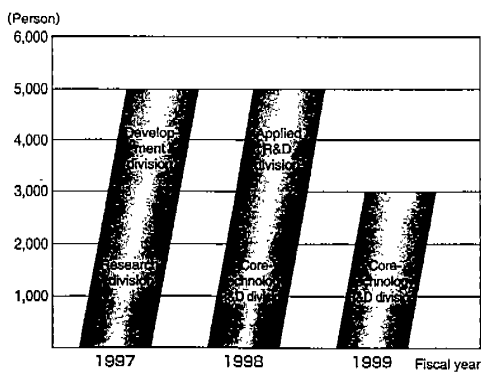


Estimated from the former study period (1993-1996) data of ITU-T and of the Ministry of Posts and Telecommunications, Japan.

## Main Commendations and Prizes Awarded in 1999

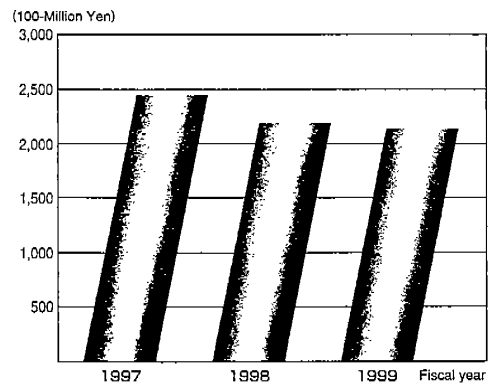
Organization and Award	Items
Science and Technology Agency Persons of Scientific and Technological Merits	Development of Silica Planar Lightwave Circuits using Flame Hydrolysis Deposition Method
Science and Technology Agency Remarkable Invention	System for Re-Transmission in Data Communication
Communications Association Maejima Award	Development and Deployment of Economical Optical Access Systems by using PDS Method
The Okochi Memorial Foundation The Okochi Memorial Technology Prize	Development of Silica Planar Lightwave Circuits
The Institute of Electronics, Information and Communication Engineers Achievement Award	Pioneering Research on Photonic Transport Network
The Institute of Electronics, Information and Communication Engineers Achievement Award	Advanced Research and Development of Behavioral Hardware Description Language and High-Level Synthesis Technology

## Number of R&D Personnel



With the reorganization of the NTT Group in July 1999, the Applied R&D division was transferred to operating companies.

## R&D Expenditure



**Cyber Communications Laboratory Group**

Research and development of new products for use in information sharing business applications

↳ **Cyber Solutions Laboratories**  
Research and development of products and services for the information sharing business, and provision of solutions technology

↳ **Cyber Space Laboratories**  
Research and development of elemental technology for the information sharing business (contents-creation support technology, media technology, database technology, software technology, etc.)

**Information Sharing Laboratory Group**

Research and development of global information sharing network services

↳ **Service Integration Laboratories**  
Creation of new marketing services centered around information sharing networks (Service Creation)

↳ **Information Sharing Platform Laboratories**  
Research and development of information sharing platforms as common elements in various information sharing network services

↳ **Network Service Systems Laboratories**  
Research and development of network services and advanced networks technologies that will support these services

↳ **Access Network Service Systems Laboratories**  
Creation of diverse access services to support information sharing, and development of more advanced and more economical access networks

**Science & Core Technology Laboratory Group**

Discovery of new principles and concepts to revolutionize information communications and research and development of cutting-edge technology

↳ **Network Innovation Laboratories**  
Research and development of optical and wireless technologies and communications software technology as the core of next-generation networks

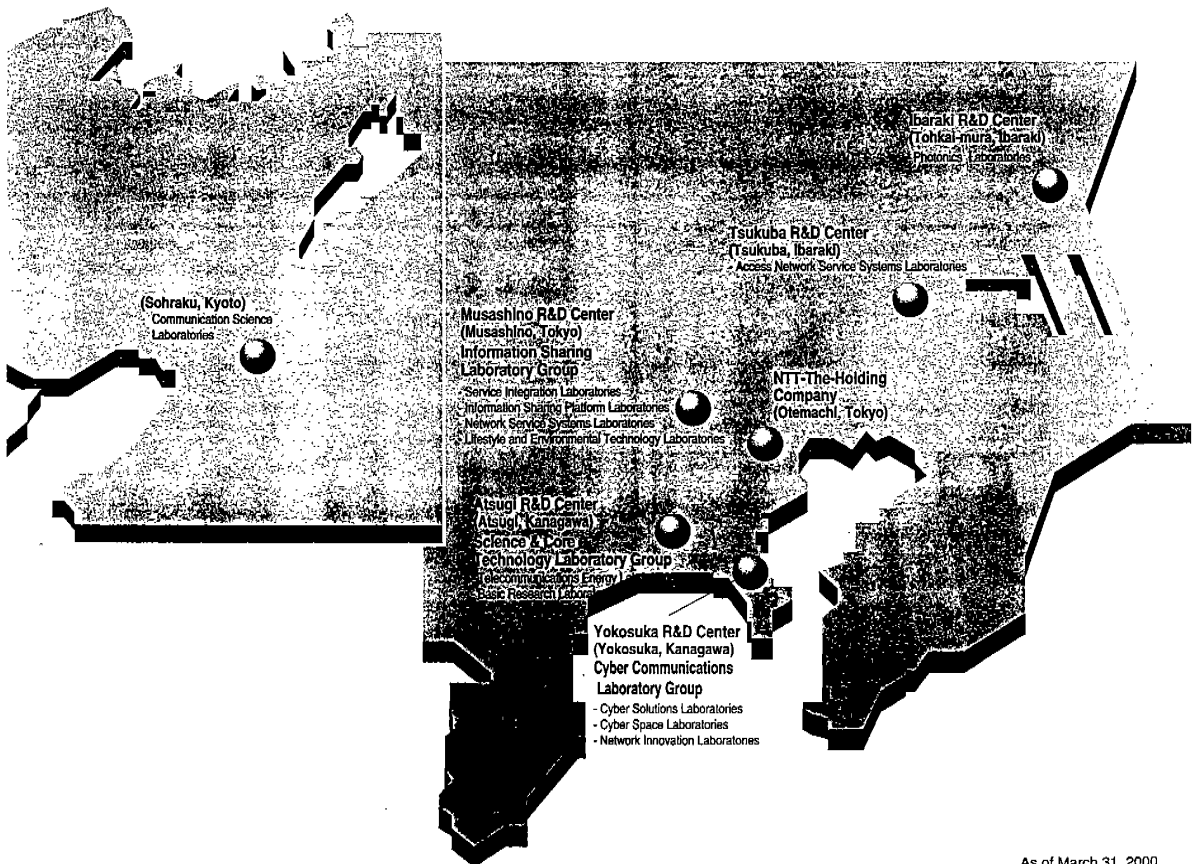
↳ **Lifestyle and Environmental Technology Laboratories**  
Research and development of lifestyle and environmental technologies based on information sharing to ease the load on the environment and revolutionize personal lifestyles

↳ **Telecommunications Energy Laboratories**  
Research and development of technologies for generating, converting, transmitting, storing, and consuming energy used in communications

↳ **Photonics Laboratories**  
Research and development of optical and electronic components, modules, materials, and other cutting-edge technologies to achieve novel forms of information communications

↳ **Communication Science Laboratories**  
Discovery of new approaches and concepts in knowledge processing and media processing to revolutionize information communications

↳ **Basic Research Laboratories**  
Research and development of innovative devices and materials and research of quantum optics and electronic materials



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**NTT**

NIPPON TELEGRAPH AND TELEPHONE  
CORPORATION



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**Cyber Communications Laboratory Group**

1-1, Hikarinooka, Yokosuka-shi, Kanagawa 239-0847, Japan

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**Information Sharing Laboratory Group**

3-9-11, Midori-cho, Musashino-shi, Tokyo 180-8585, Japan

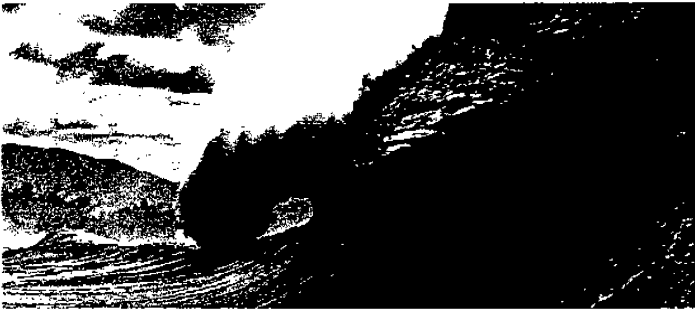
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**Science & Core Technology Laboratory Group**

3-1, Monnosato Wakamiya, Atsugi-shi, Kanagawa 243-0198, Japan

E-mail: [rd-annual@ml1.lab.ntt.co.jp](mailto:rd-annual@ml1.lab.ntt.co.jp)  
URL : <http://www.ntt.co.jp/RD/Enindex.html>

June 2000  
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*Innovation for the Information Sharing Society*





# Multimedia

拡がるマルチメディアコミュニケーション

*The World of Expanding Multimedia Communications*

新たな千年紀の幕開けを迎えた今日、情報通信はダイナミックな変革の波にさらされています。インターネットをはじめとする情報通信ネットワークの急速な発展が、情報が価値を持って流通する時代を創造し、社会やビジネスを革新する大きな要素となっています。また、コミュニケーションも従来の「音声を中心とした情報の伝達」から、「デジタル化されたさまざまな情報が流通」する時代へと移行しつつあり、情報通信市場の構造にもマルチメディアコミュニケーションによる、地球規模の大きな変化が現れています。

その変革の中心に位置するNTTグループは、高度なIT (Information Technology) を駆使し、多彩な情報が自由にネットワークを流通する「情報流通 (Information Sharing) 市場」を創造することによって、便利で豊かな社会の実現をめざしてまいります。

