出國報告(出國類別：會議)

出席瑞典 2013 寬頻大未來通往繁榮社會基礎會議暨雙邊交流會議出國報告書

出國報告摘要

會議日期：102 年 6 月 24 日至 26 日

出國地點：瑞典斯德哥爾摩

內容摘要：

　　本會為加強與國外通訊傳播主管機關交流、瞭解國際寬頻服務發展情形、促進頻譜資源有效利用等目的，特由虞副主任委員孝成率通訊營管處王副處長德威及綜合規劃處陳技正玟良，出席瑞典郵政及電信總局(PTS)舉辦 2013 年度寬頻大未來(Broadband for all)國際會議(為期 2 天：6/24 至 25 日)，主題為「繁榮社會必要的基礎建設」(An essential infrastructure for a prosperous society)，本會副主任委員並獲邀簡介我國寬頻服務市場發展概況，並與各國主管機關代表積極互動，就通訊傳播監理機制、釋照經驗、產業發展趨勢等事項進行廣泛討論。

　　本次會議邀請澳洲通訊傳播媒體局 ACMA 主席 Chris Chapman、香港通訊事務管理局辦公室 OFCA 總監利敏貞 Eliza Lee、瑞典郵政和電管理局 PTS 局長 Göran Marby、墨西哥聯邦通訊委員會 COFETEL 委員 Alexis Milo 等主管機關首長與會，並共計有全球 34 國 74 位監理機關代表出席。

　　推動寬頻化社會為全球各國提供國民資訊化生活與促進國家發展不可或缺的重要基礎，瑞典郵政及電信總局(PTS) 賡續舉辦年度主題會議，邀集各主管機關與國際組織團體代表，共同探討全球新興寬頻技術演進與應用、全球寬頻建設與發展規劃、行動通信異質網路架構(輔助型下鏈 SDL 及整合無線區域網路 WiFi)、無線頻譜資源核配與管理趨勢包含專屬執照制(Licensed)、免執照制(Unlicensed)、授權共享制(Authorized shared)等諸多面向，除提供各國交換通訊傳播發展資訊平台外，也希望統合各界意見，共同邁向寬頻化社會，相關議題深具前瞻性，可供政府做為未來決策參考。

目　錄

壹、緣起

　　推動寬頻化社會為全球各國提供國民資訊化生活與促進國家發展不可或缺的重要基礎,瑞典郵政及電信總局(PTS)每年度均辦理相關主題會議,邀集各主管機關與國際組織團體代表,共同探討全球新興寬頻技術演進與應用、全球寬頻建設與發展規劃、無線頻譜資源核配與有效管理等諸多面向,除提供各國各界一個資訊交換平台外,也希望統合各界意見協同邁向寬頻化社會,相關議題深具前瞻性,可供政府做為未來決策參考。

　　瑞典郵政及電信總局(PTS)舉辦 2013 年度寬頻大未來之國際會議,主題為「繁榮社會必要的基礎建設」(An essential infrastructure for a prosperous society),對於不斷變化和匯流環境(例如聲音變成 App 應用)之有效率資通信技術法規、為了刺激高速寬頻服務實現社經福利之政策計劃、頻譜管理方式與需求間取得平衡(Licensed、Shared、Unlicensed 頻譜)等面向,共有來自全球 34 國 74 位監理機關代表出席進行意見交流。

　　本次會議邀請澳洲通訊傳播媒體局 ACMA 主席 Chris Chapman、香港通訊事務管理局辦公室 OFCA 總監利敏貞 Eliza Lee、瑞典郵政和電管理局 PTS 局長 Göran Marby、墨西哥聯邦通訊委員會 COFETEL 委員 Alexis Milo 等代表與會。本會為加強與國外通訊傳播主管機關交流、瞭解國際寬頻服務發展情形、促進頻譜資源有效利用等目的,特由虞副主任委員孝成等代表出席會議,並獲邀簡介我寬頻服務市場發展概況,與各國主管機關代表進行意見交流及釋照經驗分享。

本會虞副主任委員孝成瑞典大會報告我國寬頻服務市場概況

貳、會議時間、地點及目的

一、 會議時間：2013 年 6 月 24 日至 6 月 26 日

二、 地點：瑞典斯德哥爾摩

三、 目的：參加 2013 年寬頻大未來通往繁榮社會基礎會議，瞭解國際寬頻服務概況、新興通訊技術發展應用及通訊傳播監理趨勢，並進我國與他國主管機關代表機會。

參、行程表

6/22 出發(臺灣 2005 出發、6/23 0700 抵達瑞典斯德哥爾摩)

6/24 參加瑞典郵政及電信總局(PTS)舉辦國際會議，包含貴賓演講、分組討論、各國發展概況簡報(本會虞副主任委員孝成並簡介我國寬頻服務發展)

6/25 參加科技趨勢研討會議、瑞典郵政及電信總局(PTS)頻譜研討會議，並與澳洲 ACMA 主委雙邊會談

6/26 拜會瑞典 TeliaSonera 電信公司

6/27 回程(斯德哥爾摩 1430 出發、6/28 1150 抵達臺灣)

肆、會議議程

日期	6/24（一）	6/25（二）	6/26（三）
地點	瑞典皇家工程科學院[1]	愛立信(Ericsson)總部	瑞典 TeliaSonera 斯德哥爾摩總部
上午		0830~1200 科技趨勢研討會	
中午	0800~1700 科技趨勢研討會	1200~1300 （PTS非正式雙邊會談）	
下午		1300~1430 PTS 頻譜研討會 1430~1530 與澳洲ACMA主委雙邊會談	1300~1430 TeliaSonera 雙邊會談

Monday June 24, 2013	
08:00 – 08:30	Registration and morning tea – networking
08:30 – 10:30	Welcome and introduction Hans Vestberg, President and CEO, Ericsson Ulf Pehrsson, VP Government & Industry Relations, Ericsson Keynote: Perspectives from the Hong-Kong Miss Eliza Lee, Director-General, OFCA, Hong-Kong Keynote: Perspectives from Australia Chris Chapman, Chairman, ACMA, Australia Keynote: Technologies for the Networked Society Ulf Ewaldsson, Group CTO, Ericsson
10:30 – 11:00	Coffee break – networking
11:00 – 12:00	Panel debate: The imperative of demand-side ICT policies Chair: René Summer, Director Government & Industry Relations, Ericsson

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[1]瑞典皇家工程科學院(瑞典語：Kungl. Ingenjörsvetenskapsakademien, IVA。英語：Royal Swedish Academy of Engineering Sciences)建立於 1919 年，是瑞典最重要的國家學院之一。該學院是獨立機構，旨在促進瑞典及國際間的工程學合作及交流，促進工業、商業、研究、和政府間的接觸和交流。瑞典皇家工程科學院是建立最早的國家工程院之一，現有院士約 1000 名，海外院士（外籍院士）約 250 人

12:00 - 13:30	Lunch - networking
13:30 - 15:30	Broadband for all in Sweden Göran Marby, Director-General, PTS, Sweden Broadband for all in Africa Mr. Abdoulkarim Soumaila, Secretary-General, ATU Broadband for all in Mexico Alexis Milo, Commissioner, COFETEL, Mexico Broadband for all in Taiwan Hsiao-Cheng YU, Vice Chairperson, NCC, Taiwan
15:30 - 16:00	Coffee break - networking
16:00 - 17:00	Panel debate: How to balance licensed, shared and unlicensed spectrum needs, also for mobile broadband services for public safety, M2M, health, etc? Chair: Tom Lindström, Director Government & Industry Relations, Ericsson Kelly Gillis, Senior Assistant Deputy Minister, Industry Canada, Canada Franck Lebeugle, Director of Technology, CSA, France Joaquin Restrepo, Head of the Outreach and Publication Division of the BR, ITU Luis Lucatero, Chief of Regulatory Policy, COFETEL, Mexico Dr Georg Serentschy, Vice Chairman of BEREC and Managing Director of RTR's Telecommunications and Postal Services Division, Austria
17:00	End of afternoon session
2013/06/25	Ericsson Technology Briefing
08:30 - 09:00	Registration and morning tea
09:00 - 09:10	09:00 - 09:10 Welcome and introduction - Mikael Halén, Director, Government & Industry Relations, Ericsson
09:10 - 10:00	Heterogeneous networks - including seamless WiFi integration - Dr Magnus Frodigh, Director, Wireless Access Networks, Ericsson
10:00 - 10:30	Coffee break and technology demonstrations
10:30 - 11:00	Technologies for new spectrum access - Dr Mikael Prytz, Manager Radio Network Deployment & Spectrum Management, Ericsson
11:00 - 11:30	5G - The next frontier - Dr Sara Mazur, VP & Head of Ericsson Research, Ericsson

12:00 - 13:00	Lunch is served in the Ericsson Studio (bilateral meeting with PTS)
13:00 - 13:30	Recent and coming licensing of spectrum suitable for mobile broadband ➢ Urban Landmark, Head of Spectrum Department, at Swedish Post and Telecom Authority (PTS) will talk about PTS' recent auctions in the 800 MHz and 1800 MHz bands, as well as PTS' future licensing of spectrum suitable for mobile broadband. How to conduct a successful spectrum auction and enable modern technology as well as an early roll-out through proactive and foresighted spectrum management.
13:30 - 14:00	The Swedish long term spectrum strategy ➢ Ylva Mälarstig, Chief Advisor at the Spectrum Department, Swedish Post and Telecom Authority (PTS) will talk about how PTS will work to ensure that spectrum will be used efficiently and to maximum societal benefit in the future.
14:00 - 14:30	Q&A and discussion
14:30 - 15:30	bilateral meeting with Chris Chapman, Chairman, ACMA, Australia

伍、會議內容摘要

一、Keynote：Perspectives from Hong-Kong

香港目前計有 19 家固網業者及 5 家行動業者,固網寬頻滲透率(Penetration)為 86％,而行動通信服務滲透率(Penetration)更高達 228％,市場充分競爭。第三代行動通信執照即將屆期,目前刻正研議頻譜再釋出方式。香港自 2009 年開始陸續拍賣釋出 2.3GHz 及 2.6GHz 頻段,供電信業者建構 4G 無線寬頻網路。

香港推動寬頻服務發展,係依市場發展為導向,主管機關角色則以低度管理、促進有效率市場為原則,政府並無特別編列基金投入寬頻基礎建設。以光纖網路佈建為例,香港係採非強制性、登記制,目前 FTTB/FTTH 涵蓋已超過 80％家戶。

二、Keynote：Perspectives from Australia

澳洲通訊傳播媒體局 ACMA 主席 Chris Chapman 從數位匯流觀點、政府因應作為與宏觀管理角色探討。過去主管機關採分層管理方式(layers-based)適合於協助了解已知、可預期的匯流[2]服務之面貌,而隨著新興科技應用服務不斷推陳出新趨勢,各分層之間界線將逐漸模糊。

目前智慧型裝置已經有很多應用程式(App)可以提供語音、資訊服務等功能,國際研究機構 Ovum 統計,此語音(voice)及訊息(messaging)應用服務於 2011 年約佔全球電信業者 9％營收,傳統電話號碼服務逐漸失去原本不可取代地位,內容層應用將有類似於基礎層可提供接取、服務影響力。

未來於高度連結(hyper-connected)與網路社會,僅以簡易、單一管理方式,將不足以因應多維(multi-dimensional)且複雜通訊傳播匯流環境,主管機關面對多變數位匯流環境,管理架構及方式應保留彈性、維持動態檢視與調整可能性。

三、無線頻譜資源管理與應用趨勢探討

(一)國際無線頻譜管理類型

行動寬頻服務需求與日遽增,無線頻譜資源如何更有效利用,為各主管機關持續探討重要議題。國際無線頻譜管理方式,約略可區分為以下 3 種類型

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[2] 澳洲主管機關 ACMA 匯流係指電信(telecommunications)、廣播(broadcasting)、無線電通信(radiocommunications)及網際網路(網際網路)等 4 大市場。匯流架構則以水平切割為基礎層(infrastructure)、網路層(Networks)、內容應用層(Content and Applications)及設備層(Devices)等 4 層,為 ACMA 數位匯流管理基本輪廓。

1. 專屬執照制(Licensed)：政府經拍賣或審議方式，核配業者專屬頻譜且免於干擾並供特定目的使用，其特性為可確保通訊服務品質 QoS，並適合於較大通訊範圍使用，可提供經營者明確投資條件。

2. 免執照制(Unlicensed)：例如無線區域網路(WLAN)或藍芽(Bluetooth)應用，相關通訊設備發射功率及通訊協定均應符合國際標準組織規範，使用者無需申請執照即可共享並使用該頻譜資源，通訊服務品質相對亦隨著通訊環境而變動，適合於區域性範圍使用。

3. 授權共享制(Authorized shared)：例如數位無線電視閒置頻譜(TV White Space)共享，利用感知無線電(Cognitive Radio)技術提升及動態頻譜共享架構概念，在不干擾優先用戶條件下，於頻譜閒置期間(Spectrum Hole)，利用該無線電視台閒置頻譜，供行動通信服務使用，充分利用無線頻譜資源。相關機制可確保頻譜優先及次要等不同使用者之服務品質，具有上述專屬執照制(Licensed)、免執照制(Unlicensed)等優點特性，惟採行該核可制，尚需考量頻譜使用之時間與空間因素，授權方式較為複雜，為各國近期探討議題。

關於利用數位無線電視閒置頻譜(TV White Space)概念，原係考量國際普遍使用於數位無線電視頻段之頻譜特性，提供行動寬頻服務具有其涵蓋優勢。本次會議談論相關應用可行性，考量使用數位無線電視閒置頻譜，為避免干擾數位無線電視用戶之接收，基站發射功率亦將受限，原利用頻譜特性涵蓋優勢之利基將受影響，另外，人口越密集區域，則可供利用之數位無線電視閒置頻譜亦越少，因此相關機制恐將適用於短距離通訊。

德國如參採數位無線電視閒置頻譜(TV White Space)機制為例，經評估結果，全國約有 32％地區完全沒有頻道(channel)可供利用，而僅有 10％的地區至少有 9 個頻道可用。
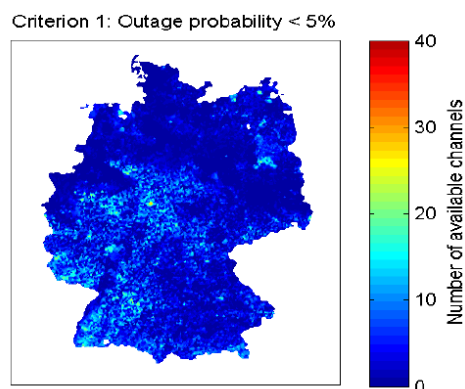
德國數位無線電視閒置頻譜評估

資料來源：本次會議 Broadband for all 提供參考資料

(二)瑞典行動寬頻頻譜政策探討

　　瑞典郵政及電信總局(PTS)提出明確的頻譜中長期策略，以促進頻譜有效利用、符合各頻譜資源使用目的及社會公義、提供市場更多機會以滿足新增行動服務需求。PTS政策目標為：

1. 提供國人優質通話及寬頻通訊服務。
2. 有效利用頻譜及號碼資源。
3. 促進市場有效競爭，提供消費者更多元選擇及合理費率。
4. 消費者享有可靠、安全的通信網路與服務。

　　此外，瑞典郵政及電信總局(PTS)頻譜之政策主要為下列四項原則，後續將確實檢視現階段頻譜使用情形並至2022年所需頻譜資源(300MHz至6GHz之間頻段)、檢討現行法令與管理方式應有利於社會經濟發展：

1. 頻譜使用符合技術中立與服務中立。
2. 拍賣方式為頻譜釋出首選考量。
3. 允許頻譜執照二次交易。
4. 頻譜資源之利用無嚴重干擾之虞者，可考量採免執照制(Licence exemption)。

　　PTS規劃採下列4項分類管理方式，基於最有利於社會經濟之原則，持續檢視頻譜使用情形，同時放寬或解除管制法令，相關頻譜策略預定於2013年第3季徵詢各界意見，其經驗將供各界參考：