NTTマルチメディアセンターは、これらNTTグループが取り組む最先端の技術とサービスを、さまざまなアプリケーションやコンテンツを通じてご紹介しています。

当センターで、マルチメディアの今日と明日を存分に体験していただきたいと思います。

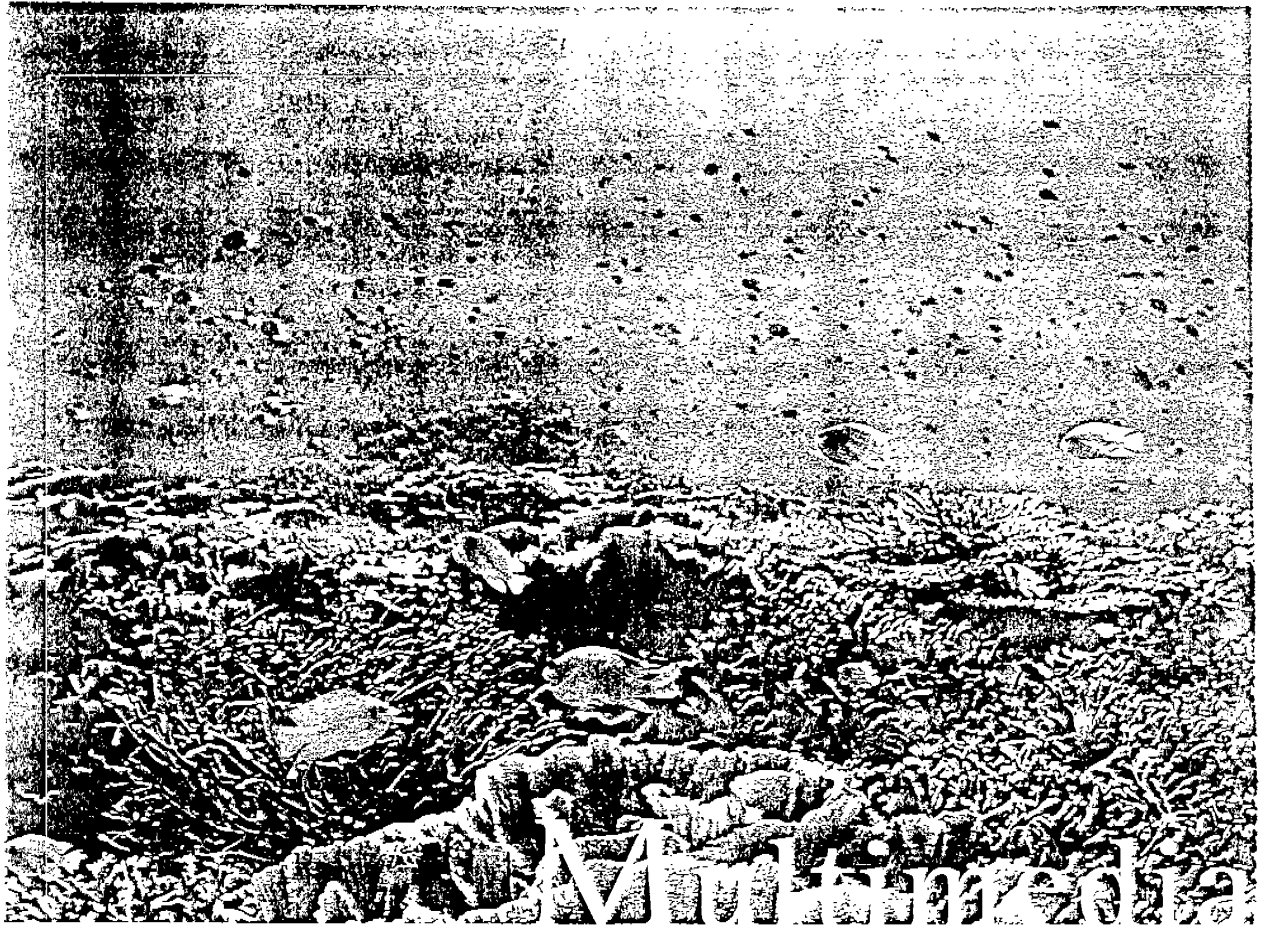
# Presence

の世界

In the new millennium, information communications is undergoing dynamic change. The proliferation of such information communications networks as the Internet has become an essential part of communicating society and business by creating a foundation for value-added information distribution. Communications are shifting from the transmission of information centering on audio to the distribution of diverse digital data. Major changes spurred by multimedia communications are felt around the world in the creation of new information communications markets.

Strongly positioned amid this phenomenon, the NTT Group aims to create more convenience and wealth in society by developing information sharing markets that distribute diverse data freely over networks through the use of advanced information technology (IT).

NTT Multimedia Center introduces cutting-edge technologies and services developed by the NTT Group through a variety of applications and content. The Center offers opportunities to experience the full potential of multimedia technology available today and in the near future.



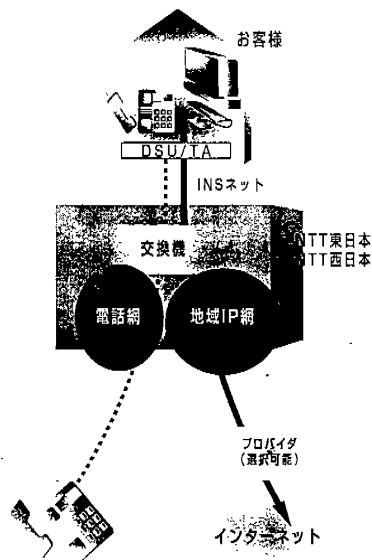
## *Gateway to the Information Sharing Society*

情報流通時代に不可欠なネットワークへの  
高速で多様なアクセスサービスを提供し、  
豊かなインターネットコミュニケーションを  
実現します。

*The NTT Group provides diverse, high-speed network  
access services essential to sharing information and intensi-  
fied Internet usage.*

## 情報流通の実現に向けて。今、注目を集めるフレッツ・ISDN

### ◆フレッツ・ISDN



### フレッツ・ISDN

マルチメディア技術の進展により、本格的な情報流通時代の到来が間近となった今、インターネットアクセスの高速化・料金定額制に対する関心・要望が高まっています。NTT東日本とNTT西日本では、そのご要望にお応えするため、インターネット接続向けの新サービス「フレッツ・ISDN」を提供しております。

フレッツ・ISDNは、INSネット回線を利用してインターネットサービスプロバイダーに接続する際の通信料が完全定額となるサービスです。お客様がご利用されているINSネット回線からお客様それぞれの専用電話番号にダイヤルしていただくと、NTT地域会社が地域IP網を介して、お客様がご契約いただいているインターネットサービスプロバイダーに接続するしくみです。

フレッツ・ISDNは誰でも手軽に安心してインターネットでコミュニケーションを楽しめるマルチメディア社会への入口として期待されています。

# Presence

### FLET'S-ISDN

With the advancement of multimedia technology, demand for high-speed, fixed-rate Internet access is rising amid the imminent arrival of a full-fledged information sharing era. In response to this demand, Nippon Telegraph and Telephone East Corporation (NTT East) and Nippon Telegraph and Telephone West Corporation (NTT West) began providing FLET'S-ISDN, a new Internet connection service.

FLET'S-ISDN utilizes INS-Net lines and offers dial-up connections to a provider at a fixed rate. By dialing an assigned telephone number from an INS-Net line, customers connect to their choice of Internet service providers through local Internet protocol (IP) networks of regional NTT companies.

As an exceptionally easy-to-use standard Internet connection service, FLET'S-ISDN is expected to become a portal to multimedia communications over the Internet.



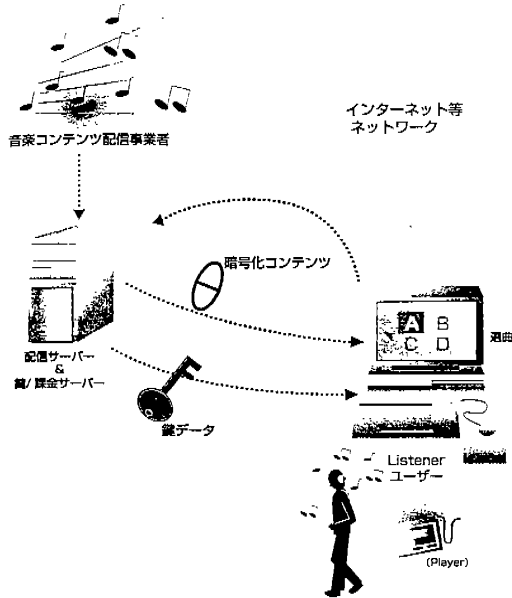
## *Cutting-Edge Content Services*

ネットワーク上を行き交うさまざまな情報。  
音楽配信サービスや電子マネーなど、  
情報流通時代の進化形がここにあります。

*Data streaming over networks: From music distribution  
services to electronic money, information sharing is advancing  
at the speed of light.*

## 先進性と利便性へ。進化するコンテンツサービス。

### ◆ SolidAudio System



### 音楽がネットワークを流通する / SolidAudio

「SolidAudio」とは、デジタル音楽の配信サービスを実現する新しいネットワークオーディオの方式です。

高品質音楽圧縮技術により、高音質な楽曲を、手軽にネットワークからダウンロードすることが可能です。また、メディア固有のIDを用いた暗号化およびコンテンツ配信技術により、違法コピーをプロテクトする確実な著作権保護を実現します。SolidAudioは、情報流通時代にふさわしい、安全で確実な音楽配信 / コンテンツ流通サービスを可能にします。

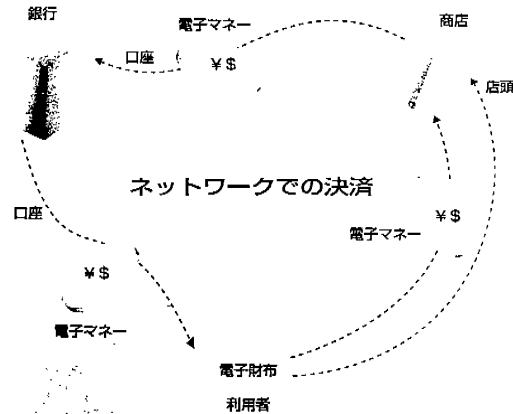
NTT東日本ではSolidAudioの普及推進のため、様々な分野の企業と連携し、SolidAudio関連サービスの開発やシステム提供などを行っています。

### 身近になる EC プラットフォーム / 電子マネー

電子マネーは、それ自体が価値をもつ情報として、紙幣やコインと同様に買い物をしたりサービスを受けたりすることができ、インターネットを通じた電子商取引などネットワークビジネスに不可欠な要素となっています。NTTの電子マネーは、1枚のICカードにどんな金額でも格納、携帯することができ、セキュリティについても、優れた暗号技術を応用することにより保証しています。また、人から人への譲渡機能、支払いの匿名性、複数の銀行が参加できるなど、現金と同様の機能も兼ね備えることができます。NTTグループは、電子マネーの流通する社会の実現に向け、今後もさまざまな実験を通して、さらなる開発・検討を重ねていきます。

# Presence

### ◆ 電子マネーとは



- 特徴
- ネットワークでも使える
  - 換金性がある
  - 補助貨幣、おつりが不要になる

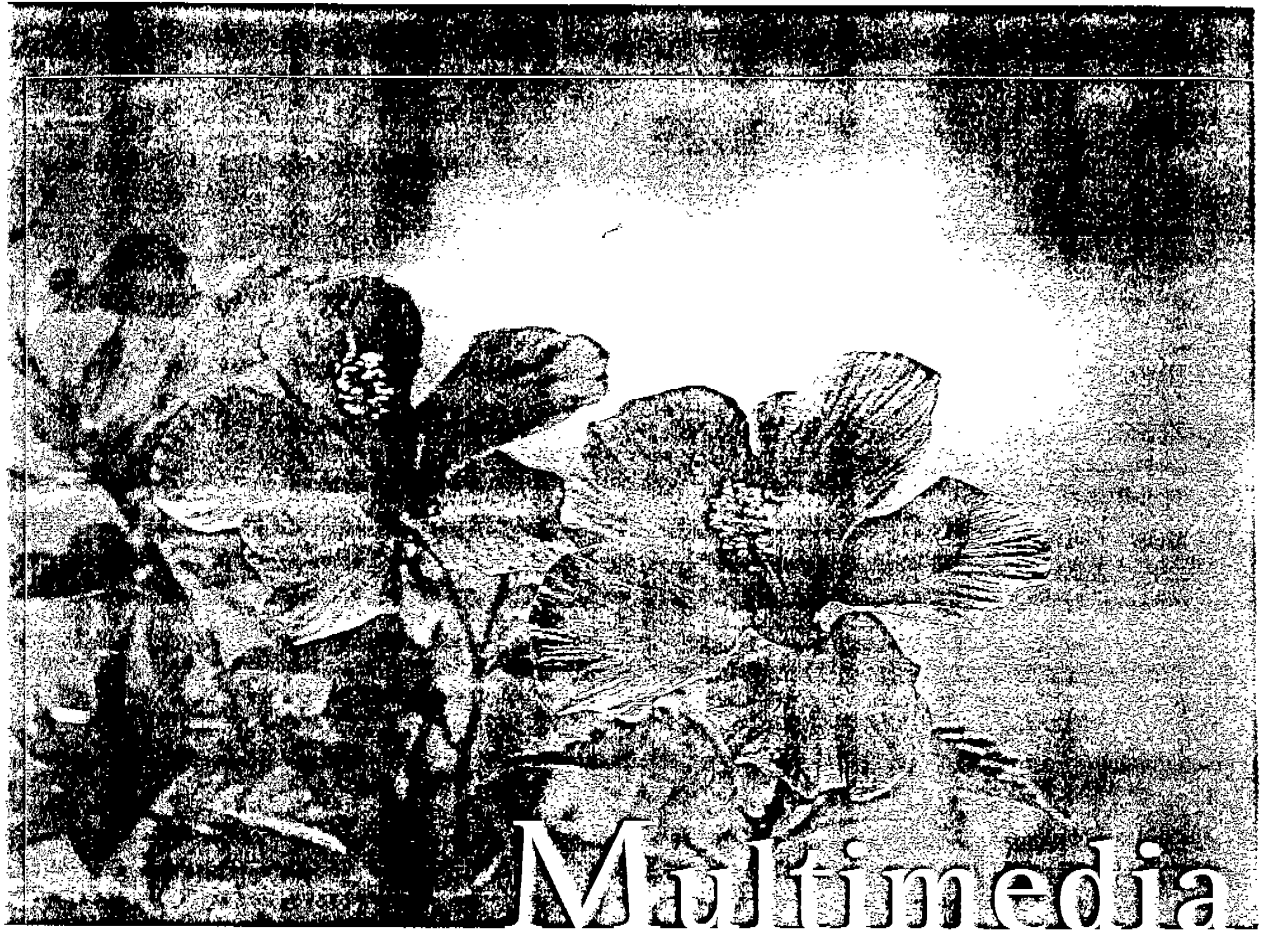
### SolidAudio—Distributing Music Over Networks

SolidAudio is a state-of-the-art digital music distribution system. High-quality digital music files are easily downloaded over the Internet and private networks using the advanced audio compression technology of SolidAudio. Encryption that utilizes media-specific IDs and robust content distribution technology, other features of SolidAudio, protect on-line digital music from piracy. SolidAudio is a key technology for growing information-sharing needs for secure digital music distribution.

NTT East will foster its alliances with leading companies to develop and provide SolidAudio services and systems to promote the spread of the system.

### E-Commerce Platforms and Electronic Money

Electronic money is an essential element for conducting business over networks, including electronic trading over the Internet. As data with intrinsic value, electronic money is the same as using conventional currency for shopping and services. Any amount of NTT's electronic money can be carried and stored on a smart card. Security is assured with powerful encryption technology. In addition, NTT's electronic money permits monetary transactions from person to person, anonymous payments and the participation of multiple banks. With these features, NTT's electronic money is as convenient as traditional cash. The NTT Group is advancing development and studies through a variety of experiments to realize the circulation of electronic money in society.



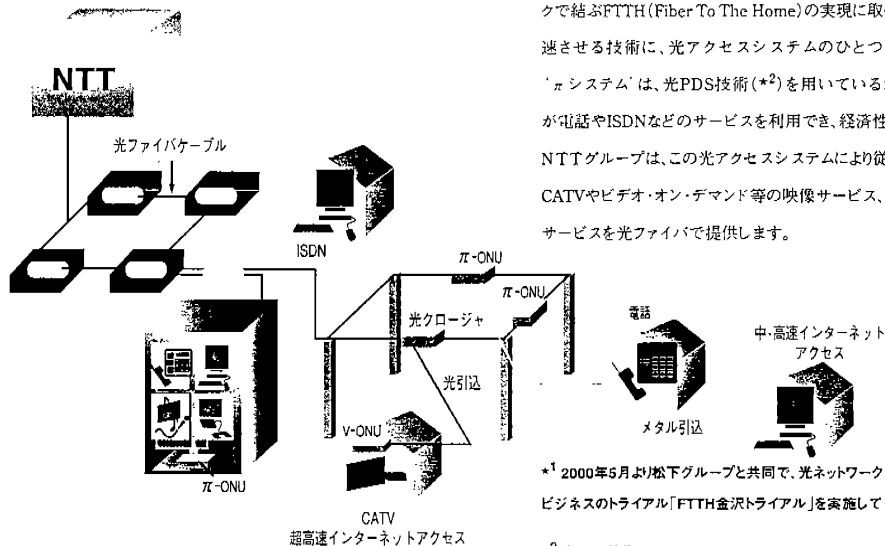
*R&D to  
Realize Future  
Potential*

光化の推進による新たなネットワークの未来へ。  
高品質、低価格なネットワークサービスを可能にする  
光化技術をご紹介します。

*Toward a future of advanced optical networks—introducing  
optical technology for high-quality, low-cost network  
services*

夢を形に。情報流通の未来を創造する研究開発。

◆光アクセスシステムの概要  
An outline of the Optical Access System



新光アクセスシステム (πシステム)

NTTグループは、情報流通社会の到来に備え、当社とお客様のご家庭までを光ネットワークで結ぶFTTH(Fiber To The Home)の実現に取り組んでいます(\*1)。FTTHの実現を加速させる技術に、光アクセスシステムのひとつである「πシステム」が挙げられます。「πシステム」は、光PDS技術(\*2)を用いているため、1本の光ファイバで複数のお客様が電話やISDNなどのサービスを利用でき、経済性に優れた設備構築も可能にしています。NTTグループは、この光アクセスシステムにより従来の電話/専用線等の通信のみならず、CATVやビデオ・オン・デマンド等の映像サービス、高速インターネットアクセス等、さまざまなサービスを光ファイバで提供します。

\*1 2000年5月より松下グループと共同で、光ネットワーク(FTTH)と情報家電を組み合わせた情報流通ビジネスのトライアル「FTTH金沢トライアル」を実施しています。

\*2 光PDS技術

PDS(Passive Double Star)は、スプリッタと呼ばれる光デバイスで光信号を分岐・合光させることにより、複数のお客様が1つの伝送機器を共有することを可能にします。

# Presence

The New Optical Access System (π System)

The NTT Group is making all-out efforts to advance Fiber To The Home (FTTH), which connects NTT optical networks and customer homes\*1. An Optical Access System, the πSystem is one of the technologies that accelerates full implementation of FTTH. The π System employs optical passive double star (PDS)\*2 technology. It allows for the construction of highly economical facilities and for multiple customers to simultaneously use such services as telephone and ISDN over a single optical fiber line. The NTT Group will provide a variety of services with the Optical Access System, including such visual services as cable TV (CATV) and video on demand, high-speed Internet access, as well as conventional telephone and dedicated communications line services.

\*1 The NTT Group, in cooperation with the Matsushita Group, started the FTTH Kanazawa Trial in May 2000, a project for information sharing business utilizing Fiber To The Home (FTTH) and information appliances.

\*2 Optical PDS Technology

Passive double star (PDS) allows several customers to share a single transmitter by splitting and combining optical signals with a device called an optical splitter.

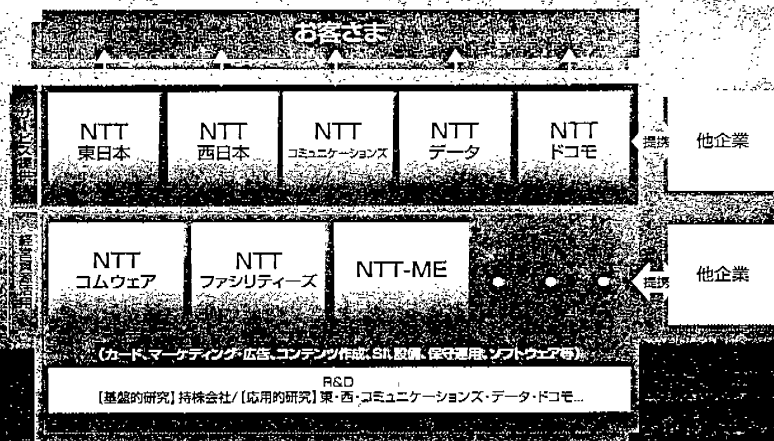


The NTT Group creates  
value-added services  
and dynamic synergies  
continuous innovation.

# new technologies, through

NTTグループは、革新的な技術を背景に情報流通に関するお客様の多様なニーズにお応えしています。さらに、グローバルダイナミクスを発揮し、魅力あるサービスとネットワークを提供することによって、豊かな社会を実現する情報流通市場の発展をめざしてまいります。

While meeting diverse customer needs related to information distribution with innovative technology, the NTT Group aims to develop information distribution markets for a better tomorrow by harnessing Group-wide innovative services and networks.





NTT  
**DoCoMo**

Beyond The Mobile Frontier

MAGIC WORLD  
CLUB-D

# Presenting our vision of the future.

Magic World CLUB-D is an executive space for presenting NTT DoCoMo's vision of MAGIC communications.

Here we hope to provide key players from around the world with views of the magic to come and the business opportunities arising in mobile multimedia communications.

## Concept Theater

In the Concept Theater, our "Vision 2010" movie provides a tantalizing glimpse of how mobile multimedia communications will benefit society in the 21st century.



▲Scenes from the "Vision 2010" movie



▲Concept Theater

## Magic World CLUB-D also provides:



▲An impressive view of Tokyo.



▲A large conference room with advanced presentation facilities.



▲A small meeting room with a congenial atmosphere.

# Display Zones

NTT DoCoMo's services, technology and vision of the future are presented in three display zones.

Demonstrations and displays of our latest activities cover present and future mobile communications and promote the development of new business opportunities and ventures.



Prologue to the mobile frontier

## 1 DoCoMo Today

Zone One introduces NTT DoCoMo's current and yet-to-be-marketed products and services made possible by exhaustive R&D.



▲Corporate profile and R&D corner



▲Topics corner, where state-of-the-art mobile multimedia can be experienced



▲Products lineup corner with recent terminals and services including i-mode

Challenging the mobile frontier

## 2 DoCoMo Technology

Zone Two presents NTT DoCoMo's recent technology and explains its efforts to establish the next-generation mobile communication standard. Various potential applications for W-CDMA are covered, suggesting future business possibilities.



▲W-CDMA corner



▲Application corner

The mobile frontier envisioned by NTT DoCoMo

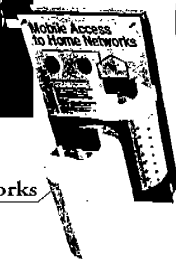
## 3 DoCoMo Vision

Zone Three introduces examples of the magic communications envisioned in our "Vision 2010". NTT DoCoMo is determined to make the magic of mobile multimedia communications a reality through collaboration with global partners.



▲Vision 2010 corner

Mobile Access to Home Networks



Automobile Multimedia



Wireless E-Commerce



▲MAGIC corner

## **Vision 2010**

**At NTT DoCoMo, we're determined to make the magic of mobile multimedia communications a part of everyday life by the year 2010.**

**Our Vision 2010 is comprised of five major elements, represented by the letters of the word MAGIC.**

**M**  
**Mobile Multimedia Communications**

**A**  
**Anywhere, Anytime with Anyone**

**G**  
**Global Mobility Support**

**I**  
**Integrated Wireless Solution**

**C**  
**Customized Personal Service**

**NTT DoCoMo Magic World CLUB-D**

**Sanno Park Tower, 29th Floor 11-1, Nagata-cho 2-chome, Chiyoda-ku, Tokyo 100-6150 Japan**

**Telephone +81 3 5156 1820 Facsimile +81 3 3519 6139**

Change  
Communications to  
.com



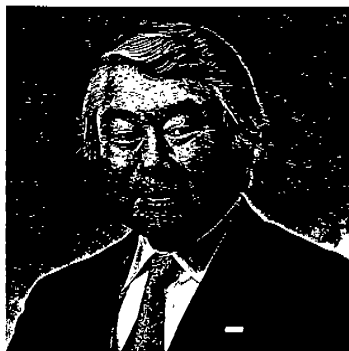
**NTT Communications**



**Aiming to become a "dot-com" company that can fully support your efforts to create new businesses and lifestyles**

The globalization of telecommunication services is gaining speed day by day, dramatically changing economic and social structures, as well as the ways that people live. Since NTT Communications was established last year, our company has assumed the role of a challenger in the global info-communications market. Accordingly, we have made steady efforts to launch new businesses in numerous sectors, particularly in the IP-network and info-communications platform sectors.