1. 專屬獨佔頻譜 (Dedicated Spectrum Exclusive Use)
2. 共享使用(Shared Use)
3. 最低限度條件共享使用(Least Restrictive Conditions Shared Use)
4. 最低限度條件獨佔使用(Least Restrictive Conditions Exclusive Use)等共計。
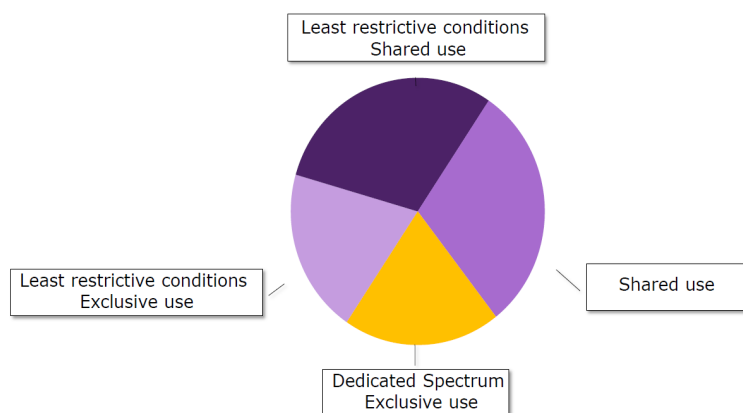
瑞典郵政及電信總局(PTS)規劃頻譜分類管理方式與比例

資料來源：本次會議瑞典郵政及電信總局(PTS)提供頻譜管理策略資料

上述機制中，PTS 未來頻譜釋出策略，將朝向採頻譜共享(Spectrum Sharing)為主要法則，且各頻段未使用之頻譜皆可考量釋出；頻譜採最低限度條件(Least Restrictive Conditions)機制，將可提供各種技術發展機會；頻譜管理模式之態樣(例如區塊化分、專屬或免執照之發射功率大小等)將影響網路發展及商業模式。而專屬獨佔頻譜資源之執照，未來將考量減少釋出，屆時該類執照業者，部分頻譜資源可能依個案及動態管理方式(例如依時間、地理位置、部分頻寬等)供其他業者使用之模式。
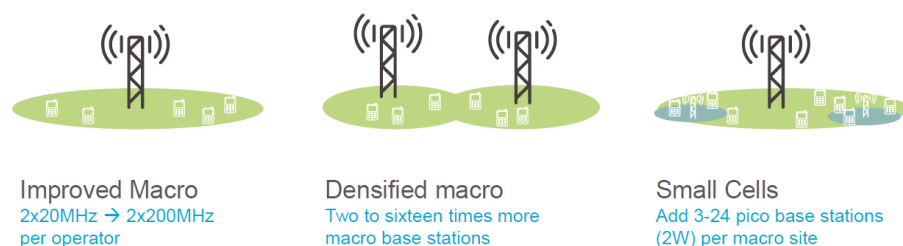
PTS 對於頻譜資源規劃將依三階段：檢視頻譜需求與供給、評估各頻段使用情形、決定或調整各使用頻段之管理方式(專屬獨佔、共享使用、最低限度條件共享或獨佔等 4 項分類)等循環程序，以符合頻譜政策目標與策略。

四、行動通信異質網路整合

(一) 建構無縫隙之行動寬頻網路服務概念

瑞典愛利信(ERICSSON)公司提出整合現有行動通信網路及小型、微型基站構想，未來為達到用戶可達 100Mbps 頻寬目標，網路建設規劃建議應同時考量下列要件：

1. 行動通信網路增配無線頻譜(各家業者應有上下行 200MHz 頻譜資源)。
2. 提升行動通信網路基站佈建密度(現階段密度之 2 至 6 倍)。
3. 整合並增建小型、微型基站(各行動通信網路基站內增建 3 至 24 個)。

Improved Macro
2x20MHz → 2x200MHz
per operator

Densified macro
Two to sixteen times more
macro base stations

Small Cells
Add 3-24 pico base stations
(2W) per macro site

整合無縫隙高速行動寬頻網路服務案例圖示
資料來源：瑞典愛利信(ERICSSON)公司會議資料

(二) 輔助型下鏈(Supplemental downlink ,SDL) 概念

觀察終端用戶使用寬頻服務之資訊流量(data traffic)情形，通常下行流量遠大於上行之不對稱現象，尤其是消費者使用視訊(Video)娛樂、網頁瀏覽等應用，研究機構預估於 2015 年相關應用將佔整體行動通信訊務量 66％以上，下載資訊頻寬需求明顯。

輔助型下鏈(Supplemental downlink ,SDL)概念，即於行動通信網路增配下

鏈之頻譜資源，專供下行傳輸資料使用，為紓緩行動通信網路壅塞、提升傳輸容量之另一解決方案。本次會議談論亦提出未來歐洲地區規劃 L-band1.4GHz (1452-1492MHz)頻段供用之可能性。而美國電信業者 AT&T 公司，則規劃採 700MHz 頻段，預估最快將於 2014 年提供服務。
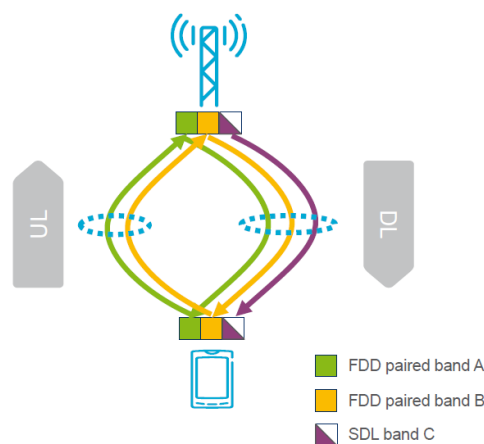
輔助型下鏈(Supplemental downlink ,SDL) 概念圖例
資料來源：瑞典愛利信(ERICSSON)公司會議資料

　　圖例為未來可能之新興行動通信異質網路整合概念，電信業者提供寬頻服務之容量，將以政府核配之專屬頻譜資源，並輔以輔助型下鏈(Supplemental downlink ,SDL)、搭配授權共享制(Authorized shared)頻譜及整合免執照 (Unlicensed)頻譜資源應用（例如業者自建或第三方建置之 WiFi 頻寬資源）等整體網路架構，以因應消費者行動寬頻服務需求倍增趨勢。
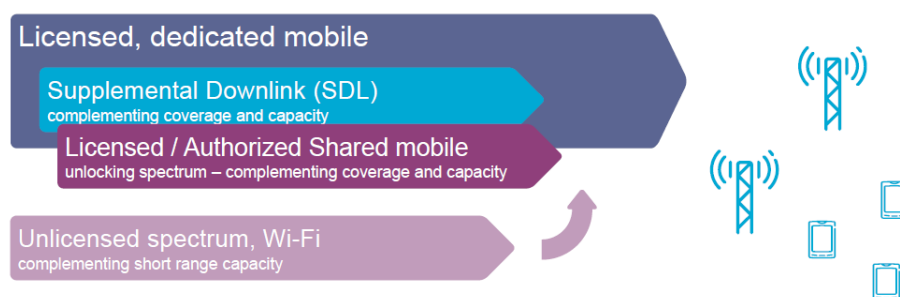
新興行動通信異質網路整合概念
資料來源：瑞典 2013 寬頻大未來-繁榮社會必要的基礎建設會議資料

五、新興行動通信技術發展議題

(一) LTE Broadcasting

　　多媒體廣播多播技術（Multimedia Broadcast and Multicast Services, MBMS）概念，為行動通信業者規劃部分頻寬，採廣播方式提供線性(linear)或隨

選(on demand)等多型態之多媒體內容服務,可同時供眾多用戶接收視聽內容提升頻譜利用率,並減緩用戶接收視訊造成頻寬壅塞情形,為近年來各界持續關切議題;LTE 採進階版 eMBMS 技術標準,依據會議研究報告資料,美國電信業者 Verizon 公司,規劃預定於 2014 年推出服務。

(二) 下一世代行動通信技術標準 5G 概念

本次會議亦探討第五代行動通信(5G)發想概念,因應消費者智慧型手機頻寬需求倍增、各種設備之間大量應用訊息傳遞等預期趨勢,除了持續提升通訊品質、支援高速移動能力、更高頻寬、低功耗、低延遲及技術相容等面向外,裝置之間連接(connected devices)應用,為邁向資訊化社會願景之關鍵要素。

制訂下世代行動通信技術標準 5 大挑戰要素
資料來源:瑞典 2013 寬頻大未來-繁榮社會必要的基礎建設會議資料

為因應未來行動通信技術標準發展趨勢,彈性無線頻譜管理方式,例如專屬執照制(Licensed)、免執照制(Unlicensed)或授權共享制(Authorized shared)等機制,將有利於實現下世代行動多樣性(diversified)服務應用環境。

六、非洲地區寬頻發展概況

非洲於近 3 年為行動寬頻服務滲透率成長最高區域,行動通信服務可提升民眾便利性、降低通訊成本、促進經濟與社會繁榮發展等諸多優點,為非洲帶來新的機會。

推動非洲地區之寬頻服務發展,因為固定網路覆蓋率不佳,無線通信將為目前主要傳輸方式,頻譜資源規劃更顯其重要性,尤其是較低頻之頻段,近期將優先考慮數位紅利(Digital Dividend)700 或 800MHz 頻段。

非洲地區金融體系服務未盡普及,因此行動通信業者與銀行合作,用戶經過申請後,即可藉由行動錢包(Mobile Money)之應用,進行購物交易或付款,例如近期肯亞(Kenya)推出 M-pesa 及 Airtel-money 相關服務後,已廣為消費者使用。

陸、雙邊會談摘要

　　本次參與瑞典會議除與各監理機關代表討論寬頻趨勢外，本會會議期間與澳洲 ACMA 主委 Chris Chapman 及瑞典 PTS 代表進行雙邊交流會議，並與瑞典電信業者 TeliaSonera 公司之系統發展部門副總裁(Vice President of System Development) Mr. Tommy Ljunggren 會談，了解跨國電信公司經營策略。

一、澳洲雙邊會談

　　ACMA 為推動澳洲寬頻服務發展、因應未來全球數位化機會，於 2009 年成立國家寬頻網路(National Broadband Network, NBN)公司，預估以 12 年時間由政府出資並投入總金額將超過 330 億歐元經費，建構全國性寬頻網路服務，預估將有 93%採光纖到戶(Fiber To The Premises ,FTTP) 網路，並將以批發(wholesale)方式銷售，初期以 100Mbps 為目標，預期未來將提升至 1Gbps。

　　關於行動寬頻近期發展，ACMA 甫於本(2013)年 5 月 7 日同時釋出 700MHz (Asia-Pacific Telecommunity ,APT 規格)、2.5GHz 等頻段頻譜資源，並採 CCA 拍賣方式釋照，其中 700MHz 頻段為數位轉換紅利，為全區經營執照，預估於 2015 年開始提供服務；另外，2.5GHz 頻段為分區執照。

　　ACMA 主委 Chris Chapman 並強調該頻段採 APT 規格，將有利於亞太地區國家間之頻譜和諧使用，包含紐西蘭及印度已正式確定 700MHz 頻段將採 APT 規格，而汶萊、印尼、馬來西亞、新加坡近期聲明該將加入規劃行列，其他地區包含國際電信聯合會第 1 區域(ITU region 1)中東及非洲地區等亦可能參與，預期將具相當之經濟規模與影響力。

二、瑞典雙邊會談

　　瑞典為全球最早並於 2009 年推出 LTE 服務國家，PTS 會議代表 Urban Landmark 先生分享自 2008 年起陸續釋出 2.6GHz、800MHz 及 1800MHz 等多組頻段經驗：

1. 瑞典於 2008 年拍賣 2.6GHz 頻段(2500-2690MHz) 190MHz 頻寬，為歐盟地區最早釋出國家，並分為 FDD Mode 14 個區塊(2x5MHz)及 TDD Mode 1 個區塊(50MHz)，單 1 業者至多可取得之頻譜上限總計為 140MHz，拍賣方式為 SMRA-Switching，且拍賣過程不公開暫時得標者。經 112 回合拍賣結果，共計有 5 家業者得標。

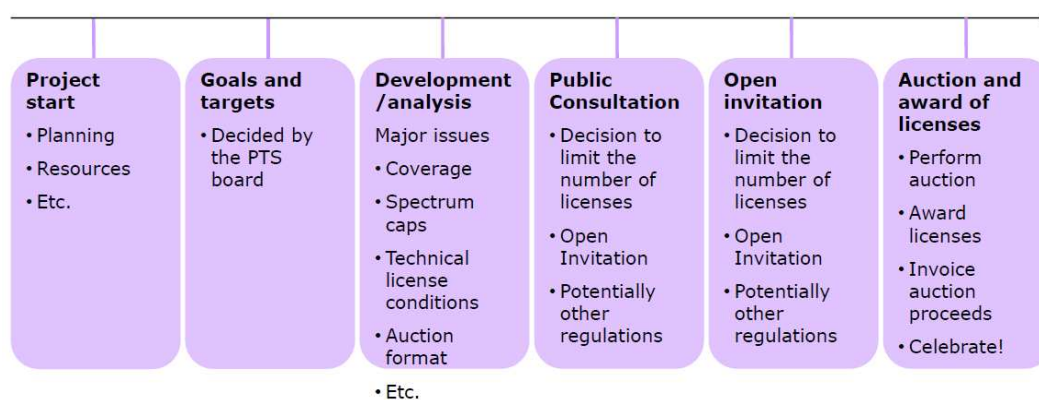2. 2011 年拍賣 800MHz 頻段，共計釋出 6 張執照(每張為 2x5MHz 頻寬)，單 1

業者至多可取得 2 張執照，拍賣方式為 SMRA-Switching 與 2.6GHz 頻段相似。

3. 2011 年拍賣 1800MHz 頻段計 2x35MHz 頻寬，並以 2x5MHz 為單位釋出，未限制單 1 業者可標得頻寬，採 Clock auction 二階段拍賣方式。

PTS 釋照目標，包含優質行動寬頻服務帶來的各項應用、稀有資源有效利用、促進市場競爭國民得享有物美價廉通訊服務，與我國「行動寬頻業務」釋照相近。另外，瑞典人口多數集中於部分城市，為達成瑞典寬頻政策於 2020 年 90% 的家戶和企業能享有寬頻接取之目標，爰於釋出無線頻譜資源中，特別規範獲得 800MHz 頻段之其中 1 張執照業者應有涵蓋義務，而涵蓋義務之業者，總投資金額最高上限為瑞典克朗 1.5 億至 3 億元（約新台幣 7 億至 14 億元），應涵蓋之家庭範圍，則由 PTS 參考固網寬頻涵蓋情形後指定之。

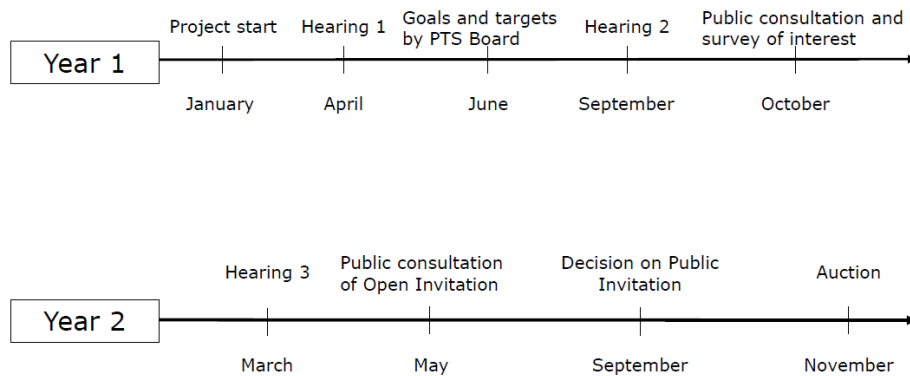關於瑞典 LTE 涵蓋率，2012 年 10 月統計已達 93%，而主管機關 PTS 釋照時並無要求電信業者相關建置率，但日前業者已承諾將持續建設網路，涵蓋率目標將達 99% 人口。

關於釋照規劃與過程，PTS 依序為釋出頻譜資源、釋照目標、各項議題（涵蓋率、頻譜上限、拍賣方式）分析、公開意見徵詢、進行拍賣等，一般完整釋照程序共計約需 2 年時間。

瑞典郵政及電信總局(PTS)釋照規劃過程圖例說明
資料來源：本次會議瑞典郵政及電信總局(PTS)提供頻譜管理策略資料

	Project start	Hearing 1	Goals and targets by PTS Board	Hearing 2	Public consultation and survey of interest
Year 1	January	April	June	September	October

	Hearing 3	Public consultation of Open Invitation	Decision on Public Invitation	Auction
Year 2	March	May	September	November

瑞典郵政及電信總局(PTS)釋照規劃期程說明

資料來源：本次會議瑞典郵政及電信總局(PTS)提供頻譜管理策略資料

三、拜會瑞典 TeliaSonera 電信公司

瑞典 TeliaSonera 電信公司代表 Mr. Tommy Ljunggren 會談，介紹該公司因應寬頻服務趨勢之經營策略。TeliaSonera 電信公司原分別為瑞典 Telia 及芬蘭 Sonera 等 2 家公司於 2003 年合併組成，目前已於歐洲地區 15 個國家成立分公司提供跨國服務，共計約有 7 千 1 百萬用戶。

TeliaSonera 電信公司為全球最早推出 LTE 服務業者，該公司已標得 800MHz、1800MHz 及 2.6GHz 等多頻段頻率，發展初期仍以 LTE 提供寬頻上網服務，2G 及 3G 提供語音服務，後續將推動 LTE 語音服務。Mr. Tommy Ljunggren 並說明目前刻正洽商歐洲地區國家，規劃採 800MHz、2.6GHz 等頻段提供 LTE 國際漫遊服務。

隨著行動通信服務之多樣化，應用內容服務層之營收逐步增加趨勢，而傳統語音營收則逐漸流失， TeliaSonera 電信公司後續將以提供消費者垂直服務策略，以留住既有電信用戶，除持續推動加值應用，並積極跨足電視頻道等多角化經營服務。

柒、心得與建議事項

隨著寬頻技術不斷躍進、各種類型應用軟體競相推出，帶動網路寬頻需求倍增趨勢，各主管機關積極營造寬頻服務發展環境，推動成為資訊化社會。

本次出國參與瑞典郵政及電信總局(PTS)舉辦年度寬頻大未來會議，各國監理機關代表藉由參與討論之機會，瞭解國際新興技術發展趨勢、因應匯流環境變遷監理思維、促進無線頻譜資源利用，共同邁向寬頻大未來。以下謹整理會議重點及因應建議：

一、建立我國中長期頻譜策略，持續性評估、調整、規劃釋出機制

無線頻譜資源規劃，為推動行動寬頻服務重要關鍵因素，主管機關除順應國際無線頻譜趨勢，規劃釋出頻譜資源，供電信業者建設更高效率行動寬頻網路外，掌握各項目的使用之頻譜資源使用情形及符合消費者需求，評估未來中、長期頻譜因應規劃方針，將可提升國家政策透明性，並有利於整體行動產業投資環境。

以瑞典 PTS 為例，規劃國家頻譜政策目標與策略，依三階段：檢視國家各種無線頻譜資源使用目的之需求與供給、再評估各頻段使用情形、最後決定或調整各使用頻段之管理方式(專屬獨佔、共享使用、最低限度條件共享或獨佔等 4 項分類)等循環程序，以期提升稀有資源最有效利用，相關機制可供我國頻譜資源主管機關參考。

二、密切關注國際頻譜共享(Spectrum Sharing)技術發展趨勢

全球數位無線電視閒置頻譜(TV White Space, TVWS)應用仍屬發展初期，而近期英國、美國、新加坡、日本及韓國等國家，陸續推動相關實驗計畫，廣泛應用於智慧公共能源監控、國土安全監控、智慧防災即時傳輸、智慧交通監控、港口管理及行動頻寬分流等面向，其市場規模、頻譜和諧使用均為重要發展因素。

本次於瑞典會議雖探討 TVWS 之應用，為避免干擾數位無線電視用戶之接收，基站發射功率恐將受限，原利用頻譜特性涵蓋優勢之利基將受影響，且人口越密集區域，可供利用之數位無線電視閒置頻譜亦越少，因此相關機制恐將適用於短距離通訊其他頻率之疑慮，而參酌國際 TVWS 相關技術可支援之頻段甚寬[3](VHF 頻段：30MHz～300 MHz、UHF 頻段：300MHz～3,000 MHz)，因此，未來仍有機會

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[3] 資策會 2013.08.28「全球 TVWS 發展分析」。

落實頻譜共享(Spectrum Sharing)概念,後續須密切觀察國際趨勢,並預為檢視我國推動相關機制之法令環境。

三、因應頻譜共享(Spectrum Sharing)管理方式與法規架構調整

我國目前頻譜資源管理方式,主要可區分為執照制及免執照制等 2 種類型。執照制,依電信法規定核配頻率及核予特許執照或專用電信執照,執照頻率為專屬使用且具有免受干擾之權益;免執照制,使用者僅需購買符合本會「工業科學醫療用電波輻射性電機管理辦法」、「低功率電波輻射性電機管理辦法」等規定設備,毋須申請執照即可使用,通訊品質受當時使用多寡等環境條件之限制。

為因應頻譜共享(Spectrum Sharing)逐漸成熟趨勢,除頻譜使用權分配方式(資料庫建立)及干擾處理規範等挑戰外,我國現行通訊與傳播法制架構,仍以業務(事業)執照並核配使用無線頻譜之管理機制,未來如納入頻譜條件授權共享使用機制,需考量業務執照管理架構之適用及調整。

四、新興行動通信技術標準 5G、輔助型下鏈(SDL)及多媒體廣播多播技術(MBMS)

行動通信系統之演進均有其推動目標與定義,第一代為 AMPS 類比式通信系統,第二代 GSM 通信系統則具有類比轉換為數位之重要意義,第三代 UMTS 通信系統(3G)帶動數據加值服務應用發展,第四代 IMT-Advanced 行動通信系統(4G)則以提升傳輸容量為演進目標。

第五代行動通信(5G)技術標準,全球目前尚無具體明確之定義。本次會議探討 5G 定義與發展目標,除了持續提升通訊品質、支援高速移動能力、更高頻寬、低功耗、低延遲及技術相容等面向外,裝置之間連接(connected devices)功能,亦將為未來 2020 年可能之應用。此外,為提升頻譜利用率,輔助型下鏈(SDL)、多媒體廣播多播技術(MBMS)、WiFi 無縫隙應用並整合於行動網路等應用功能均已逐漸成熟,為本次會議討論未來可能之應用趨勢,待觀察後續密切觀察,俾利我國發展行動寬頻與國際先進國家同步。

五、瑞典釋出 800MHz 頻段無線涵蓋率規定與固定網路併同考量

本次與瑞典主管機關代表雙邊交流會議探討推動寬頻發展各面相,瑞典寬頻政策於 2020 年 90%的家戶和企業能享有寬頻接取之目標,爰於釋出無線頻譜資源中,特別規範獲得 800MHz 頻段之其中 1 張 FDD6 執照業者應有涵蓋義務規定,而涵蓋義務之業者,總投資金額最高上限為瑞典克朗 1.5 億至 3 億元(約新台幣 7 億至 14 億元),無線網路應涵蓋之家庭範圍,則由瑞典主管機關 PTS 參考固網寬頻涵蓋情形後指定之,其發展寬頻策略係以無線網路搭配固定網路做為整體涵蓋率之考量,可供各界參考。

捌、活動相片

本會副主任委員與澳洲 ACMA 主委 Chris Chapman 會面
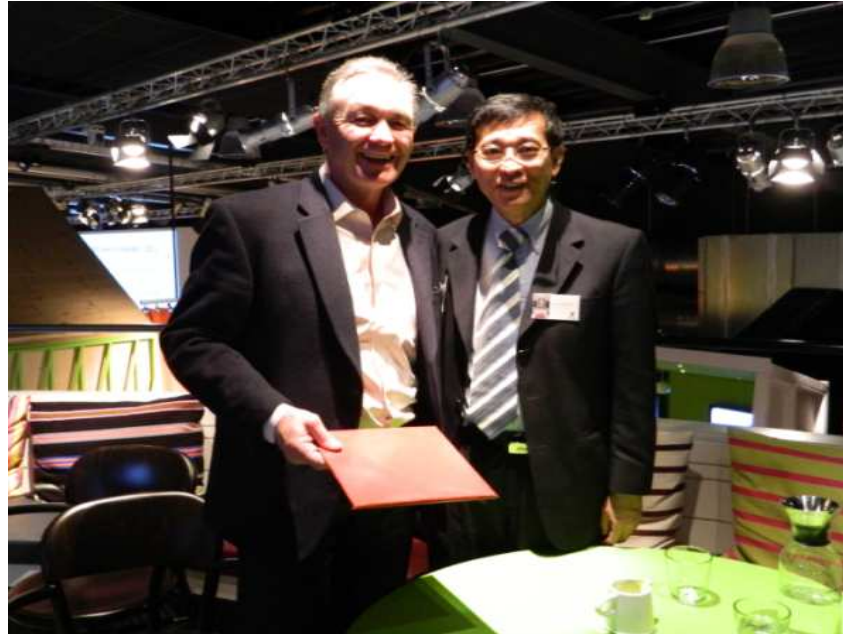
本會與瑞典 PTS 代表會面

本會副主任委員與香港通訊事務管理局辦公室 OFCA 總監利敏貞 Eliza Lee 會面

本會副主任委員與加拿大工業部門代表 Kelly Gillis 會面

玖、附件

附件一:「Keynote:Perspectives from Hong Kong」簡報資料
附件二:「Keynote:Technology for the Networked Society」簡報資料
附件三:「Regulation for Innovation」簡報資料
附件四:「Broadband for all in Africa」簡報資料
附件五:「Broadband for all in Mexico」簡報資料
附件六:「Hetereogenous Networks including seamless WiFi
integration 」簡報資料
附件七:「Technologies for new spectrum access」簡報資料
附件八:「LTE Broadcasting」簡報資料
附件九:「5G The next frontier」簡報資料
附件十:「PTS recent and coming licensing of spectrum」簡報資料
附件十一:「PTS long term spectrum strategy work」簡報資料

附件一：「Keynote：Perspectives from Hong Kong」簡報
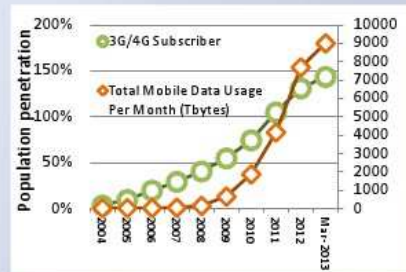
Market-Driven Approach

Market Leads, Government Facilitates
Big Market, Small Government

Government to facilitate the market to operate effectively

No Government funding is involved in rollout of broadband infrastructure

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3

Coverage of self-built Customer Access Network (CAN)

Households having access to
1 CAN : 97%
2 CANs: 87%
3 CANs: 76%
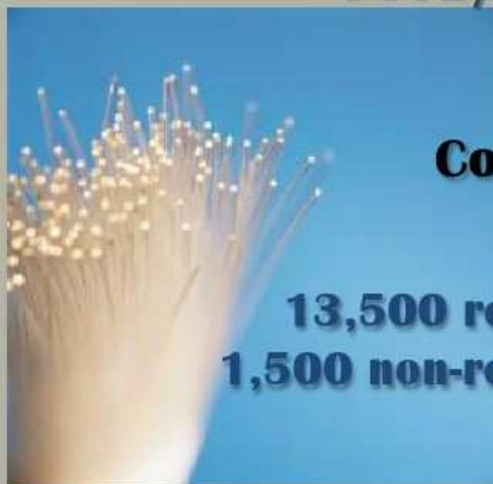
OFCA 通訊事務管理局辦公室
OFFICE OF THE
COMMUNICATIONS AUTHORITY

4

Spectrum Policy Framework

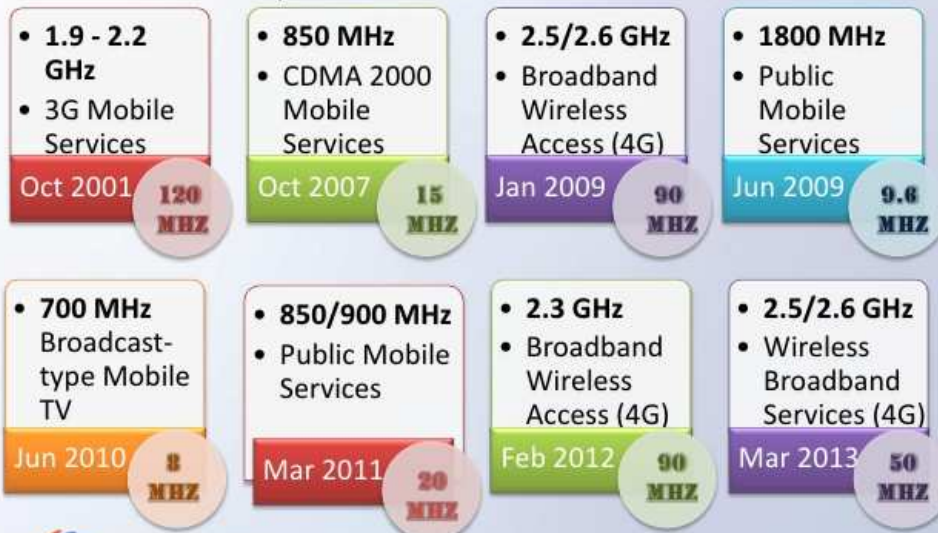| Guiding Principle in Spectrum Management	• Market-based approach (e.g. auction) for spectrum with competing demands from providers of non-Government services • In case there are overriding public policy reasons to do otherwise, the reasons will be published
Spectrum Rights	• No legitimate expectation on right of renewal or right of first refusal of any licence or spectrum assignment upon the expiry
Supply of Spectrum	• Publication of spectrum release plan

6

Timely Release of Spectrum Through Auctions

- Total amount of spectrum assigned through auctions: 400 MHz at US$1.4 billion

• 1.9 - 2.2 GHz • 3G Mobile Services Oct 2001 — 120 MHZ	• 850 MHz • CDMA 2000 Mobile Services Oct 2007 — 15 MHZ	• 2.5/2.6 GHz • Broadband Wireless Access (4G) Jan 2009 — 90 MHZ	• 1800 MHz • Public Mobile Services Jun 2009 — 9.6 MHZ
• 700 MHz Broadcast-type Mobile TV Jun 2010 — 8 MHZ	• 850/900 MHz • Public Mobile Services Mar 2011 — 20 MHZ	• 2.3 GHz • Broadband Wireless Access (4G) Feb 2012 — 90 MHZ	• 2.5/2.6 GHz • Wireless Broadband Services (4G) Mar 2013 — 50 MHZ

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7

Outcomes Achieved

- **Global Information Technology Report**: Ranked **1st** among 143 economies in terms of international Internet bandwidth

- **State of the Internet Report**: Ranked **1st** among 98 economies in terms of average peak connection speed

- **The World Competitiveness Yearbook**: Ranked **1st** in terms of technological infrastructure development

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Conclusion

- **We are committed to our light-handed and market-driven approach in facilitating broadband development in Hong Kong**

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附件二：「Keynote：Technology for the Networked Society」簡報
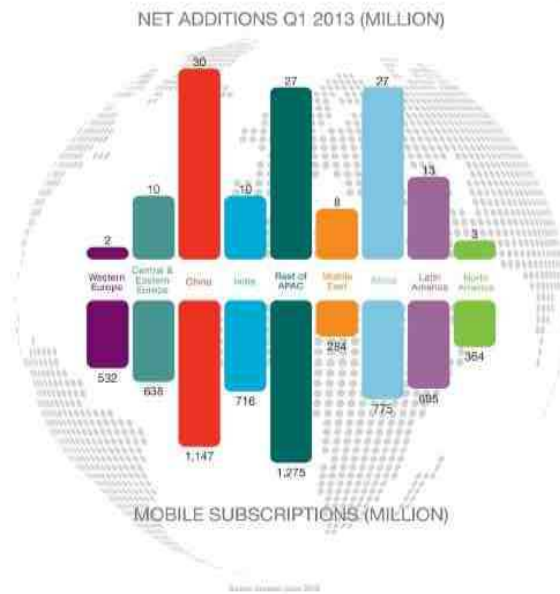
MOBILE SUBSCRIPTIONS
Q1 2013

6,4 BILLION

MOBILE SUBSCRIPTIONS GLOBALLY IN Q1 2013

Note: Number of subscribers around 4.5 billions

130 MILLION

NET ADDITIONS Q1 2013

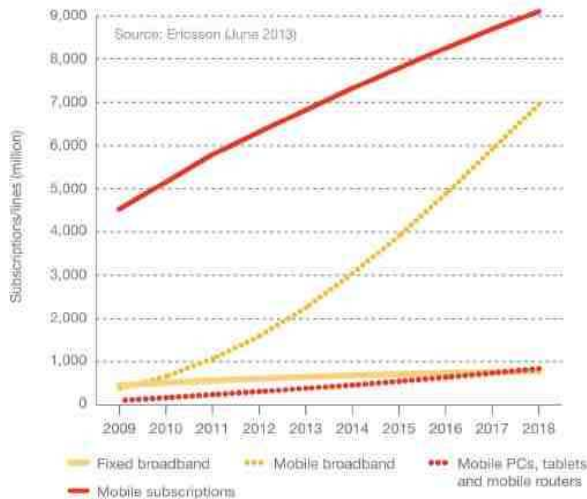NET ADDITIONS Q1 2013 (MILLION)