In March 2000, we made a "dot-com declaration" in which we expressed our determination to strengthen the above strategy and pledged to propose new business models and new lifestyles. We plan to make NTT Communications a company that is capable of extending comprehensive assistance whenever you create a new business or change your lifestyle. Also, we will continue to provide an ample array of services by attaching top priority to your needs and values.



President and CEO  
**Masanobu Suzuki**

A handwritten signature in black ink, which appears to read "Masanobu Suzuki". The signature is written in a cursive style with a long horizontal stroke at the end.

**Amid the current trends toward globalization and networking, NTT Communications is providing, as a "dot-com" company, a new stage for communications—a stage that we refer to as the "e-theater."**

A so-called New Economy, centering on the Internet, has emerged, and it is about to experience explosive growth. NTT Communications, as a "dot-com" company in such an era, supports the creation of new businesses and new lifestyles through Internet-protocol (IP) technology.

The "dot-com" era is also expected to be an age of globalization.

Accordingly, NTT Communications is expanding its service coverage not only in Japan, but also to Asian, American, and European countries.

At the foundation of the services that we provide are networks centering on IP technology. Based on these

networks, NTT Communications provides platforms, guaranteeing speedy and secure transactions.

Moreover, we offer various services through various partnerships for the applications and contents, that are developed over these networks.

NTT Communications considers the foundation of its business to be components ranging from networks to platforms, and it regards them as a stage that is referred to as the "e-theater." This "e-theater" will not only open the way for new communications possibilities, but will expand your business opportunities as well.



**Applications & Contents**  
Based on its networks and platforms, NTT Communications promotes diverse services by cooperating with various partners.

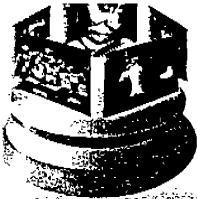
**Platforms**  
NTT Communications provides platforms that enable one-stop functions such as server hosting, directory service, security, authentication, and account-settlement service.

### NTT Communications' "e-theater"



**Data centers (DC)**  
Through cooperation with many companies, NTT Communications provides unified and value-added customer support based on its accumulated know-how, such as that related to outsourcing through the use of IP networks.

**IP connectivity**  
NTT Communications has constructed a large-volume IP backbone, is providing wideband-access networks, is expanding its "OCN," and is developing its IP services in the global market.



Applications & Contents

Platforms

**Networks**

**Advanced IP networks and high-value-added data centers constitute the foundation of our "dot-com" business.**

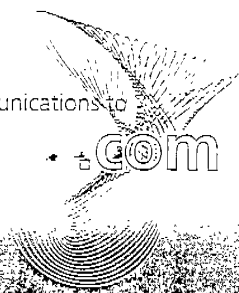
NTT Communications is providing the foundation for a networked society, and is creating a high-quality, simple environment that includes a network bandwidth. We are responding to your global needs with a wide range of services, such as by constructing a nationwide IP backbone, providing wideband-access networks, expanding our "OCN," and developing our IP services.

Moreover, we are putting our efforts into data-center service and support businesses that utilize the IP networks. Related to this, we have established, in major cities around the world, data centers that provide high-value-added services, such as server housing and hosting, and consolidated customer-support services. Most of these new facilities are located in Asia.

The IP Backbone Networks



Change  
Communications to



**High-value-added and reliable outsourcing services**

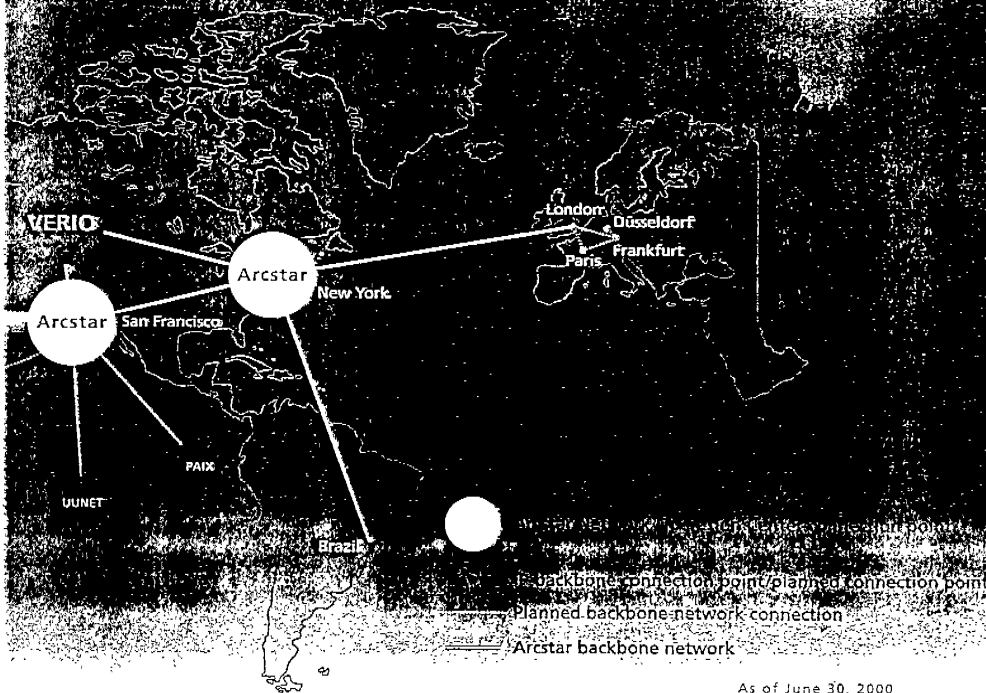
With regard to the management and maintenance of the data centers, we have been cooperating closely with many partners, such as computer companies, system-integrators, and system-management-solution providers. We have already obtained a high-level of management and maintenance know-how.

**"Global One Network"**

In May 2000, NEE Communications announced that it would acquire and merge with U.S.-based Verio Inc., which has the world's largest Web-hosting sites. With this merger, we will create a "Global One Network" that will connect Japan, Asia, the United States, and Europe.

**"OCN" expansion**

"OCN," an Internet access service, currently boasts more than 1.5 million subscribers. We plan to increase that number by adding value-added services. For example, we will offer new services, provide a more-competitive service-rate system, and introduce a special payment plan that will incorporate telephone-call charges.



As of June 30, 2000



Applications & Contents

**Platforms**

Networks

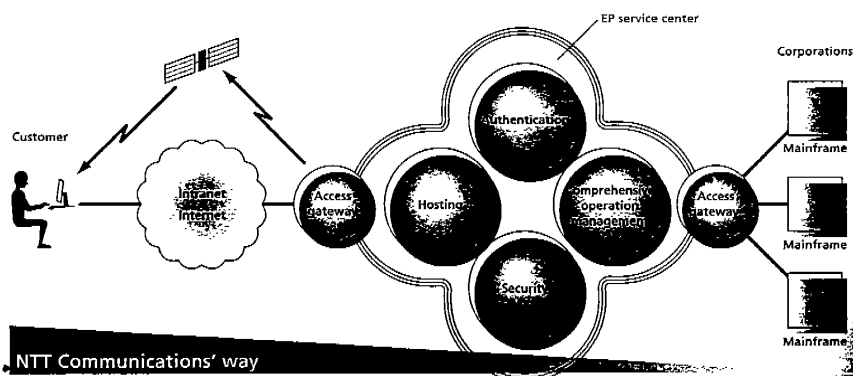
Achieving advanced supply chains based on cross-industry platforms  
Our platforms strongly support corporations in challenging themselves to  
create new business models.

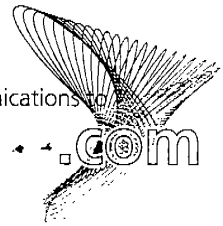
By making the most of its high-level security technology and other highly reliable technology, NTT Communications provides authentication and account-settlement platforms that can contribute to the success of any "dot-com" business. The platforms are easy for end-users to utilize, and they create an environment in which service providers can conduct business safely and reliably. Furthermore, our industry-wide and cross-industry platforms enable firms

to realize advanced supply-chain management.

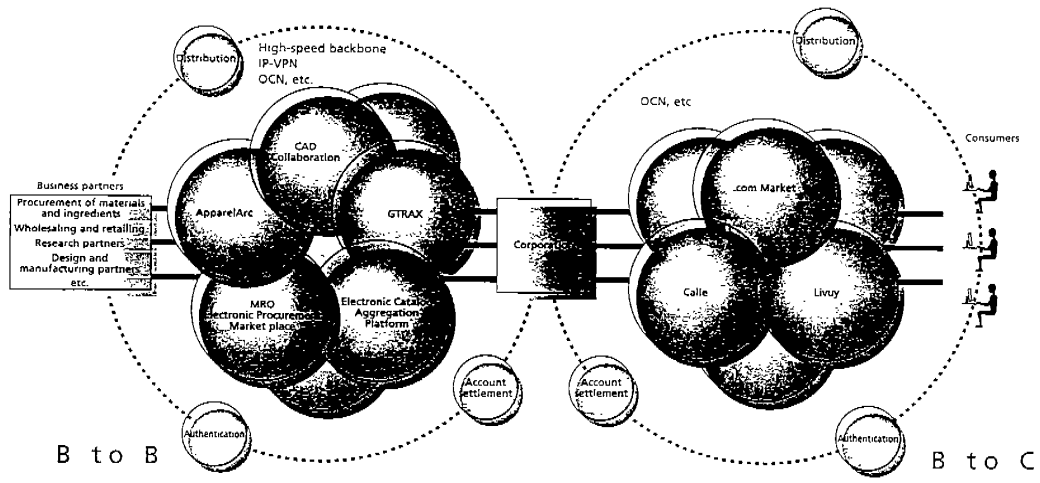
We offer a wide variety of related services, such as our "CAD Collaboration," which is Japan's first platform for supporting joint-design work; "Calle," which is an e-commerce platform that enables settlement of small payments via the Internet; ".com Market," which is a service to support online shops; and "GTRAX," which is a distribution platform with large-capacity contents.

#### E-Platform Service Functions





Platforms based on optimal networks



**Construction of cross-industry platforms**

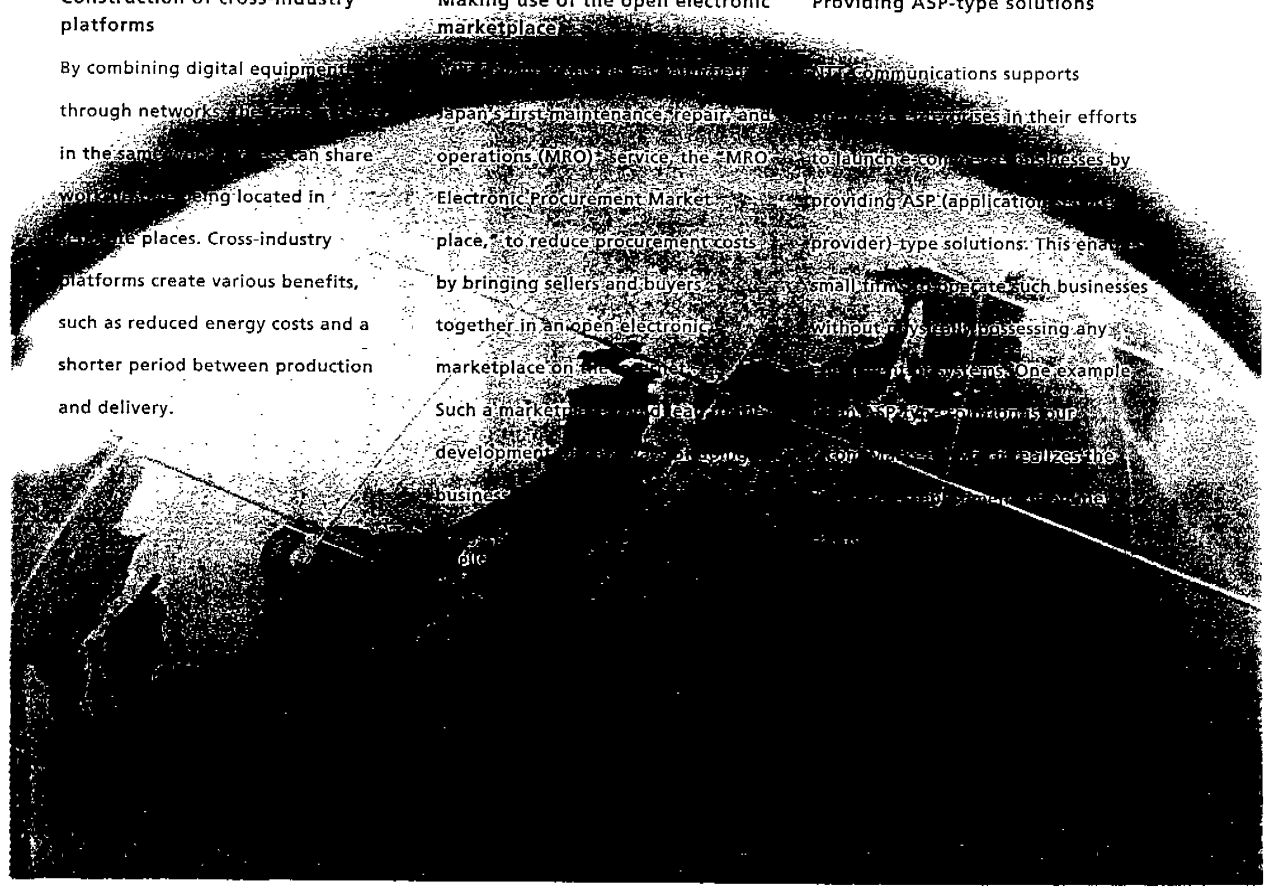
By combining digital equipment through networks, the firms can share in the same work. Firms can share work without being located in the same places. Cross-industry platforms create various benefits, such as reduced energy costs and a shorter period between production and delivery.