Western Europe	Central & Eastern Europe	China	India	Rest of APAC	Middle East	Africa	Latin America	North America
2	10	30	10	27	8	27	13	3
532	638	1,147	716	1,275	284	775	095	364

MOBILE SUBSCRIPTIONS (MILLION)

CAGR 2012-2018: 6%

Mobile subscriptions by region, Q1 2013

FIXED AND MOBILE SUBSCRIPTIONS
2009-2018

>9 BILLION

MOBILE SUBSCRIPTIONS BY THE END OF 2018

Source: Ericsson (June 2013)

Subscriptions/lines (million)

- Fixed broadband
- Mobile broadband
- Mobile PCs, tablets and mobile routers
- Mobile subscriptions

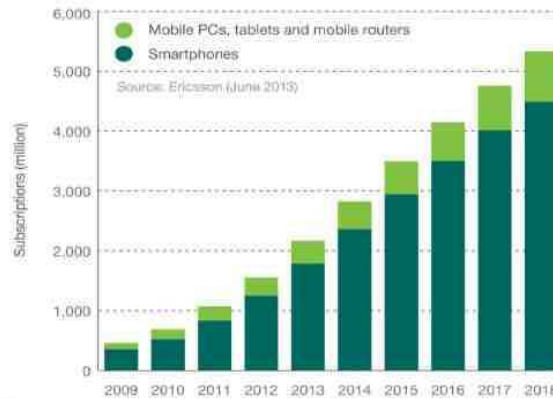M2M subscriptions not included

26

4.5 BILLION SMARTPHONE SUBSCRIPTIONS END 2018

› 4.5 B smartphone subscriptions by the end of 2018

› 50% of phones sold during Q1 were smartphones

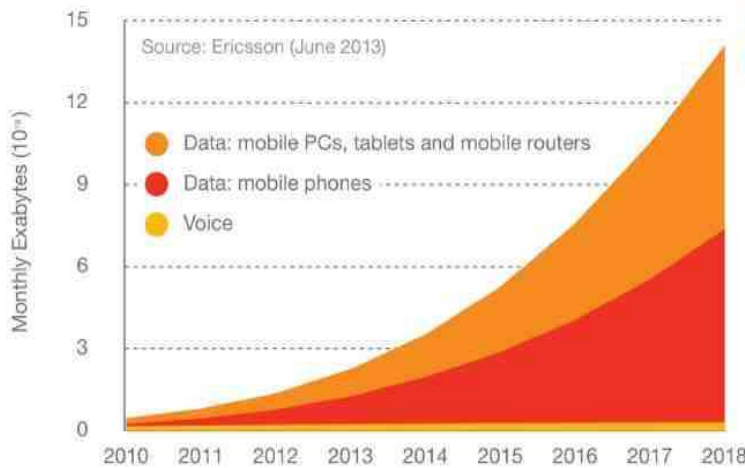› By 2018 the average smartphone subscription will use 2GB of data per month

4X

MORE MONTHLY DATA TRAFFIC PER SMARTPHONE BY THE END OF 2018

Smartphone, PC, mobile routers and tablet subscriptions with cellular connection 2009-2018

12 TIMES MOBILE DATA TRAFFIC BY END OF 2018

Global mobile traffic: voice and data 2010-2018

12X

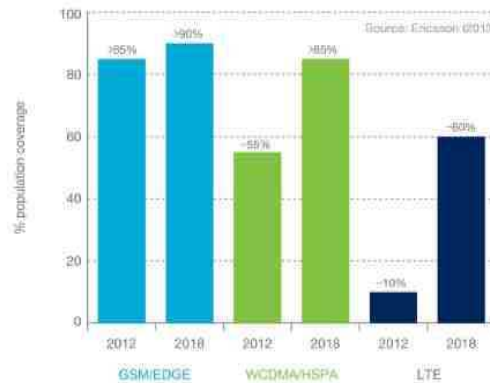MOBILE DATA TRAFFIC WILL GROW BY ~12 TIMES BETWEEN 2012 AND 2018
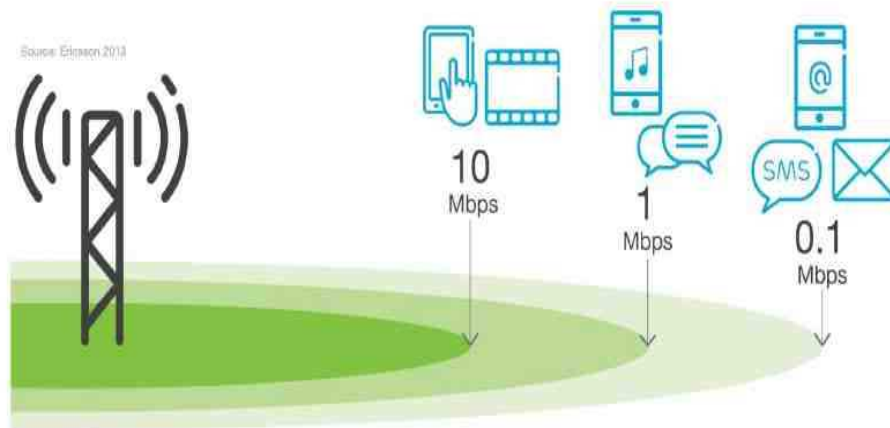
POPULATION COVERAGE

60%

LTE WILL COVER AROUND 60 PERCENT OF THE WORLD'S POPULATION BY 2018

> More than 85% of world´s population covered by WCDMA/HSPA in 2018
> LTE network deployments continue in all regions of the world, as LTE population coverage doubled in 2012 compared to 2011 (10% vs 5%)
> 60% of world's population covered by LTE in 2018

APP COVERAGE

10 Mbps

1 Mbps

0.1 Mbps

"App Coverage" – the area where my app works as I expect"

SPECTRUM BAND USAGE

Coverage and capacity for nation-wide and deep indoor

Capacity and additional coverage for urban-wide

Supplemental downlink for area-wide coverage and capacity

Flexible capacity for local area dynamic uplink and downlink

Small-cell for hot spot capacity

Service providers

need

the combination of the different properties

to

optimize offerings and performance

SPECTRUM MANAGEMENT
-DIFFERENT REGULATORY APPROACHES

Spectrum management toolbox

Licensed

Unlicensed

Shared

Licensed – All cell sizes; QoS,
Clear rules for attracting investments

Unlicensed – Local area; best effort

Licensed Shared Access
Shared access for mobile broadband in under-used spectrum (ASA/LSA)

USE OF SPECTRUM

Spectrum management toolbox

Licensed
- Mobile Broadband

Unlicensed
- Bluetooth, WiFi

Shared
- ASA/LSA for mobile

350 MHz (current average) to about 1.5-2 GHz by 2020

Current allocation (>500 MHz) below 6 GHz estimated to be sufficient until 2020

Suitable for low or localized utilization due to restrictions (military, radar, satellite). ASA/LSA:
- 2.3 GHz in some countries in Europe
- 3.5 GHz in the US

Global harmonization of the bands key to industry scale and roaming

MAINSTREAM MOBILE ALLOCATIONS
CURRENT ASSUMPTION FOR SUB 1 GHZ BANDS

The APT700 band – Low & High Duplexer | The E850 Lower and the 850 MHz bands | The 900 MHz band | APAC & Latin America >200 MHz

703 | 2x45 MHz | 803 | 807 824 | 844 852 869 | 889 890 915 | 935 960

The APT700 band – Low Duplexer | The CEPT 800 band | The 900 MHz band | Europe, Middle East & Africa 190 MHz

703 | 2x30 MHz | 788 791 | 821 832 | 862 | 880 | 915 925 | 960

The band 700 MHz (USA) | The E850 Upper band | US & Canada 160 MHz

699 716 729 746 756 777 787 | 814 824 | 849 859 869 | 894
718 728 758 768 788 798

New momentum

= Uplink
= Downlink
SDL = Supplementary Downlink

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TV WHITE SPACES

- TV White Space use is not suitable for wide area coverage
  - the advantages of low frequencies are lost due to transmit power limitations and interference to TV receivers
  - use cases are limited to short range wireless extension

- Re-purposing of the UHF spectrum
  - A way forward to multi-service mobile broadband in collaboration between the broadcasting and mobile industries

TV White spaces are not so white

Criterion 1: Outage probability < 5%

Number of available channels
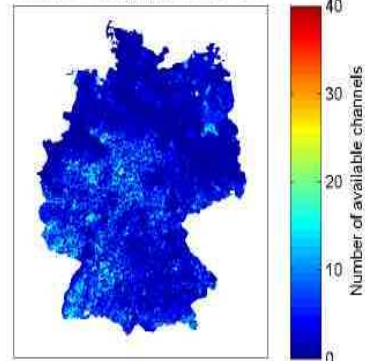
> **32%** of Germany has **no channels** available

> Only **10 %** of Germany has at least **9** channels

WRC-15 CHALLENGES

1800 – 2000 MHz of spectrum in total **for IMT**

spectrum bands **< 6.5 GHz**

satisfying **the needs** for 2020

a new agenda item for the following WRC is needed
- larger bandwidths in a distant future
- > 6.5 GHz

Very important WRC

and

it is very short of time

SECURITY, TRUST AND RESILIENCE

- Trust
- SIM
- Authentication; Authorization
- Designed with security in mind

CONCLUSIONS

› Data centric market
› Business models
› User centric
› Business & Society
› Efficiency & Innovation
› Security & Regulations
› Provide & Enable
› Networked Society

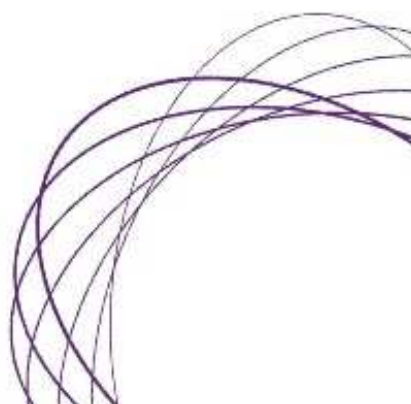附件三：「Regulation for Innovation」簡報

Regulation for innovation

Göran Marby
Director-General
Swedish Post and Telecom Authority

PTS Swedish Post and Telecom Authority

Market developement 2012

⇑ Mobile services
  ⇑ Use of data
  ⇑ Subscriptions
  ⇑ Traffic
  ⇑ Revenues

⇑ IP-telephony, IPTV
⇑ Broadband via fibre
⇑ Transmission speed
⇑ Bundled services

⇓ Fixed telephony
  ⇓ Subscriptions
  ⇓ Traffic
  ⇓ Revenues
⇓ Sms

⇔ Revenues in total

⇔ Fixed broadband
  ⇔Subscriptions
  ⇔Revenues

PTS

Do we need a change?

- Todays' regulation is based on technology, but consumer demands have shifted. Consumers want:

  - Speed
  - Access everywhere from all devices and platforms
  - Mobility
  - Quality

PTS

The first question

- Will the regulatory model of today make future business models possible?

PTS

The second question

- What are customers willing to pay for, and will that be enough to sustain healthy profits?

PTS

The third question

- If access to Internet is something everybody needs, as all services will be ip-based, how do we make sure that everybody can get what they need at prices they can afford.

PTS

Future market definitions?

- Maybe new definitions are needed:

  - Access
  - Speed
  - Mobility
  - Services

PTS

Then we may have to kill some darlings?

- Bill and keep instead of todays' rules for voice termination?

- Symmetric access regulation for all fixed networks, but no prices regulation?

- And, regarding recent EC initiative: everyone must give access to ducts for broadband.

- Demand-driven development instead of support for investment.

PTS

From voice to data to services which are unique for operators

- Changed revenue streams, from voice to data, is a prerequisite for investments in fast broadband networks.

  - Do traditional operators overestimate the threat from OTT players?

  - Can phone numbers and guaranteed quality of service be a competitive advantage?

PTS

When can we de-regulate?

- When consumers get what they expect and pay for.
- When new business models can show balance between risk and investment.
- If there is no risk for protection of old business models and services.

PTS

Remember

We have only seen the beginning off the benefits that the connected society can give to the world.

PTS

附件四：「Broadband for all in Africa」簡報

African Telecommunications Union

Broadband for All in Africa

Abdoulkarim SOUMAILA
Secretary General

a.soumaila@atu-uat.org
www.atu-uat.org

| | June 2013 | Slide 1 of 15 |

Presentation Outline

1. Relevant statistics
2. Characterization
3. Backbone Connectivity Status
4. Key aspects for broadband for all in Africa – general
5. Key aspects for broadband for all in Africa – immediate issues
6. Conclusions

| | June 2013 | Slide 2 of 15 |

Relevant Statistics

- In 2012, 36 African countries had a mobile-cellular penetration above 50%, compared to 10 countries in 2007. Out of those 36 countries, 13 had mobile-cellular penetration above 100% in 2012 compared to none in 2007.

- In 2012, 18 African countries had an internet user penetration above 15% compared to 5 countries in 2007. Out of those 18 countries, 8 countries had an Internet user penetration above 30% in 2012 compared to only 1 in 2007.

- The uptake of both fixed (wired)-broadband and mobile-broadband services have continued to grow worldwide and Africa is the region with the highest growth rates over the past three years with mobile broadband penetration increasing from 2% in 2010 to 11% in 2013.

- By the end of 2012, 146 governments including 29 African countries had adopted or were planning to adopt a national policy, strategy or plan to promote broadband

Source: ITU

Characterization

- Access to internet is extremely low at 10%
- Access to mobile services is at an appreciable 50%
- Africa is a fast growing market with very young population
- Africa remains a cost sensitive market in the foreseeable future
- Mobile technology has brought new possibilities to the African continent – as it can connect individuals to individuals, societies, information, markets and services
- The mobile based application and development projects sometimes known as 'm-development' have the potential to facilitate the delivery of financial, agricultural, health and educational services
- Mobile has greatly reduced communication costs thereby allowing individuals and firms to send and obtain information quickly and cheaply on a variety of economic, social and political issues
- The majority of the people remain unbanked – yet the majority of these have access to mobile telephony
- Many people still do not have access to health care and education
- Costs related to access to conventional services such as banking by the rural communities remains high

Connectivity Backbone Status – Submarine Cable /1
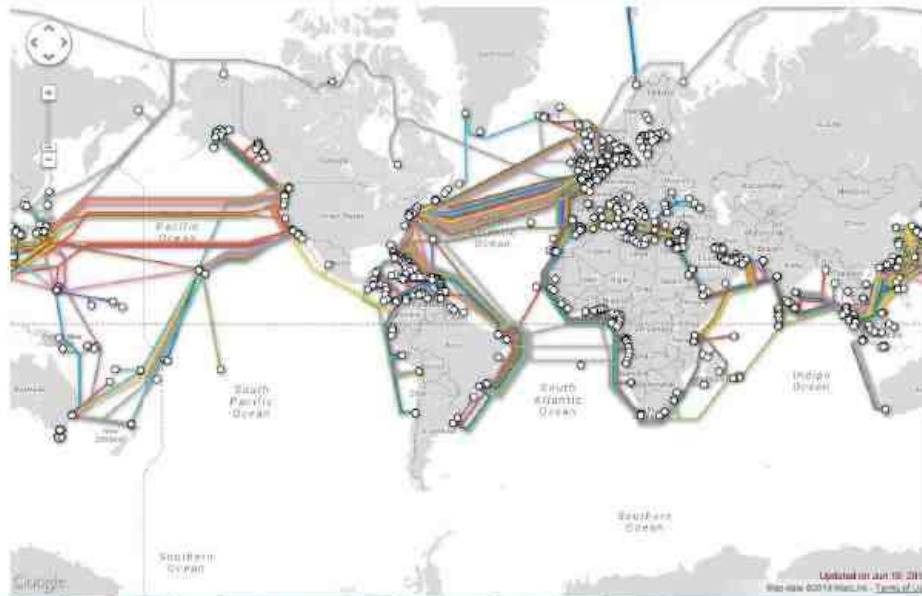
Connectivity Backbone Status: C-band Satellite /1

› Locations of Earth stations registered with one satellite operator and receiving in the 3.4–3.625 GHz band

- › Each denoted site may include one or more stations.
- › Map does not show earth stations not registered with the satellite operator.
- › Sites that are located on water are associated with stations on marine platforms.
- › The receiving FSS earth stations shown comprise 48 stations.