**Making use of the open electronic marketplace**

Japan's first maintenance, repair and operations (MRO) service, the "MRO Electronic Procurement Market place," to reduce procurement costs by bringing sellers and buyers together in an open electronic marketplace on the Internet. Such a marketplace is being developed by Change Communications.

**Providing ASP-type solutions**

Change Communications supports small and medium-sized businesses by providing ASP (application service provider) type solutions. This enables small firms to operate such businesses without really possessing any IT systems. One example is our ASP-type solution is our ".com Market" that realizes the business-to-business market.





## Applications & Contents

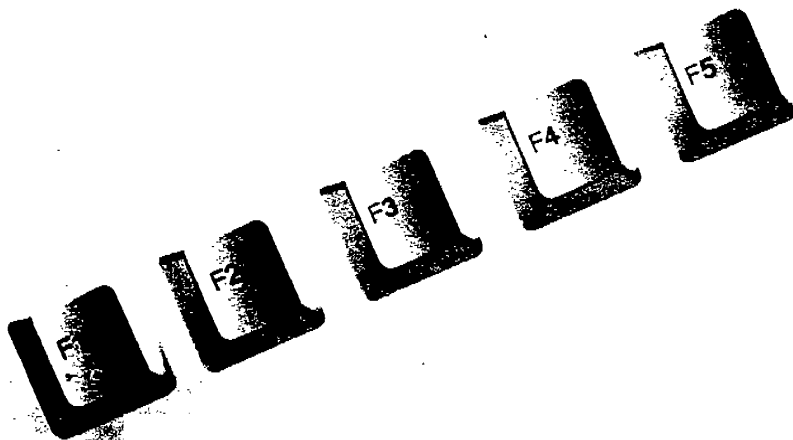
Platforms

Networks

Applications and Contents have unlimited potential. In tie-ups with various types of business partners, we will carry out many projects in our "e-theater."

New business players play an active part in the Applications and Contents layers, which are created on a stage that we refer to as the "e-theater." The stage is comprised of various components, ranging from networks to platforms.

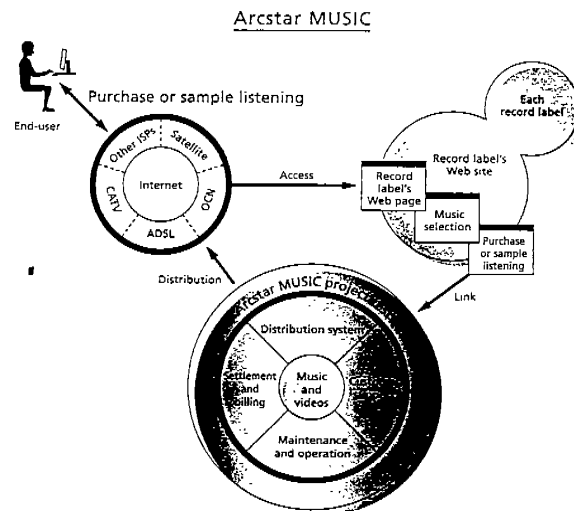
NTT Communications, in collaboration with various application-content providers, has launched many projects, such as "Arcstar MUSIC," a service that supports music-distribution businesses on the Internet, and application hosting as an aid in reforming corporate management systems.





### Creating a new B-to-C business model

In the past, in order to operate a content-distribution business over the Internet, it was necessary to have a content-distribution system, a network, a customer-support system, and fee-collection and account-settlement systems. The large amounts of funds, time, and energy necessary to create such systems were major obstacles to launching content-distribution businesses. However, "Arcstar MUSIC," a comprehensive system for distributing music over the Internet, is a means by which NTT Communications will support record companies' new business by handling the necessary complicated operations single-handedly. Our company, in cooperation with major Japanese record labels, is now experimenting with this system. Our aim is to put this system into commercial operation. In addition, we plan to propose a new business model that will deliver more-interesting contents to users. Such contents include interactive online computer games, music, and animation, all of which will be delivered via our "OCN."



### Application hosting

Our application-hosting service helps firms to process their business tasks via the Internet or by other telecommunications networks. This service makes it possible for firms both to reconstruct their business processes and to manage their business effectively.

NTT Communications is continuing to form partnerships in order to promote such an application-hosting service, which includes the provision of enterprise resource planning (ERP) software.



**Providing both nationwide and worldwide services that will meet a wide range of business needs, including those involving IP, data, voice, and platforms**

For business users, we provide a wide variety of services under the "Arcstar" brand name. These include seamless and total solutions involving domestic and international telecommunications; "dot-com" services concerning security, hosting, outsourcing, and so on; and telephone services.



#### Arcstar IP Network Series

- Super OCN
- Business OCN
- OCN Economy
- Arcstar OBN Service
- Super VPN
- Arcstar21
- Arcstar Global EBN Service
- Arcstar Global Internet VPN Package
- Arcstar InternetFAX
- Arcstar IP Backbone Service

#### Arcstar Access Series

- Arcstar Value Access
- Arcstar Direct
- Arcstar Air Access

Change  
Communications



**Services for Corporate Users**

# Arcstar

## Platforms

- .com Market
- MRO Electronic Procurement Market place
- GTRAX
- ApparelArc
- CAD Collaboration
- Electronic Catalog Aggregation Platform
- Call/Livvy
- Super Cash
- Arcstar MUSIC
- Clearinghouse
- AutoWeb

## Arcstar Data Network Series

- Super Relay
- Super Relay City
- Digital Reach Service
- ATM Mega Link Service
- ATM Share Link Service
- Original Based Line Service (OSL)
- Arcstar Gateway
- Arcstar Global Managed Frame Relay Service
- Arcstar Global Managed Packet Switch Service
- Arcstar High Speed Digital Network Based Circuit Service
- Arcstar Full Service Network
- Arcstar Global ATM Service

## Arcstar Voice Network Services

- Member Net
- Corporate Net
- Access Net
- Standard Net
- Arcstar Global Managed Digital
- MRO Shared Line Service
- Access Net
- Access Net
- Access Net
- Access Net
- Access Net



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Communications to



## Services for Residential and SOHO Users

### **Discount and Package Services**

Shabericchi  
TELE-CHOICE  
INS TELE-CHOICE  
Home Discount  
OCN Home Pack            Others

### **International Calls/Communications**

0033                            Others

### **Internet**

OCN                            Calle  
OCN PC Pack                Livuy  
OCN Hosting Service       Others

### **Other Services**

Point Talk Program  
Credit card calls  
Dengon Dial                   Others



As of June 30, 2000

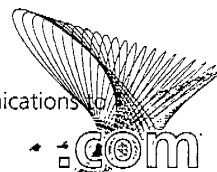
## Establishing a management system that is suitable for a "dot-com" company

Since NTT Communications was inaugurated in July 1999, we have formulated Our Business Philosophy (OBP) that stipulates that Our Mission is to "create and provide the best global services to benefit our customers" in light of our role as "challengers in the global info-communications market." Also, based on this OBP, we have been carrying out various reforms pertaining to our company's management and our corporate culture.

In an attempt to develop our company into a global company, we have implemented corporate-management reforms, including the sharing and implementing of Our Values and Our Code of Business Conduct, both of which are based on Our Mission. We have also been introducing a new system of merit ratings and awards, employing specialists, reviewing various in-house regulations, and reforming our business processes to make them suitable for a "dot-com" business.

Meanwhile, the business environment surrounding us is changing rapidly and dramatically. At all times we will continue to strive to perceive the on-going changes and to consider our customers' evaluations of our services. We will also continue the comprehensive reform of our management system, so that we can respond to the needs of our customers worldwide.





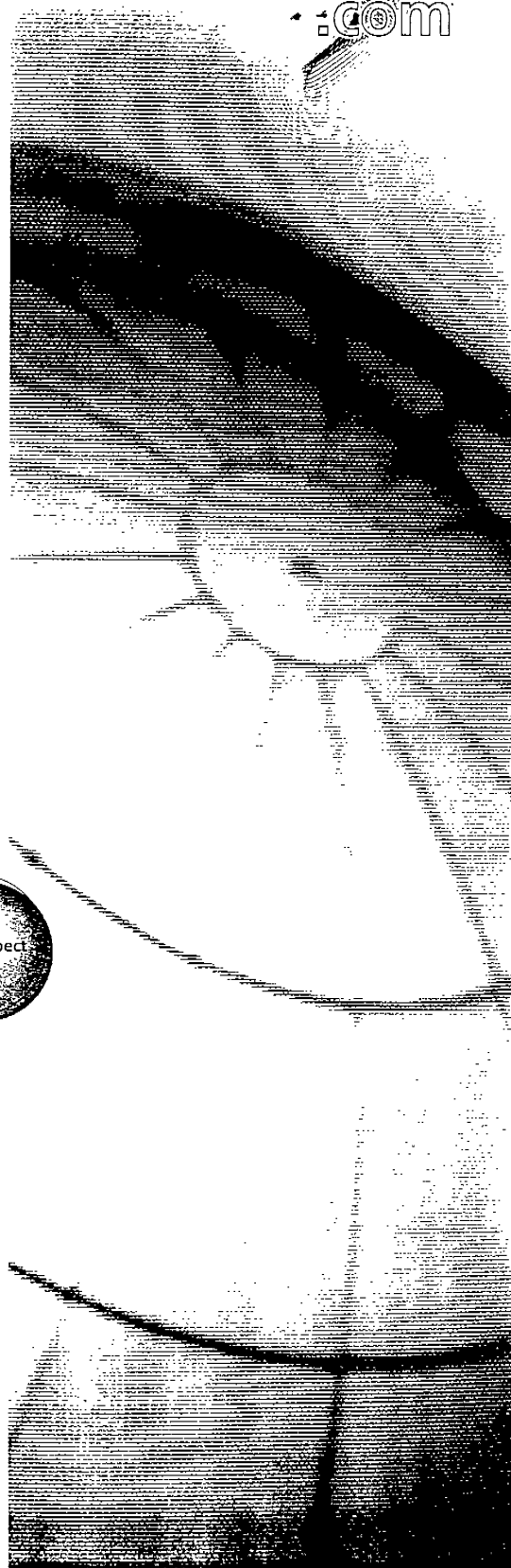
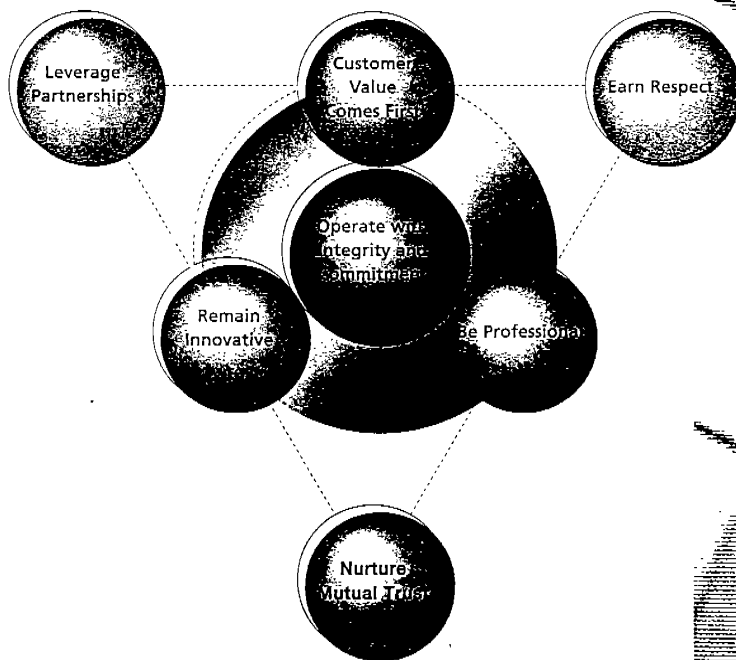
### Our Business Philosophy