Connectivity Backbone Status: C–band Satellite /2

‣ **Locations of Earth stations registered with one satellite operator and receiving in the 3.625–3.7 GHz band**

- ‣ Each denoted site may include one or more stations.
- ‣ Map does not show earth stations not registered with the satellite operator.
- ‣ Sites that are located on water are associated with stations on marine platforms.
- ‣ The receiving FSS earth stations shown comprise 1062 stations.

Connectivity Backbone Status: C–band Satellite /3

‣ **Locations of Earth stations registered with one satellite operator and receiving in the 3.7–4.2 GHz band**

- ‣ Each denoted site may include one or more stations.
- ‣ Map does not show earth stations not registered with the satellite operator.
- ‣ Sites that are located on water are associated with stations on marine platforms.
- ‣ The receiving FSS earth stations shown comprise 6620 stations.

42

Key aspects for broadband for all in Africa   /1

1. **Policy and Regulations:**
   - Need to have stable, predicable, certain and sound policy and regulations that follow the prevailing best practice
   - Establishment of written national, regional, continental broadband plans
   - Recognition of broadband as essential infrastructure/service and as a factor of production
   - Mainstreaming of broadband into all sectors of the governance
   - Designation of broadband as an alternative means to providing key services such as banking
   - Policy harmonization
2. **Technology:**
   - Availability of wide range of technologies (3G, 4G, LTE…) at lower cost
   - Ensuring backward and forward compatibility as far as possible - as has been the case with 2G and 3G UMTS systems
   - Taking full advantage of the complimentarity of technologies (terrestrial, satellite and cable) such as the new Ka band satellite broadband services
3. **Spectrum:**
   - Need to recognize that broadband is spectrum and spectrum is broadband in Africa - due to poor cable networks
   - Need to make ample amounts of spectrum in the lower bands as soon as possible particularly the Digital Dividend 2
   - Undertake comprehensive studies for broadband spectrum requirements at national, regional, continental levels
   - Establishment of written national, regional, continental broadband spectrum plans
   - Need to apply newer market driven spectrum licensing mechanisms in order to attract best players

Key aspects for broadband for all in Africa   /2

1. **Infrastructure:**
   - Recognition of broadband infrastructure as essential infrastructure
   - Establishment of robust backbone infrastructure as national, regional and continental level - e.g. the SADC fiber inter-country network
   - Equal access to marine backbone infrastructure by all countries particularly landlocked countries as envisaged by Resolution 1 at WCIT-12
   - Exploitation of all available technology - terrestrial, satellite and cable
   - Need to provide the support infrastructure such as power, roads, etc
2. **Funding**
   - Establishment of special funding mechanisms at national, regional and continental level with emphasis on making funding available at the right time and right cost
3. **Traffic Management**
   - Enhancement of Internet Exchange Points (IXPs) at national, regional and continental level
4. **Tariffs:**
   - Africa will remain a cost sensitive market for the foreseeable future - there is therefore need to keep service charges low
   - Need to address the data roaming charges which are currently extremely high - Roam as a Local Model is worth pursuing - already the SADC region has adopted the model in principle
5. **Applications:**
   - Promotion of local applications such as, 'mobile money', 'e-farm', to make the service relevant to addressing local challenges, e.g. the huge success of M-pesa and Airtel-money in Kenya
   - Promotion of e-government services - government financial spend is crucial
   - Promotion of e-services

Key aspects for broadband for all in Africa   /3

1. **Taxation:**
   - Need for governments to consider low or no taxation on ICT equipment – to recognize broadband as a crucial factor for production
2. **Investment Funding**
   - Establishment of special funding mechanisms at national, regional and continental level with emphasis on making funding available at the right time and right cost – e.g. the SADC region has adopted the model in principle
   - Ensuring backward and forward compatibility as far as possible – as has been the case with 2G and 3G UMTS systems
   - Taking full advantage of the complimentarity of technologies (terrestrial and satellite)
3. **Traffic Management**
   - Need to recognize that broadband is spectrum and spectrum is broadband in Africa – due to poor cable networks
   - Need to make ample amounts of spectrum in the lower bands as soon as possible particularly the Digital Dividend 2
   - Establishment of written national, regional, continental broadband spectrum plans
   - Need to apply newer market driven spectrum licensing mechanisms in order to attract best players
4. **User Equipment:**
   - Simple to keep the purchase price low but robust enough
   - Robust/longer battery life
   - Universal charging – with solar charging an added advantage

Key aspects for broadband for all in Africa   /4

1. **Deployment:**
   - Need to build on the success story of mobile and hence focus on mobile broadband

2. **Incubators:**
   - Formalization of ICT incubators
   - Identification of talent in the area of innovation in particular creation of mobile applications
   - Affordable venture capital for commercialization of ideas

3. **Customization:**
   - Need of customization of applications e.g. facebook on sms

Key aspects for broadband for all in Africa – immediate issue

1. Doubling up efforts for affordable broadband in rural and remote parts of Africa
   - Making spectrum available in particular suitable spectrum in the 700/800 MHz band (the digital dividend)
   - Affordable access to marine optical fiber cables by landlocked countries in line with Resolution 1 of WCIT-12
   - Completion of inter-country cross-border backbone links
   - Embracing new and high speed satellite services
   - Affordable access to satellite communications
   - Implementation of Universal Access programmes

conclusions

1. In the particular case of Africa, '*spectrum is mobile broadband and mobile broadband is spectrum*'

2. Thus far, mobility has had a remarkable and positive influence on individuals, societies and governments

3. However more needs to be done as the majority still do not have access to broadband due to affordability issues or lack of broadband itself

4. The digital dividend spectrum remain the best opportunity to realizing affordable mobile broadband among other factors.

附件五：「Broadband for all in Mexico」簡報

SCT
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Y TRANSPORTES

Mexico´s Constitutional Ammendment on Telecommunications, Broadcast and Economic Competition

Stockholm, June 24th, 2013

I. Why is this a fundamental Reform for Mexico?

II. The ABC of Telecomms Reform in Mexico

III. Benefits.

IV. The Six Fundamentals of the Constitutional Amendment.

V. After the Constitutional Ammendment: Next Steps to Overhaul Mexico´s Telecomms Sector.

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Y TRANSPORTES

I. Why is this a Fundamental Reform for Mexico?

- During his inauguration speech, President Peña Nieto stressed that lack of competition in strategic economic sectors, such as telecommunications, seriously compromised Mexico's capacity to generate growth. Hence, on his first public address in office, he commited to work on a Constitutional amendment proposal, in order to transform the telecommunications sector, to make access to ITCs and broadband a universal right and to foster competition in broadcasting.

- This urgent call to action by President Peña Nieto was joined on the next day by the leaders of Mexico's three main political parties, under a bold new consensus-building mechanism, named 'Pact for Mexico' -through which structural economic reforms are now crafted according to specific common objectives; the first of which addressed telecommunications, broadcasting and economic competition , as a single package.

- The Pact for Mexico mechanism was succesful in rallying support for this first Constitutional Ammendment Proposal in both houses of Congress, so that approval was attained in record time: the corresponding Presidential decree became effective on June 11th, 2013.

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Y TRANSPORTES

II. The ABC drivers of the Reform

A. <u>Access with universal Coverage</u>: i.e. extending the coverage ot telecommunications, data and broadcasting services throughout the farthest corners of Mexico.

B. <u>Better Prices:</u> so as to ensure that all telecommunications services become more affordable to everyone, at internationally-competitive prices-

C. <u>Content and Service Quality</u>, so that all Mexicans can have fast and reliable services, as well as access to more diversity in contents.

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III. Benefits

- **Companies and investors win:** due to the enhanced oponness of the telecommunications sector; as well as to the prosecution of anti-competitive or monopolistic behaviour in the marketplace .

- **The population at large wins:** due to the democratization of access to the benefits of the digital era, as well as to the skills necesary to fully partake in the global knowledge economy –for everyone in every corner of our country.

- **Mexico wins:** for enhanced competition in strategic sectors of the economy; particularly in telecomms and broadcasting, will propell a more productive and dynamic –hence more competitive- country.

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Y TRANSPORTES

IV. The 6 Building Blocks of the Reform (1/2)

FIRST. <u>Extended and strengthened fundamental rights, so that telecommunications, broadcasting, telephony and data services can be delivered in all of Mexico.</u>
- ✓ The scope of freedom of expression and of access to information is extended to include access to information technologies, particularly broadband access.
- ✓ The State will see to it that telecommunication services shall be delivered under conditions of competition, quality, plurality, universal coverage, interconnection, convergence, continuity, free access and free from arbitrary interference.
- ✓ Moreover, the State shall guarantee that broadcasting services are provided in conditions of competition, quality and will also see to it that they deliver the benefits of culture to the population at large, whilst preserving infromation plurality and trustworthiness; as well as fostering national identity values.

SECOND. <u>Updating of the legal framework of the telecommunications sector, in order to make its services accesible to all socio-economic groups with internationally-competitive tariff rates.</u>
- ✓ Issuing of a single legal framework, to regulate, spectrum, networks and services under the new single-license regime. .
- ✓ An effective fine and penalty regime, which can also contemplate the possibility of license withdrawal.
- ✓ Asymetric regulation to preponderant economic agents.

THIRD. <u>Strengthening of the Institutional Framework</u> : .
- ✓ Creation of a new Federal Institute of Communications, as well as a Federal Economic Competition Commission – both as constitutional autonomous agencies.
- ✓ Creation of special legal courts on telecommunications, broadcasting and economic competition.

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Y TRANSPORTES

Procedure to nominate and select Commissioners for new Constitutionally-autonomous regulatory agency, the Federal Telecommunications Institute

Seven Commissioners will be designated for up to 9 years by proposal of the Executive Branch and ratification by the Senate, after an evaluation and approval process of suitable candidates, which will be carried out by a selection committee –formed by the heads of constitutionally-autonomous agencies:

1. Bank of Mexico
2. National Institute for the Evaluation of Education
3. National Geography and Statistics Institute

This committee will issue a public/open selection contest, it will also verify the required qualifications for each candidate and will apply a knowledge test to all; two higher education institutions will provide input to this process.

The committee will decide by majority voting on who will make it into the list of 3-5 suitable candidates for each of the 7 positions. The list will then be submitted to the President, who will select the candidate for each position to be ratified by 2/3 of the Senate.

The President of the IFT will be appointed by 2/3 of the Senate for a term of 4 years, which may be extended to another 4 yr period, only once.

6 building blocks of the Reform (2/3)

FOURTH. Promotion of Competition.
✓ FDI is now fully allowed to invest 100% in telecommunications and satellite services; as well as a 49 percent in broadcasting, provided there is reciprocity by the country to which such company belongs. ,
✓ Rights of nationwide broadcast providers to have their programming retransmitted; as well as the right of pay TV license-holders to have their signals be carried or retransmitted by pay-TV providers in non-discriminatory manner.
✓ Auction of two nationwide TV licenses.

FIFTH . Executive Branch Mandate on Universal Digital Inclusion / National Digital Agenda .
✓ New policy focused on infrastructure, accesibility, connectivity, effective ICT use and digital skills.
✓ Bottom line: at least 70% of households and 85% of SMBs have ready access to broadband at globally competitive download speeds.

SIXTH. Direct stimulus to the extension of broadband infrastructure
✓ Deployment of a nationwide optic fibre transport network; as well as of a wholesale wireless broadband access network , using analog-TV- liberated 700 MHz spectrum.

V. Action items triggered by Consitutional ammendment (1/3)

Deadline	Outcome	Responsible(s)	Next Steps
180 natural days	Issue new convergent secondary legislation and modifications to adjacent laws	Ministry of Communications and Trasports (SCT), Current Telecomms Regulator (COFETEL), Ministry of the Interior	Drafting – voting of new secondary convergent legislation (Telecomms + broadcasting)
Withing 60 days	Installation of selection committee for new regulatory agencies Sending candidates list for Presidential nomination	Bank of Mexico, National Statistical Information Institute, National Education Evaluation Commission	
10 natural days	President sends one candidate per each Commissioner position for successive vote in the Senate	President of Mexico	Revision of proposed candidates from the selection committee
10 natural days	Senate review and vote of candidate proposal done by the President; in case of rejection, only 2 rounds before President has right of direct appointment.	Senate	Revision of succesive canditates proposed by the President -2 round limit in case of rejection of proposed names.

SCT
SECRETARIA DE
COMUNICACIONES
Y TRANSPORTES

V. Action items triggered by Constitutional ammendment (2/3)

Deadline	Outcome	Responsible(s)	Next Steps
No defined deadline	Transfer of resources and pending cases from COFETEL to the new autonomous regulatory agency (IFT).	COFETEL & current Economic Competition Commission, IFT	Reduce number of pending cases and issues. Programming handover of pending cases and budget resources, HR.
With immediate effect	Foreign Direct Investment new caps	IFT	
With immediate effect	Editorial Independence of public broadcasting services	Public broadcasting organizations.	Develop rules to protect editorial independence.
With immediate effect	Protect Labour rights of telecomms sector employees		

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Y TRANSPORTES

V. Action items triggered by Constitutional ammendment (3/3)

Deadline	Outcome	Responsible(s)	Next Steps
2015	TDT (TV digital transition) implementation, nationwide	Executive and Legislative Branches, IFT.	
2014-2018	Deployment of shared wholesale wireless broadband network	Presidential Office, Congress	
Open deadline	Handover of public electric utility (CFE) telecommunications license to Telecomm-Telégrafos (former telegraph public company).	SCT, CFE, Telecomm-telégrafos.	
60 natural days	Instalation of new specialized district courts on telecommunications and economic competition	Judicial Branch	
Open deadline	Implementation of National Digital Agenda and Universal Digital Inclusion Policies	Executive Branch, IFT.	Setting of goals and targets, as well as progress indicators in the National Development Plan by the current Presidential Administration

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Y TRANSPORTES

附件六：「Hetereogenous Networks including WiFi integration 」簡報

MOBILE SUBSCRIPTIONS
2009-2018

>9 BILLION

MOBILE SUBSCRIPTIONS BY THE END OF 2018

Mobile subscriptions

Mobile broadband

Mobile PCs, tablets and mobile routers

Fixed broadband

M2M subscriptions not included
Source: Ericsson (June 2013)

MOBILE SUBSCRIPTIONS
2009-2018

by region

by technology

by region legend: LA, NA, APAC, MEA, CEE, WE

by technology legend: LTE, WCDMA/HSPA, GSM/EDGE-only, TD-SCDMA, CDMA, Other

M2M subscriptions not included
Source: Ericsson (June 2013)

GLOBAL MOBILE TRAFFIC
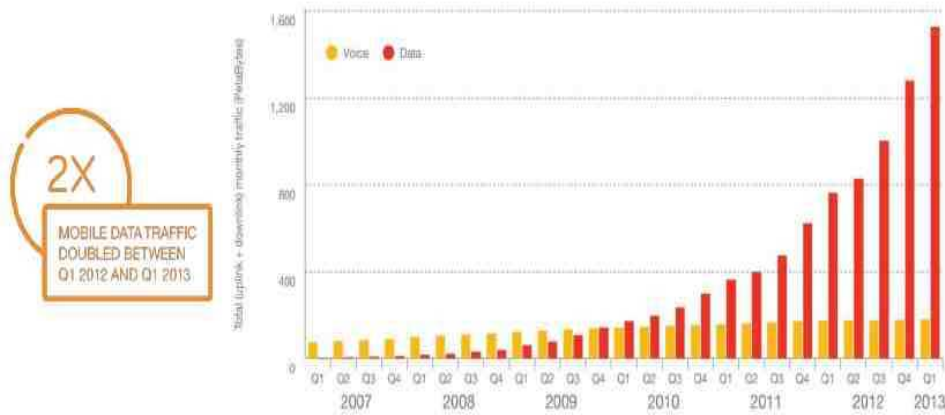
HIGHER SPEEDS DRIVE USAGE

MOBILE TRAFFIC
BY APPLICATION TYPE, 2010-2018

Source: Ericsson (June 2013)

Heterogeneous Networks | Commercial In confidence | 2012-06-25 | Page 7

LTE EVOLUTION

LTE EVOLUTION

Release 10: First major evolution step – "LTE-Advanced"