We have positioned ourselves as "challengers" in the global info-communications market, and, by sharing Our Mission, Our Values, and Our Code of Business Conduct, we will establish a new corporate culture.

### Our Mission

We are challengers in the global info-communications market. We will create and provide the best global services to benefit our customers, thereby distinguishing ourselves in the extremely competitive market and seizing the leadership position in the 21st century.

### 7 Values





**For Business Use**

**Arcstar IP Network Series**

<b>OCN Services</b> <ul style="list-style-type: none"> <li>● OCN Economy</li> <li>● OCN Standard</li> <li>● OCN Enterprise</li> <li>● Business OCN</li> <li>● Super OCN</li> </ul>	<b>International Services</b> <ul style="list-style-type: none"> <li>● Arcstar Global EBN Service</li> <li>● Arcstar Global Internet VPN Package</li> <li>● Arcstar InternetFAX※</li> <li>● Arcstar IP Backbone Service</li> <li>● NTT Communications Clearinghouse</li> </ul>	<b>Other Services</b> <ul style="list-style-type: none"> <li>● Super VPN</li> <li>● Arcstar21</li> <li>● Arcstar OBN Service</li> <li>● Calle</li> <li>● Livuy</li> <li>● ComTrack</li> </ul>
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**Arcstar Data Network Series**

<b>International Services</b> <ul style="list-style-type: none"> <li>● Arcstar Global Managed Frame Relay Service</li> <li>● Arcstar Global Managed Bandwidth Service</li> <li>● Arcstar High-Speed Digital International Leased Circuit Service</li> <li>● Arcstar Full Channel Service (FCS)</li> <li>● Arcstar Global Managed ATM Service</li> <li>● Arcstar Global ATM Service</li> <li>● Arcstar AutoWeb Global File Exchange Service</li> </ul>	<b>Leased-Line Services</b> <ul style="list-style-type: none"> <li>● Digital Leased-Line Service (HSD)</li> <li>● Digital Reach Service</li> <li>● Super High-Speed Leased-Line Service</li> <li>● ATM Mega Link Service</li> <li>● ATM Share Link Service</li> <li>● Analog Leased-Line Service</li> <li>● Enterprise Service</li> <li>● Video Transmission Service</li> <li>● Satellite Communications Service</li> <li>● Arcstar Gigaway</li> </ul>	<b>Packet Services</b> <ul style="list-style-type: none"> <li>● Packet Communications Service</li> <li>● DDX-C</li> <li>● TELEX</li> </ul>
		<b>Super Relay Services</b> <ul style="list-style-type: none"> <li>● Super Relay FR</li> <li>● Super Relay CR</li> </ul>

**Arcstar Voice Network Series**

<b>Function Services</b> <ul style="list-style-type: none"> <li>● Member's Net</li> <li>● Corporate Net</li> <li>● Free Dial</li> <li>● Navi-Dial</li> <li>● TELE-GONG</li> <li>● TELE-DOME</li> <li>● Group Security Service</li> </ul>	<b>Discount Services</b> <ul style="list-style-type: none"> <li>● Arcstar Business Discount</li> <li>● Global Discount Plan</li> <li>● Premierplan</li> <li>● Super TELE-WISE</li> <li>● TELE-WISE WIDE</li> <li>● Anonymous Discount Service</li> </ul>	<b>International Telephone Services</b> <ul style="list-style-type: none"> <li>● 0033</li> <li>● International Member's Net</li> <li>● International Free Dial</li> <li>● International ISDN</li> <li>● Arcstar International Corporate Discount</li> </ul>
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**Arcstar Access Series**

- Arcstar Value Access
- Arcstar Direct
- Arcstar Air Access

**Arcstar Network Support Series**

<b>Security</b> <ul style="list-style-type: none"> <li>● OCN Business Pack VPN</li> <li>● OCN Business Pack VPN II</li> <li>● Net Key Service</li> </ul>	<b>Hosting</b> <ul style="list-style-type: none"> <li>● OCN Hosting Service</li> </ul>	<b>Outsourcing</b> <ul style="list-style-type: none"> <li>● Housing Service</li> <li>● Network Outsourcing Service</li> </ul>
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**Arcstar Business Solutions**

<b>Platform Services</b> <ul style="list-style-type: none"> <li>● E-Platform Service</li> <li>● .com Market</li> <li>● ApparelArc</li> <li>● GTRAX</li> <li>● MRO Electronic Procurement Market place</li> <li>● CAD Collaboration</li> </ul>	<ul style="list-style-type: none"> <li>● Electronic Catalog Aggregation Platform</li> <li>● Super Cash</li> <li>● Arcstar MUSIC</li> <li>● AutoWeb</li> </ul>	<b>VCN (Value Chain Network)</b> <ul style="list-style-type: none"> <li>● BL-3000</li> <li>● BA-3000</li> <li>● BAAN (ERP)</li> </ul>	<b>Solutions</b> <ul style="list-style-type: none"> <li>● Network Outsourcing</li> <li>● TCP/IP Billing Solution</li> </ul>
		<b>Solution Tools</b>	

**For Home Use**

<b>Internet</b> <ul style="list-style-type: none"> <li>● OCN PC Pack</li> <li>● OCN Dial Access※</li> <li>● OCN Economy※</li> <li>● OCN navi</li> <li>● Calle</li> <li>● Livuy</li> <li>● ComTrack</li> </ul>	<b>Discount and Package Services</b> <ul style="list-style-type: none"> <li>● Home Discount※</li> <li>● OCN Home Pack※</li> <li>● International Home Discount※</li> <li>● Arcstar International Corporate Discount※</li> <li>● Shabericchi※</li> <li>● TELE-CHOICE※</li> <li>● INS TELE-CHOICE※</li> <li>● TELE-WISE※</li> <li>● TELE-JOZU※</li> </ul>	<b>International Telephone Service</b> <ul style="list-style-type: none"> <li>● 0033※</li> </ul>	<b>Other Services</b> <ul style="list-style-type: none"> <li>● Pointalk Program※</li> <li>● Arcstar InternetFAX※</li> <li>● Credit Call Service※</li> <li>● Message Dial Service※ (Dengon Dial)</li> </ul>
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Services marked with ※ are available at our "Virtual Shop" web site. Virtual Shop [www.ntt.com/shop](http://www.ntt.com/shop)

Customer Service Center 0120-506506

◎Details of the above services are available at our web site [www.ntt.com](http://www.ntt.com).



## Corporate Information

### Corporate Data

as of July, 2000

Company Name	NTT Communications Corporation
Head Office	1-1-6 Uchisaiwaicho Chiyoda-ku, Tokyo, Japan 100-8019
Startup Date	July 1, 1999
Stated Capital	72 billion yen
Employees	About 7,300
Business	Domestic and international telecommunications services
Subsidiaries and Affiliates	18 Subsidiaries 14 Affiliates

### First-Year Financial Results (fiscal year beginning May 28, 1999 and ended March 31, 2000)

Operating Revenues	1,075.3 billion yen
Recurring Profit	127.7 billion yen
Net Income	72.8 billion yen

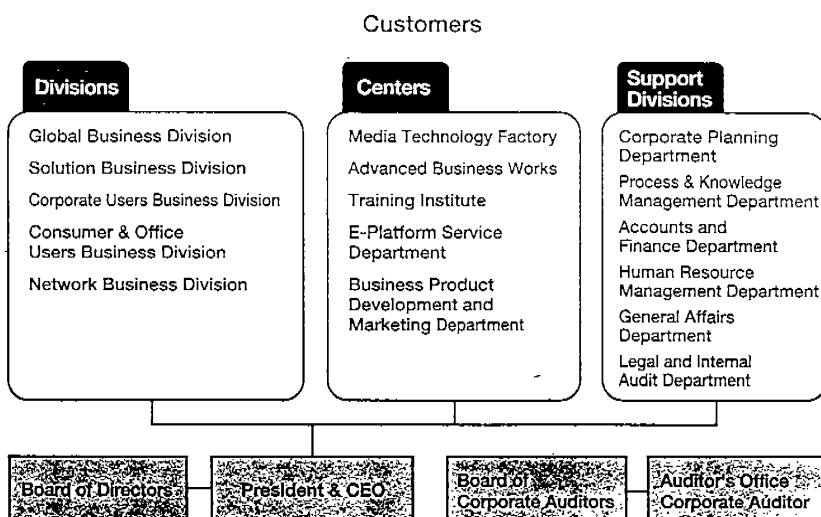
### Directors and Auditors

as of July, 2000

President & CEO	Masanobu Suzuki
Senior Executive Vice Presidents	Tadayuki Arai Katsuya Okimi
Executive Vice Presidents	Mamoru Ishida Shuuj Tomita
Senior Vice Presidents	Satoshi Fujita Yuuchi Kawamori Hideya Inoue Isamu Satoki Shunsuke Amiya Yoshio Sakata Hisao Izuka Kiyoshi Isozaki Hiromi Wasai
Corporate Auditors	Hidesada Toriyama Akio Tsuchiya Nobuyuki Tanahashi

### Organization

as of July, 2000

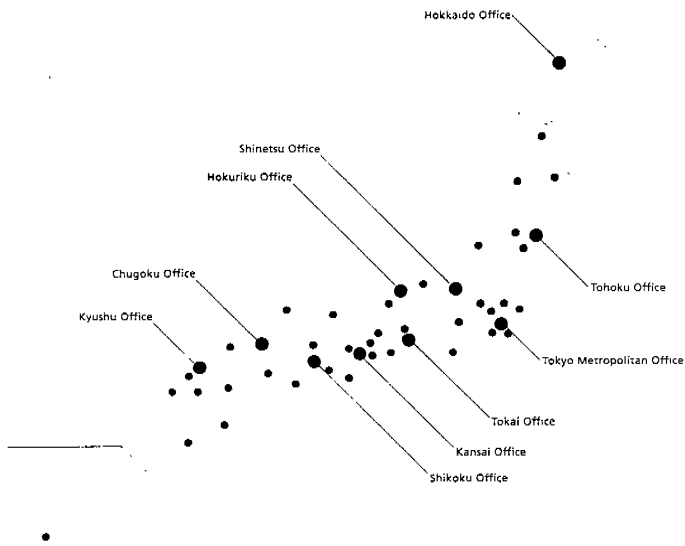


Providing new, global services on the basis of networks formed by  
 NTT Communications and its business partners