Release 11: Recently finalized

Release 12: Ongoing

Evolution will continue …

First release of LTE | IMT-Advanced | Today | Continued evolution

Rel-8 | Rel-9 | Rel-10 | Rel-11 | Rel-12 | Rel-13

LTE | LTE-Advanced

Heterogeneous Networks | Commercial in confidence | 2012-06-25 | Page 9

LTE RELEASE 10 AND 11

Carrier aggregation

Extended multi-antenna transmission

Inter-site coordination ("CoMP")

Relaying functionality

Heterogeneous deployments

Rel-8 | Rel-9 | Rel-10 | Rel-11 | Rel-12 | Rel-13

LTE | LTE-Advanced
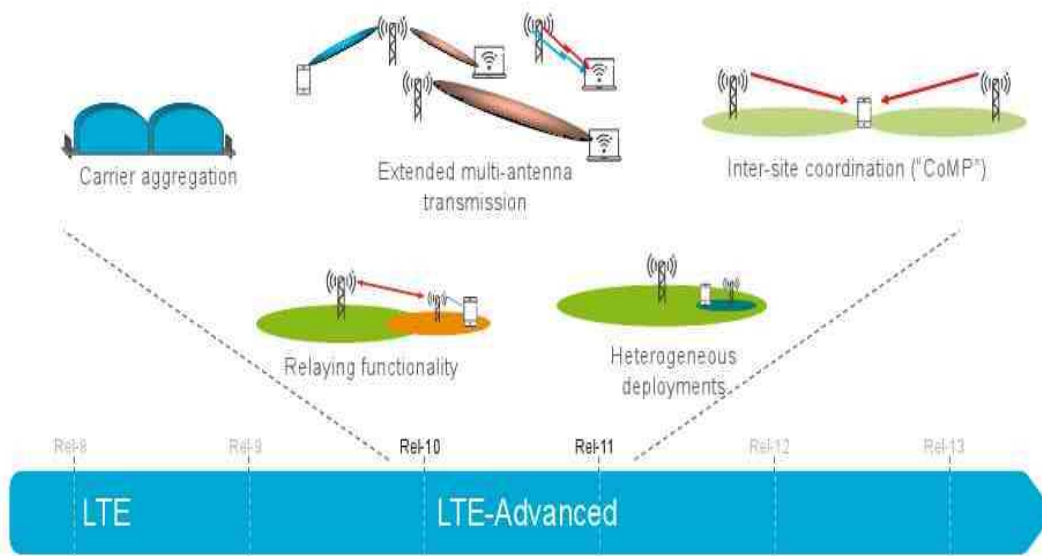
Heterogeneous Networks | Commercial in confidence | 2012-06-25 | Page 10

HETEROGENEOUS DEPLOYMENTS
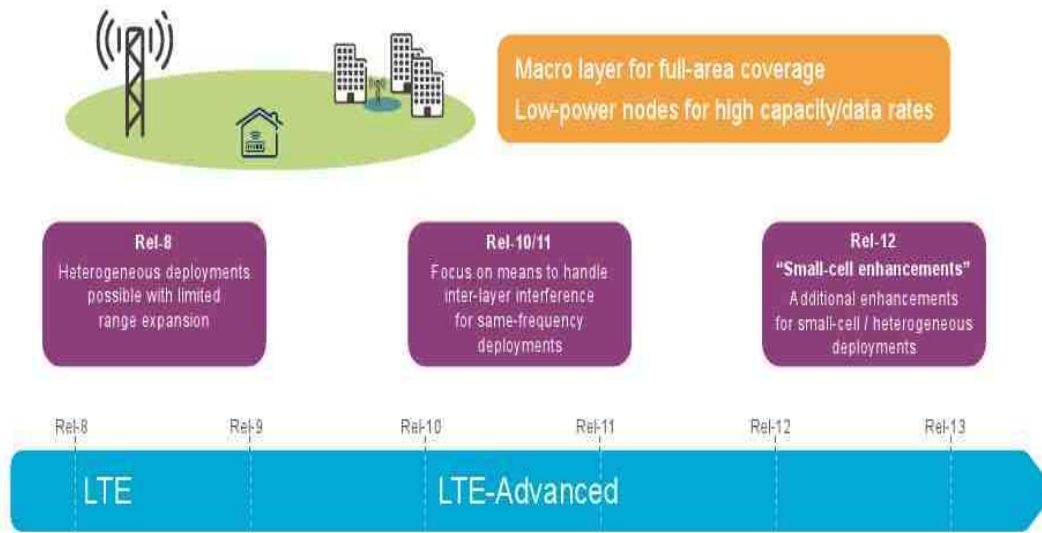
Macro layer for full-area coverage
Low-power nodes for high capacity/data rates

Rel-8
Heterogeneous deployments possible with limited range expansion

Rel-10/11
Focus on means to handle inter-layer interference for same-frequency deployments

Rel-12
"Small-cell enhancements"
Additional enhancements for small-cell / heterogeneous deployments

| Rel-8 | Rel-9 | Rel-10 | Rel-11 | Rel-12 | Rel-13 |

LTE   **LTE-Advanced**

HETEROGENEOUS NETWORKS

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APPLICATION COVERAGE

10 Mbps

1 Mbps

0.1 Mbps

SMS

App Coverage –
the area where my app works as I expect

MBB PERFORMANCE EUROPE

Mpbs

5

0

| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 |
| 2010 | | | | 2011 | | | | 2012 | | |

90th percentile

50th percentile
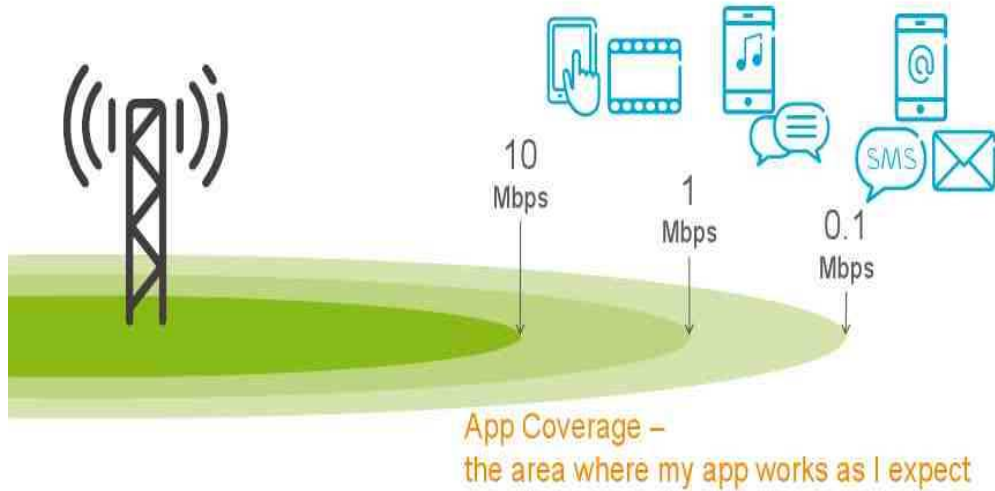
10th percentile
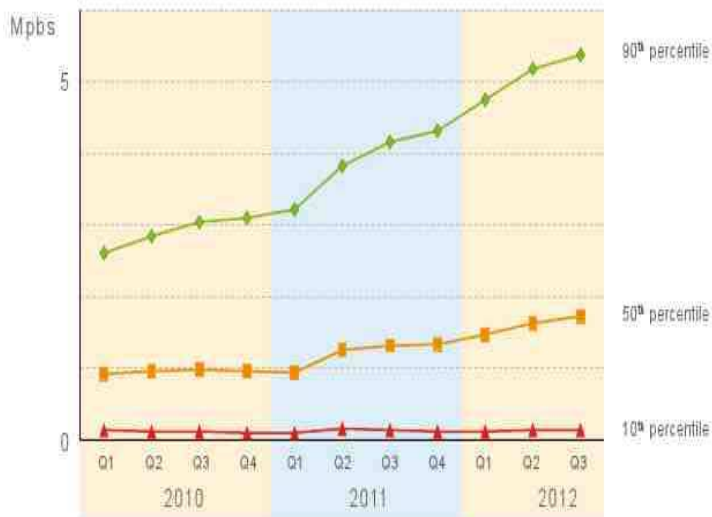
Increasing top and
median bit rates

The basic coverage
(≈0.1 Mbps) is more
or less flat over time

HOW TO PROVIDE APP COVERAGE

Improve	Densify	Add
existing sites with more spectrum, antennas, advanced processing, management and coordination	by adding macro sites	small cells, micro and pico
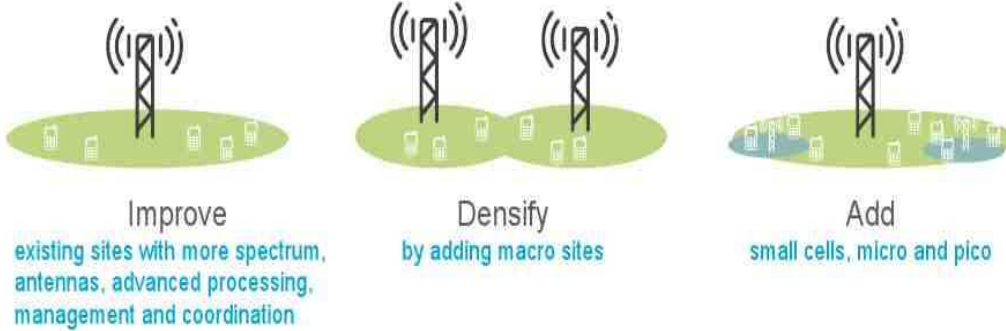
The Heterogeneous Network Toolbox

HETEROGENEOUS NETWORKS

Traffic density

≈ 50%

≈ 30%

≈ 15%

≈ 5%

Rural	Sub-urban	Urban	Dense urban
Improve	Improve Densify	Improve Densify Add	

IMPROVE

DENSIFY

ADD

Site distribution in a typical European country
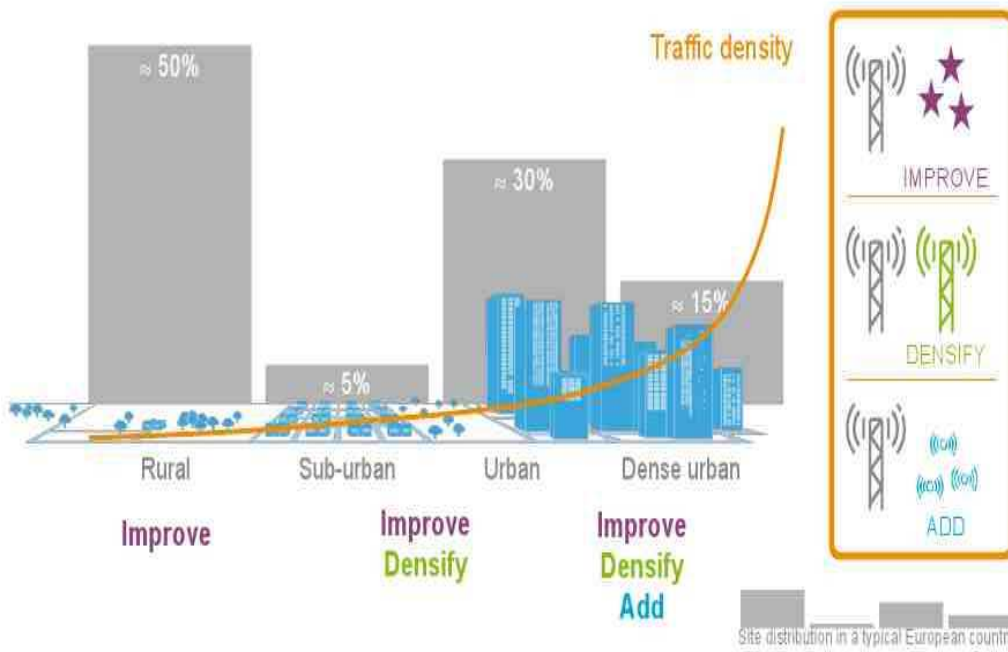
HOW REACH 100MBPS FOR ALL?
EXAMPLES

Improved Macro
2x20MHz → 2x200MHz
per operator

Densified macro
Two to sixteen times more
macro base stations

Small Cells
Add 3-24 pico base stations
(2W) per macro site

Reference: LTE FDD 2x20MHz (40W), dense urban, 300m ISD

WI-FI INTEGRATION

NOT SO SMART PHONE BEHAVIOR
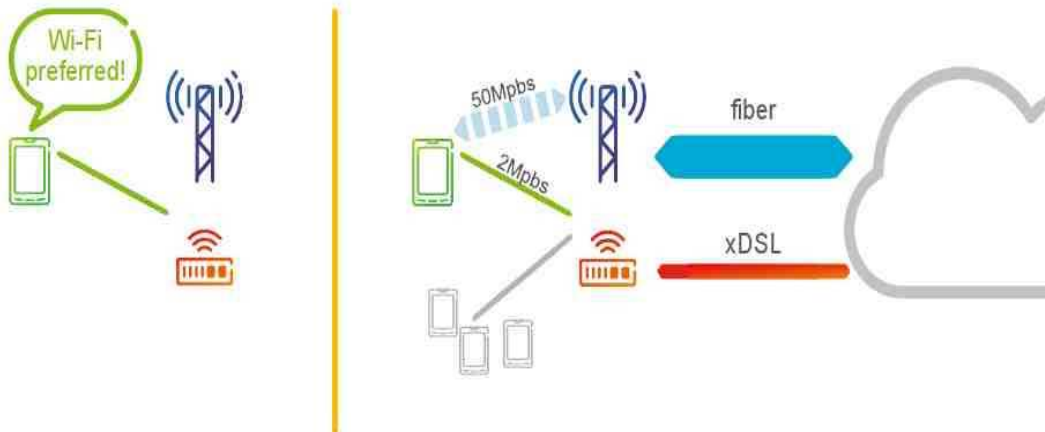
INDOOR CELLS

› What performance is achievable with indoor cells?
  – LTE only
  – WiFi only
  – combined LTE and WiFi
› Scenario – an office building
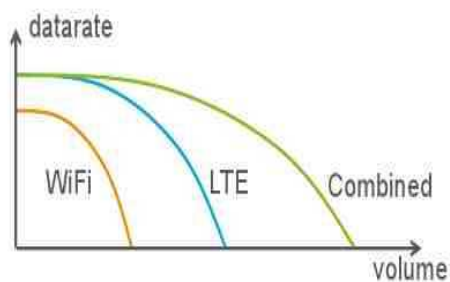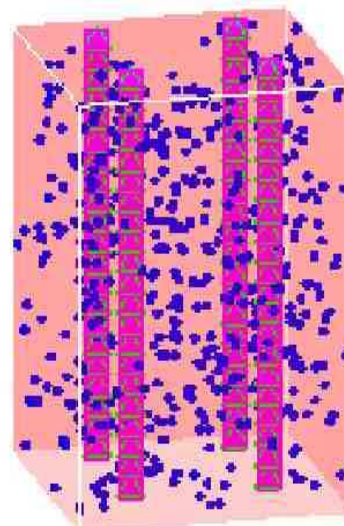
21-floor office building
40x40m floors
4 indoor cells per floor

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RESULTS

Downlink, 5th percentile / Uplink, 5th percentile

- Max user throughput selection
- LTE only, or Max P_rx
- Wi-Fi only, or Wi-Fi if coverage
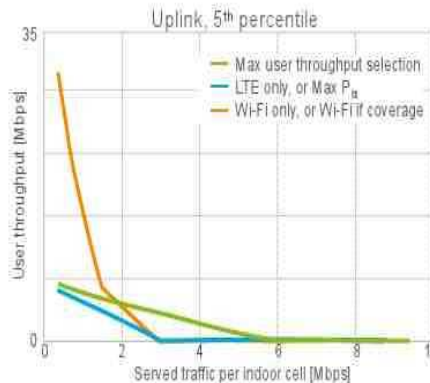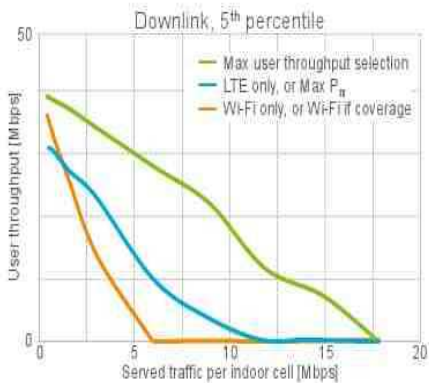
Access selection very important
"WiFi if coverage" → all users in WiFi – no gain over WiFi-only
Max P_rx → all users in LTE – no gain over LTE-only
Best performance achieved with max user throughput selection

WI-FI EVOLUTION TO HETEROGENEOUS NETWORKS
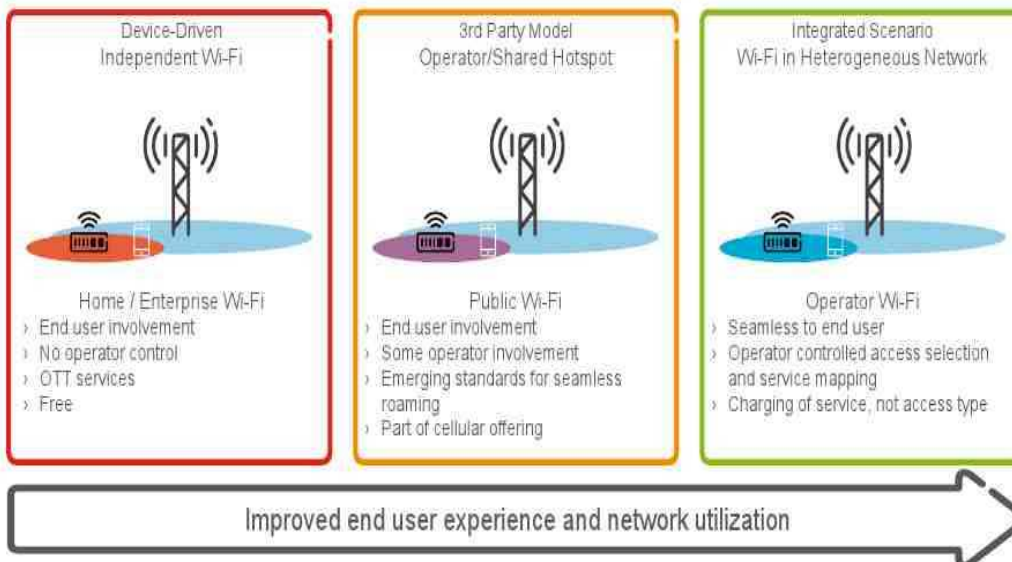
Device-Driven
Independent Wi-Fi

Home / Enterprise Wi-Fi
› End user involvement
› No operator control
› OTT services
› Free

3rd Party Model
Operator/Shared Hotspot

Public Wi-Fi
› End user involvement
› Some operator involvement
› Emerging standards for seamless roaming
› Part of cellular offering

Integrated Scenario
Wi-Fi in Heterogeneous Network

Operator Wi-Fi
› Seamless to end user
› Operator controlled access selection and service mapping
› Charging of service, not access type

Improved end user experience and network utilization

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附件七：「Technologies for new spectrum access」簡報

GLOBAL MOBILE TRAFFIC

2X

MOBILE DATA TRAFFIC
DOUBLED BETWEEN
Q1 2012 AND Q1 2013
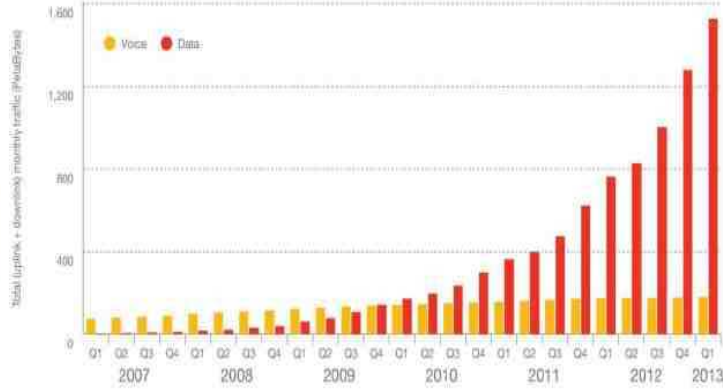
Based on actual measurements
Traffic does not include DVB-H, Wi-Fi, or Mobile WiMax
Voice does not include VoIP
M2M traffic is not included
Source: Ericsson (June 2013)

MOBILE DATA TRAFFIC FORECAST

12X

MOBILE DATA TRAFFIC
WILL GROW BY ~12 TIMES
BETWEEN 2012 AND 2018
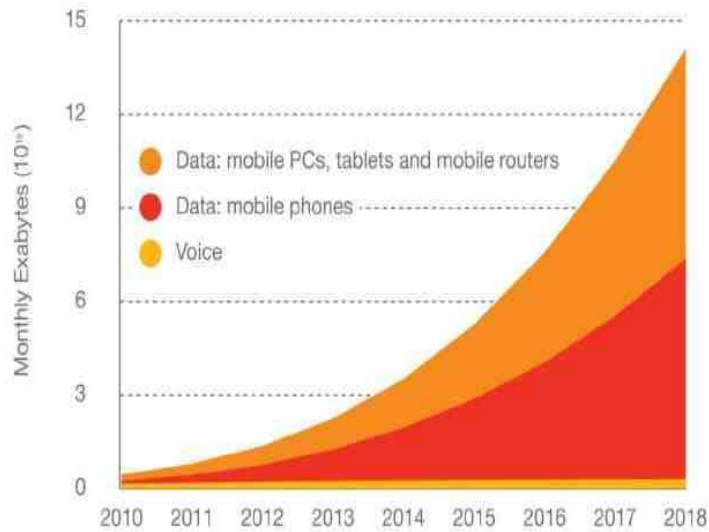
THE DIGITAL DIVIDE

› Year end 2012, there were more than twice as many mobile broadband subscriptions (~1.5 billion) compared to fixed broadband access (~0.6 billion)
  – the vast majority of Wi-Fi use is private wireless extension to fixed broadband

› By year end 2018 this ratio has increased to a factor of eleven
  – approx 7 billion mobile broadband subscribers vs. ~0.8 billion fixed / Wi-Fi

Mobile broadband key enabler to overcome the digital divide

Source: Ericsson (June 2013)

SPECTRUM UTILIZATION – NOW

Mobile bands

Relative power [dB]

Frequency [MHz]

Time [s]
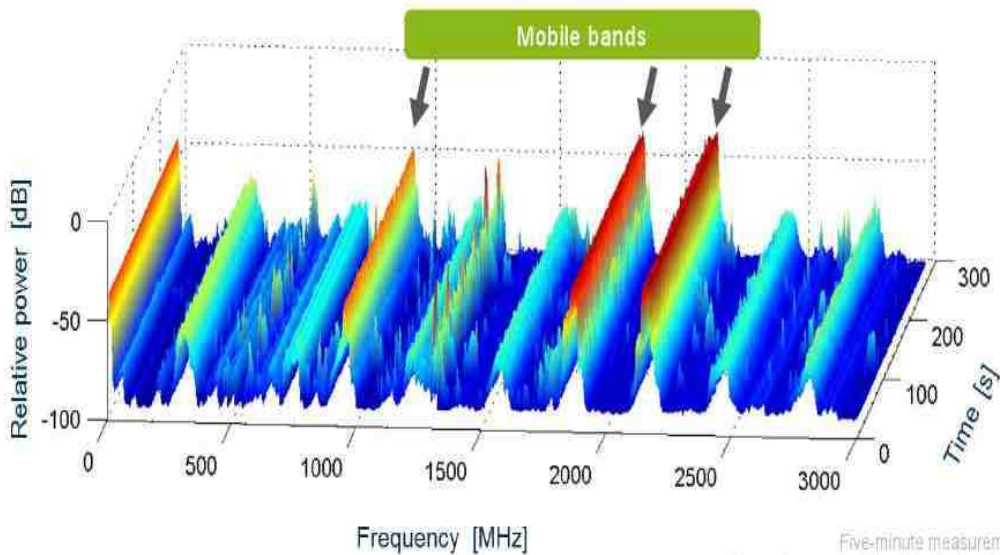
Five-minute measurement in office environment, Kista, Stockholm, Sweden (Feb 2009)

SPECTRUM USAGE PRINCIPLES

Licensed Dedicated

mainstream approach for MBB

350 MHz now, need 1500-2000 MHz

- Efficient for large area and population coverage
- Predictable quality of service
- Reliable at high load at all times
- Affordable, Economies of scale, High valuations

Unlicensed

dedicated to Wi-Fi

>500 MHz today

- Efficient for indoor / controlled environments and short ranges
- Unpredictable quality of service
- Reliable at low load, unreliable at high load

Licensed / Authorized Shared

complementary for MBB

- Fast unlocking of mobile spectrum
- Either-or usage between incumbent and licensee
- Predictable quality of service
- Protects incumbent, lends investment security

NEW MOBILE BANDS

Coverage and capacity   Capacity   Integrated Wi-Fi

Existing mobile
New mobile
Wi-Fi

300 MHz   1 GHz   2 GHz   3 GHz   4 GHz   5 GHz   6 GHz   Indicative
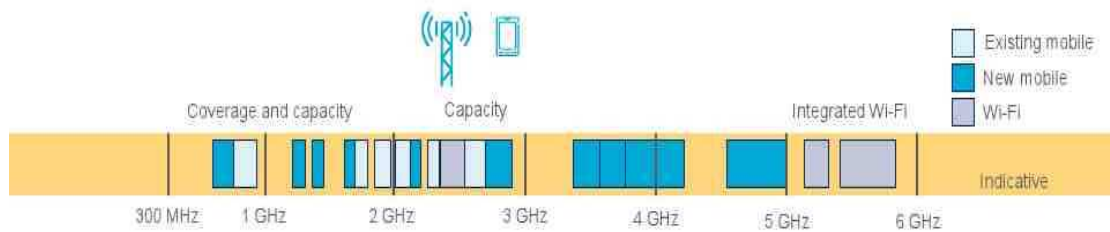
WRC-15

total spectrum need 1.5 – 2.0 GHz by 2020
→ 800-1000 MHz more

Key opportunities

600 MHz, 1.4 GHz, 2.7 GHz, 3.9 GHz

3.5 GHz – Global IMT/LTE-band,
40-100 MHz "carriers", "gigabit services"

Harmonization and global standards drive economies of scale

LTE ECO SYSTEM

Device support of LTE bands

2010	1 band
2011	2-3 bands
2012	5 bands
2013	6 and more
2014	12 -20 bands

ONE NETWORK – ADDING BANDS
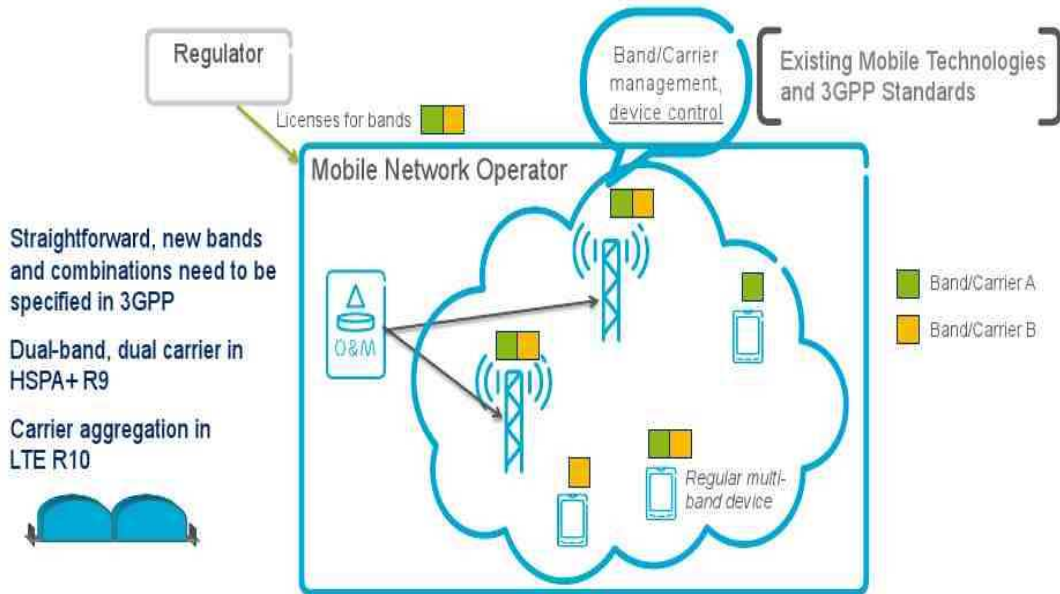
Regulator

Licenses for bands

Band/Carrier management, device control

Existing Mobile Technologies and 3GPP Standards

Mobile Network Operator

Straightforward, new bands and combinations need to be specified in 3GPP

Dual-band, dual carrier in HSPA+ R9

Carrier aggregation in LTE R10

O&M

Regular multi-band device
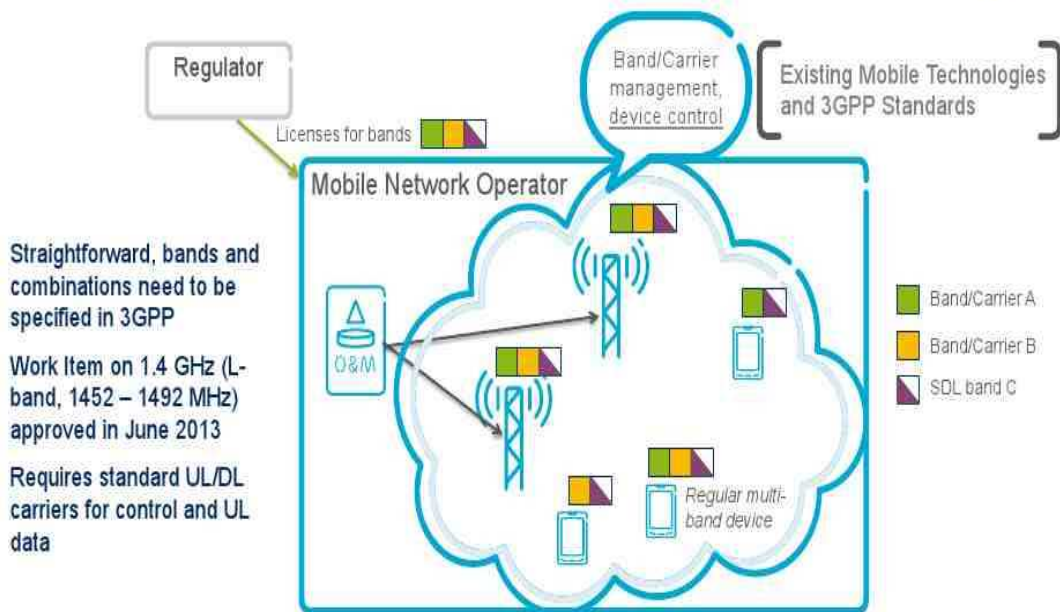
Band/Carrier A

Band/Carrier B

SUPPLEMENTAL DOWNLINK

› Supplemental Downlink (SDL)
- faster downloads, more users, enhanced user experience
- supports "video traffic pattern" (66% of mobile traffic in 2015)
- simple regulatory introduction (existing framework, fixed BS Tx)
› L-band 1.4 GHz (1452-1492 MHz)
- key opportunity in Europe to increase rural capacity and data rates
- harmonization ongoing in Europe
› 700 MHz in the US with AT&T
- planned launch as early as 2014
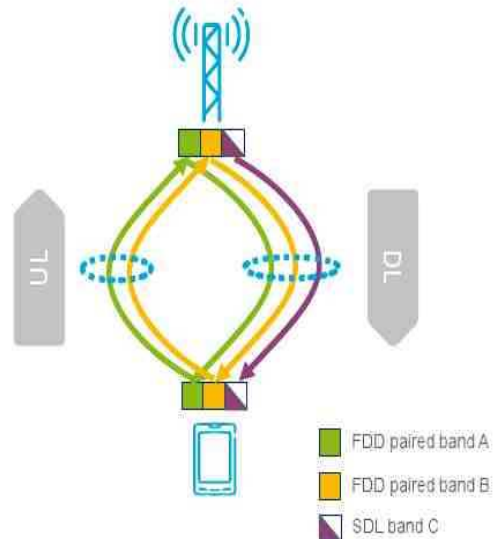
UL