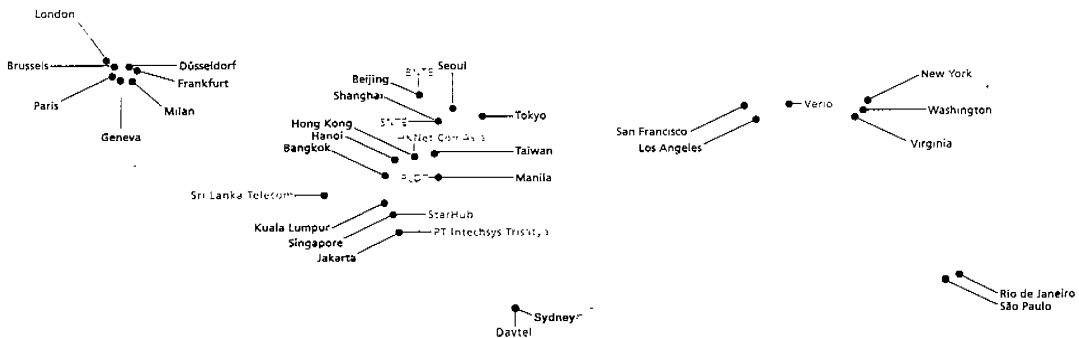
NTT Communications will continue to support the activities of our customers around the world by offering total-solutions services, Internet services, and telephone services in collaboration with our branches, our Value Partners, and our sales agencies in Japan, our overseas subsidiaries and affiliates, and our foreign business partners. Furthermore, we will continue to construct global business networks that focus mainly on Asia, the United States, and Europe, in order to provide more-enriched services on a global basis.



Domestic Offices



Overseas Offices and Major Partners



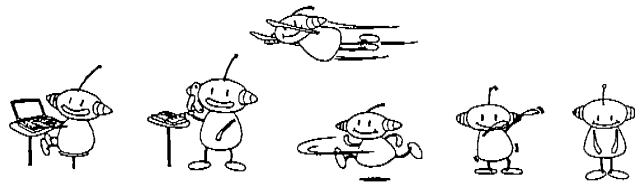
As of June 30, 2000



# Arcstar

台灣恩梯梯股份有限公司  
台灣NTT株式會社

公司簡介  
會社案内



我是台灣恩梯梯的(阿梯)

致辭

ごあいさつ

公司簡介

会社概要

役員紹介

提供サービス



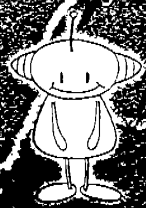
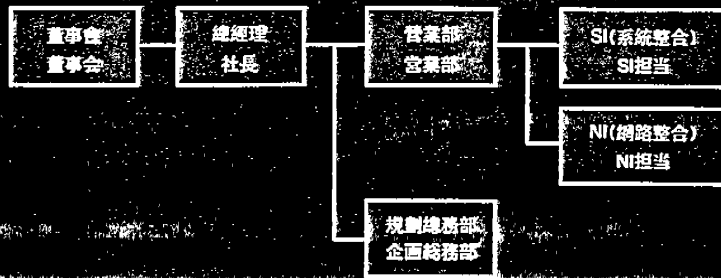
角谷三好 總經理  
角谷三好 社長

現在、圍繞在我們周遭的資訊通訊網，正急速的邁向高度化與國際化，使我們的商業環境與生活環境起了很大的變化。在這時代裡，台灣恩佛佛感受到一個使命感，對於每一位客戶我們有責任提供他們前所未有、高度且具全新形態的服務。這一點，我們深信恩佛佛集團擁有的龐大經驗與最先進的技術能力，對客戶而言將會是最好的保證與承諾。台灣恩佛佛全體員工，將盡全力努力為客戶服務，具社會貢獻，也敬請大家多多給與我們熱烈的支持與指教。謝謝!!

現在、私達を取り巻く情報通信ネットワークは、急速に高度化・国際化し、私達のビジネス環境及び生活環境は大きく変化しています。こうした時代に当たり、私ども台湾NTTは、お客様ひとりひとりに対して、これまでになく高度で、新しいかたちのサービスを提供していく重要な立場にあると認識しております。これは、NTTグループとして有する膨大なノウハウおよび先端的な技術力と連携すれば実現可能であると思われ、社員一同、お客様及び社会に役立ちますよう精一杯努力致しますので、何卒ご愛顧の程お願い申し上げます。

公司名/会社名  
台湾恩佛佛股份有限公司/台湾NTT株式会社  
地址/所在地  
台北市民生東路3段156號 宏泰世界大樓7F-E  
成立/設立  
1998年8月1日  
資本/實本金  
1億新臺幣/1億NTS

組織/組織



台灣恩悌悌公司提供每一位客戶心儀的資訊架構。

台灣NTTは、お客様ひとりひとりの目指す、情報通信を提供します。

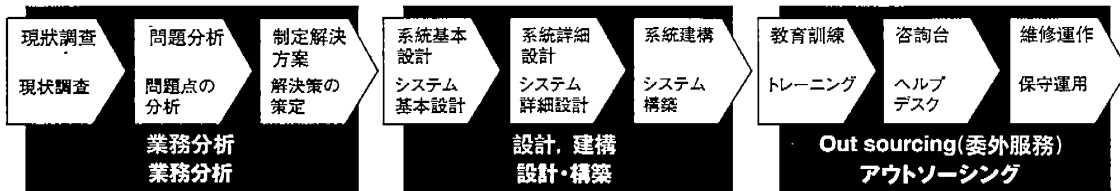
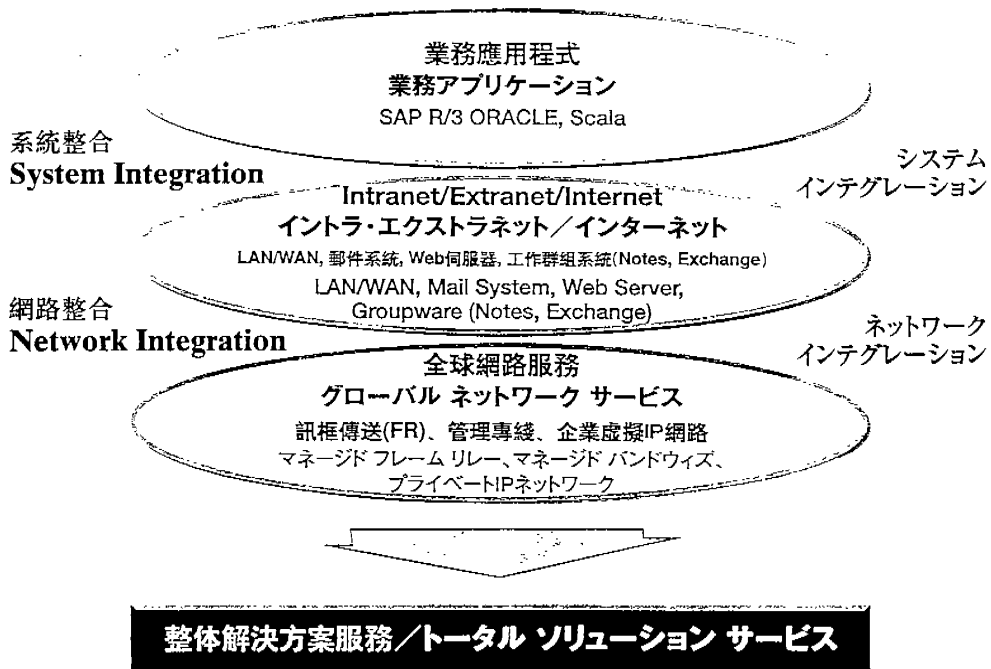


台灣恩悌悌提供能適切地滿足客戶需求的情報資訊通信系統與網路。

台灣NTTは、お客様のニーズに合った情報通信システム及びネットワークを提供致します。

針對骨幹業務及情報系統，從業務分析到設計／施工／維修／運作，整合整體資源，建構最適切的系統。

基幹業務系・情報系、業務分析から設計／工事／保守／運用まで、総合的に最適なシステムを構築致します。



貴公司如有情報通訊方面的疑問，請與台灣恩悌悌聯絡，我們將秉著誠意迅速為您解決。  
 貴社の情報通信に係るお問い合わせは、台湾NTTに、お気軽にご連絡ください。誠意をもって、迅速にお応え致します。

整体解決方案

トータル・ソリューション

單一窗口訂購

ワンストップ ショッピング

單一窗口維修

ワンストップ メンテナンス

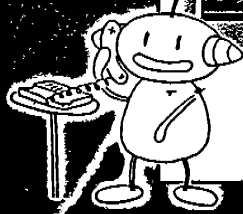
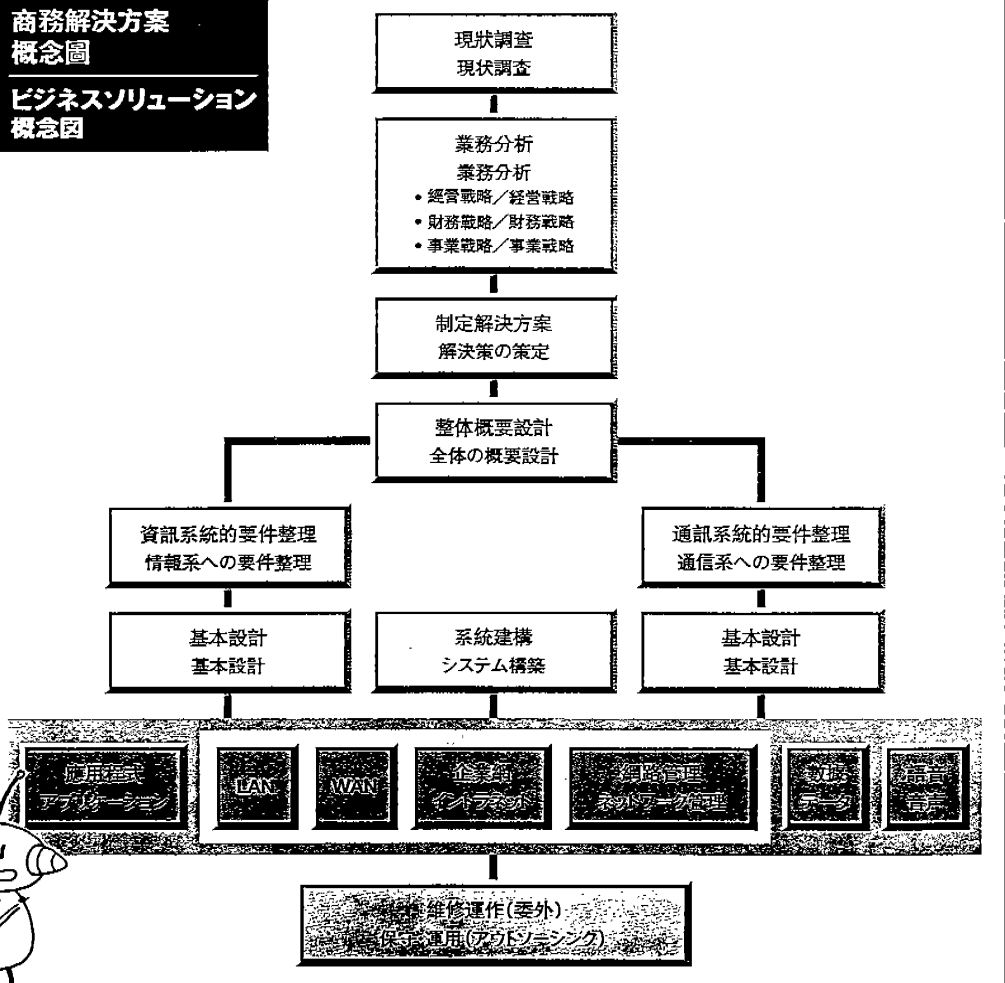
單一窗口轉移

ワンストップ ビルディング

即使擁有高水準的解決方案，若在準備或導入階段引起混亂，就不算是最好的。特別是客戶的資訊系統部門與各供應商或軟體公司直接個別交涉時，須要花費龐大的時間與金錢。台灣恩梯公司的全球商務解決方案，提供了解決此問題的“One-stop Shopping (單一窗口訂購)”服務模式。我們有專門對貴公司負責的專戶經理 (AM, Account Manager) 作為一元化窗口，從業務分析至維修全部由他來負責。這種一體感和安心，在各行各業中得到相當高的評價。

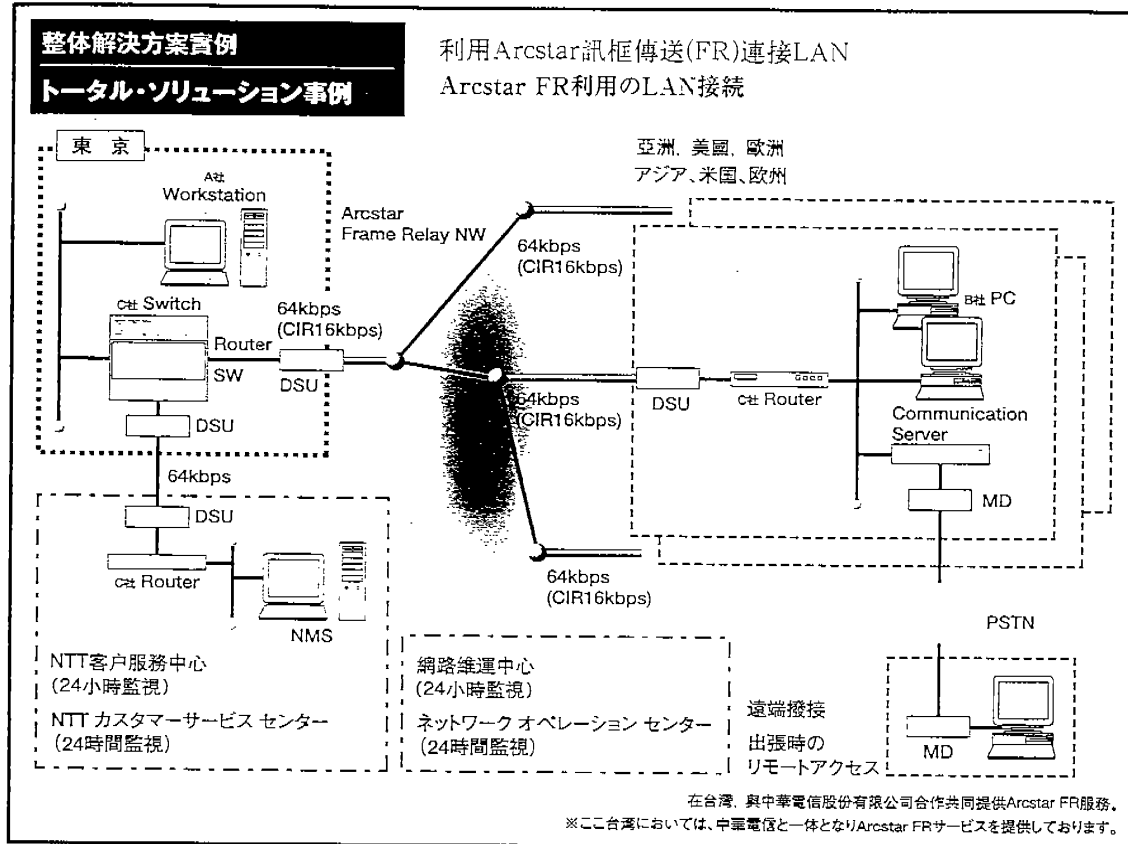
高水準なソリューションも、準備段階や導入時で混乱をきたすようでは、結果として最善とは言えません。特にお客さま企業の情報システム部門が、ベンダ各社やソフトハウスなどと個別に交渉する場合は、そこに費やされる時間やコストは膨大なものになります。台湾NTTのグローバル・ビジネス・ソリューションは、そうした問題を一気に解決するワンストップショッピング(一元管理)を実現。お客さま企業を専任で担当するアカウントマネージャー (AM) が一元窓口となって、業務分析からメンテナンスに至るまで一貫してサポート。この一体感と安心が、さまざまな分野の企業から大きな評価を得ています。

商務解決方案  
概念圖  
ビジネスソリューション  
概念圖



## 透過單一窗口訂購服務模式(One-stop Shopping)實現整體解決方案

### ワンストップ ショッピングで実現する、トータル ソリューション



### 單一窗口維修

#### ワンストップ メンテナンス

- ① 透過24小時完全支援等服務，確保合乎客戶需求的維修體制
- ② 利用遠端監視與控制，防止故障的發生
- ③ 出租最新的網路設備
- ④ 24時間完全サポートをはじめ、お客さまのニーズにあった保守体制の確立
- ⑤ リモート監視&制御で、トラブルを未然に防止。
- ⑥ 最新ネットワーク機器のレンタルサービス

### 單一窗口帳務

#### ワンストップ ビリング

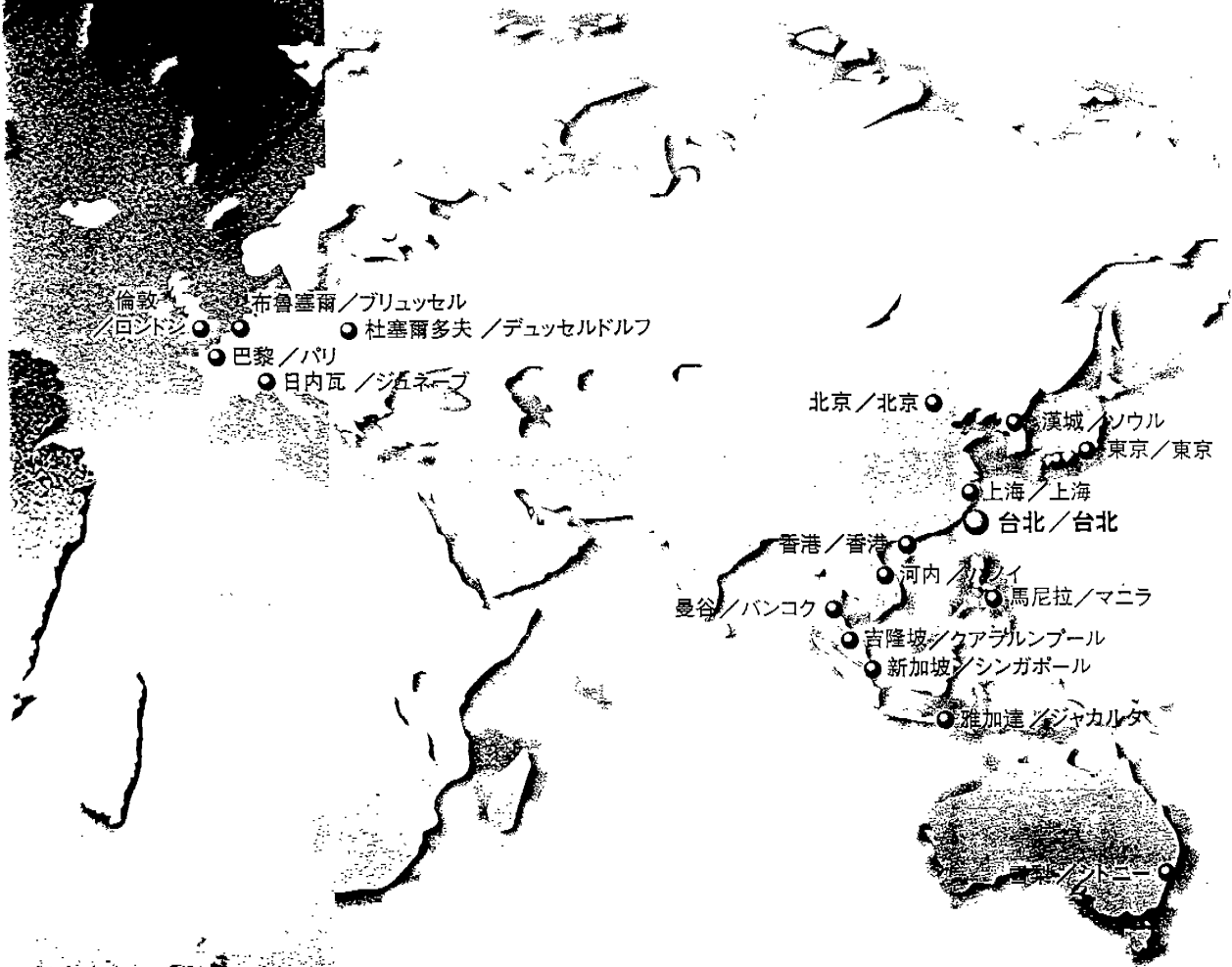
靈活對應客戶需求

お客様のご要望にフレキシブルに対応致します。

全球&無縫隙

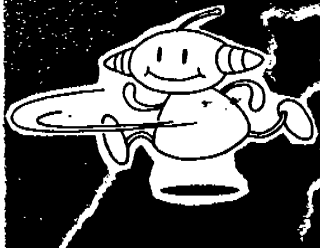
グローバル&シームレス

## 台灣NTT提供的整體解決方案，不管是在國 台灣NTTのトータル・ソリューションは、国内・海外



台灣恩梯梯，以散布在全世界各主要國家與地區的海外據點為軸心，  
提供貴公司全球性、無縫隙的整體解決方案服務。

台灣恩梯梯公司，與恩梯梯在亞洲地區及歐美等地的海外據點同樣，已建立了完善的支援體系。到目前為止，恩梯梯集團曾經為好幾千家公司提供了解決方案，包括全球性大規模網路的建構。台灣恩梯梯公司將充分發揮這些龐大的經驗與知識的最佳效能，與客戶一起來站在總體性的立場重新評估業務內容，從以徹底追求效率化為目的的情報系統的起案起，到LAN/WAN的架構，網路監控與維修、運作為止，提供高品質且為最先進的解決方案。





# 内或國外都是無縫隙的。

## ともにシームレスです。

NTT海外據點一覽表

NTTグループの海外拠点一覧

- 台北 / 台北
- 倫敦 / ロンドン
- 巴黎 / パリ
- 日内瓦 / ジュネーブ
- 杜塞爾多夫 / デュッセルドルフ
- 布魯塞爾 / ブリュッセル
- 漢城 / ソウル
- 北京 / 北京
- 香港 / 香港
- 上海 / 上海
- 馬尼拉 / マニラ
- 曼谷 / バンコク
- 吉隆坡 / クアラルンプール
- 河内 / ハノイ
- 新加坡 / シンガポール
- 雅加達 / ジャカルタ
- 雪梨 / シドニー
- 舊金山 / サンフランシスコ
- 洛杉磯 / ロサンゼルス
- 紐約 / ニューヨーク
- 里約熱內盧 / リオデジャネイロ

截止1998年9月1日  
1998.9.1現在

台湾NTTは、世界主要各国に広がるNTTグループの海外拠点を軸とし、グローバルかつシームレスにトータルソリューションサービスをご提供致します。

台湾NTTは、アジア地域をはじめヨーロッパ、アメリカ等のNTTグループの海外拠点とともに、万全のサポート体制を確立しております。また、NTTグループでは、大規模なグローバルネットワークの構築を含め、すでに数千社のソリューションをお届けしてきました。台湾NTTは、この膨大なノウハウを最大限に活かしながら、お客様とともに業務を総合的に見直し、徹底した効率化を図る情報システムのご提案からLAN/WANのエンジニアリング、ネットワーク監視や保守・運用に至るまで、高品質・最先端のソリューションをご提供致します。