DL

FDD paired band A
FDD paired band B
SDL band C

ADDING SUPPLEMENTAL DL BAND

Regulator

Band/Carrier management, device control

Existing Mobile Technologies and 3GPP Standards

Licenses for bands

Mobile Network Operator

Straightforward, bands and combinations need to be specified in 3GPP

Work Item on 1.4 GHz (L-band, 1452 – 1492 MHz) approved in June 2013

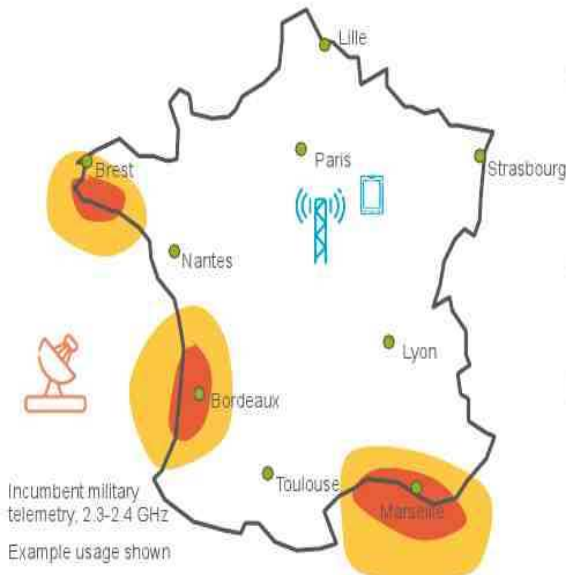**Requires standard UL/DL carriers for control and UL data**

O&M

Regular multi-band device

Band/Carrier A
Band/Carrier B
SDL band C

Extended coverage / range with higher Tx power and lower frequency

LICENSED/AUTHORIZED SHARED
UNLOCKING MOBILE SPECTRUM

Incumbent military
telemetry, 2.3-2.4 GHz

Example usage shown

› For harmonized mobile spectrum
  – low or localized utilization
  – not obtainable in reasonable time due to
    incumbent use (military, radar, satellite)
  – use existing mobile eco-system
› Examples
  – 2.3-2.4 GHz in Europe, 3GPP band 40
  – 3.5 GHz in US
› Incumbent protection
  – single sharing user, either/or usage
  – reliable enforcement of conditions
  – higher frequency facilitates sharing

LSA/ASA ARCHITECTURE

Straightforward, existing
bands and and multiband
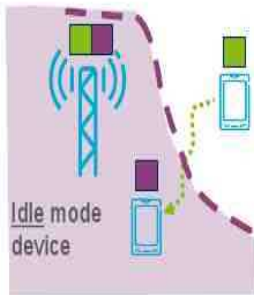devices

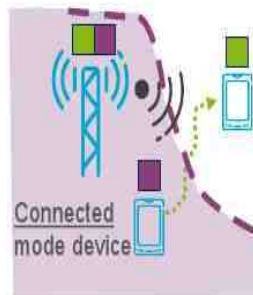New regulatory framework;
secure, reliable database
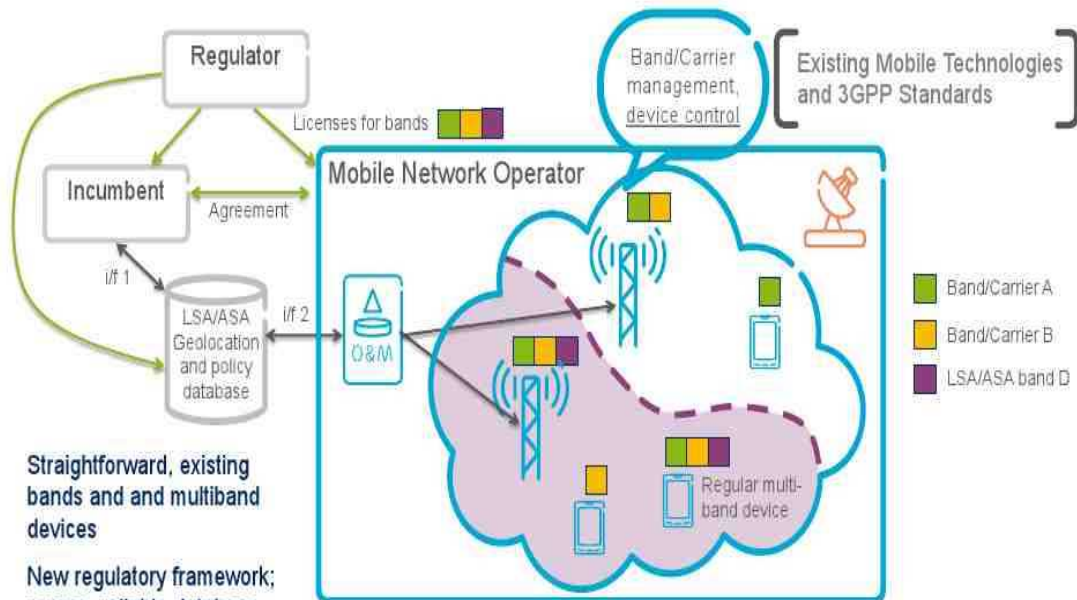
LSA/ASA BAND USE CONTROL

Reselection procedures 3GPP TS 36.304	Inter-frequency handover 3GPP TS 36.331	Carrier aggregation 3GPP TS 36.808, 36.823

Idle mode device

Connected mode device

Connected mode device with CA support

Camping on LSA/ASA band

Vacating LSA/ASA band
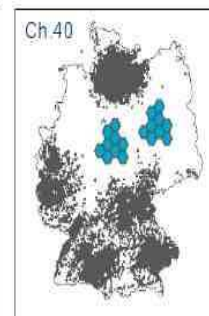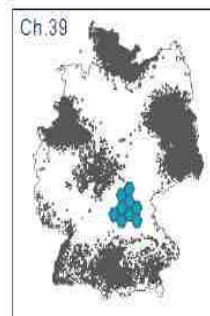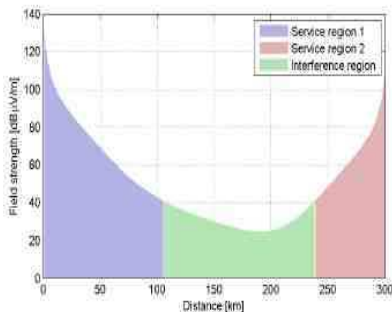Can be completed in < 1s
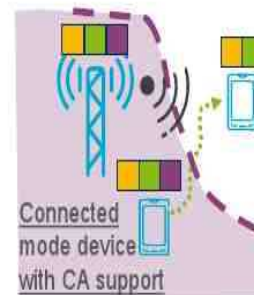
Vacating LSA/ASA band by releasing aggregated carrier

Existing Mobile Technologies and 3GPP Standards

Functionality and quality of service relies on dedicated carriers for control and data

TV WHITE SPACE

Ch.21

Ch.39

Ch.40

Field strength [dBµV/m]
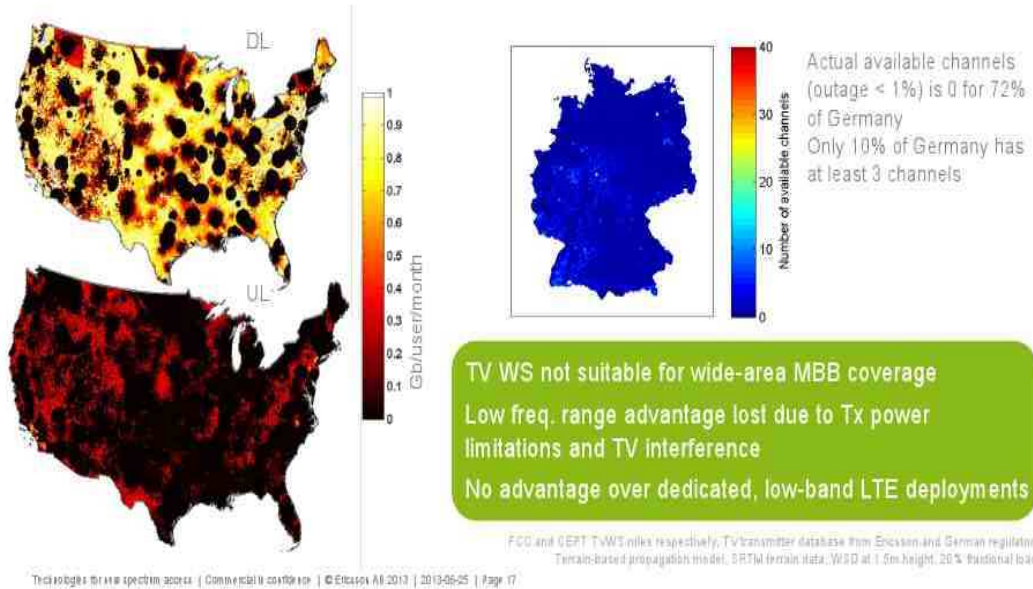
Service region 1
Service region 2
Interference region

Distance [km]

How much white space is available for an LTE network?

How well does a LTE network perform in white space, and what are the limiting factors?

LTE IN TV WS
DEPLOYMENT FOR COVERAGE

DL

UL

Gb/user/month

Actual available channels
(outage < 1%) is 0 for 72%
of Germany
Only 10% of Germany has
at least 3 channels

TV WS not suitable for wide-area MBB coverage

Low freq. range advantage lost due to Tx power
limitations and TV interference

No advantage over dedicated, low-band LTE deployments

FCC and CEPT TvWS rules respectively, TV transmitter database from Ericsson and German regulator,
Terrain-based propagation model, SRTM terrain data, WSD at 1.5m height, 20% fractional load

Technologies for new spectrum access | Commercial in confidence | © Ericsson AB 2013 | 2013-06-25 | Page 17

SPECTRUM COMPLEMENTS

Licensed, dedicated mobile

Supplemental Downlink (SDL)
complementing coverage and capacity

Licensed / Authorized Shared mobile
unlocking spectrum – complementing coverage and capacity

Unlicensed spectrum, Wi-Fi
complementing short range capacity

Existing mobile technologies and 3GPP standards enable increased
spectrum flexibility and sharing, and maximize spectrum utilization

Technologies for new spectrum access | Commercial in confidence | © Ericsson AB 2013 | 2013-06-25 | Page 18

附件八：「LTE Broadcasting」簡報

REGULATORY & MARKET CONTEXTS

Some early mobile broadcasting technologies did not gain market acceptance (DVB-H, MediaFlo)

FCC have decided to make 120MHz of the UHF TV broadcast spectrum available for mobile broadband

WRC-12 decided to allocate the 700MHz band also to the mobile service on a co-primary basis by 2015

EBU has started a strategic programme Cooperative Terrestrial Networks (CTN) with participation from companies like Ericsson, Qualcomm, ALu, NSN

LTE Broadcasting has been demonstrated at MWC 2012

Verizon announced launch for 2014

Increasing interest from mobile operators

LTE-BROADCASTING OVERVIEW

LTE Broadcasting uses LTE-MBMS
Multimedia Broadcast/Multicast Service
LTE-MBMS a.k.a eMBMS (evolved MBMS)

USE CASES

Linear TV & Instant delivery

Deliver high interest live content to many users with secured QoS, over defined areas

UE caching – pushed content

Broadcast (Podcast) most popular video, apps and webpages to device cache. Broadcast SW upgrades.

Local mass content distribution

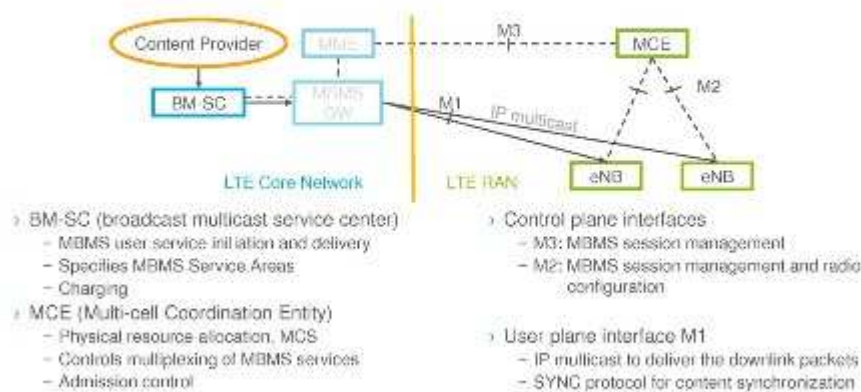Broadcast most popular content in the geographical areas it makes sense.

CODECS AND TOOLS

CODECs

audio: E-AAC+ or AMR-WB+

video: H.264; H.265 in adoption phase

Streaming delivery method for continuous reception

re-use of existing streaming protocols (i.e. RTP)

Download delivery method for file distribution

IETF file distribution protocols FLUTE and ALC

also used for stream delivery based on DASH

Service access protection

terminal/user authentication

key management via MIKEY

EMBMS OVERALL ARCHITECTURE

> BM-SC (broadcast multicast service center)
>   - MBMS user service initiation and delivery
>   - Specifies MBMS Service Areas
>   - Charging
> MCE (Multi-cell Coordination Entity)
>   - Physical resource allocation, MCS
>   - Controls multiplexing of MBMS services
>   - Admission control

> Control plane interfaces
>   - M3: MBMS session management
>   - M2: MBMS session management and radio configuration

> User plane interface M1
>   - IP multicast to deliver the downlink packets
>   - SYNC protocol for content synchronization

QUALITY OF SERVICE

> eMBMS traffic uses reserved resources
>   - guaranteed bitrate defined in service level agreement

> Very low error rate streaming using application layer Forward Error Correction

> Reliable file distribution using MBMS specific retransmissions

> Reception Reporting
>   - error rates with cell level granularity
>   - audience statistics

EMBMS RADIO INTERFACE
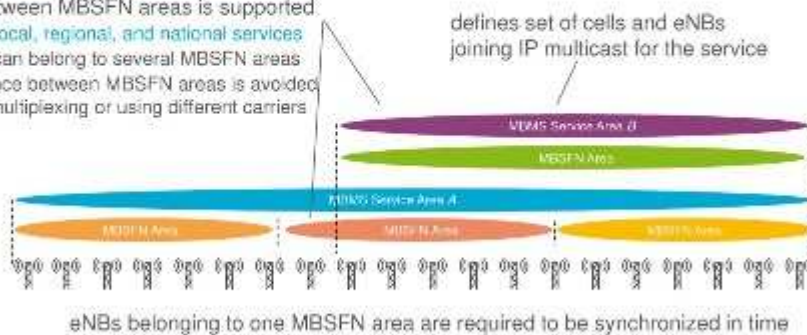
> eMBMS time multiplexed with unicast traffic
  – up to 6 out of 10 subframes can be dedicated to eMBMS

> Supported for both FDD and TDD LTE
  – for LTE-FDD, subframes for MBMS in downlink can be used for unicast in uplink

> Uses OFDM, like DVB-T and ISDB-T, put parameters differ

> Single Frequency Network (MBSFN) transmission

MBMS SERVICE AREA/MBSFN AREA

> Overlap between MBSFN areas is supported
  – enables local, regional, and national services
  – one cell can belong to several MBSFN areas
  – interference between MBSFN areas is avoided by time multiplexing or using different carriers

defines set of cells and eNBs joining IP multicast for the service

eNBs belonging to one MBSFN area are required to be synchronized in time

CONTINUOUS LIVE VIDEO

> Ericsson LTE Broadcast uses "MPEG-DASH over eMBMS"
  – DASH has been developed as a unified solution for unicast video delivery
  – In case of LTE Broadcast, BM-SC sends continuous flow of stream segment files
  – Only one format transmitted for all receivers

> AL-FEC is added for each DASH segment

> Benefits
  – same live encoder for unicast and LTE Broadcast
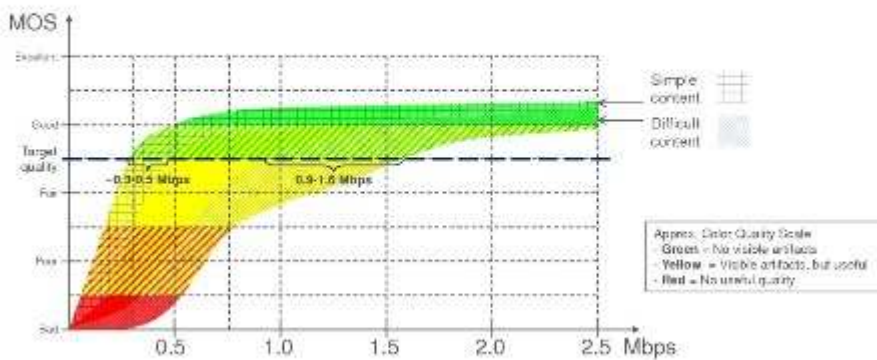 – same protocol stack & system for live video and other file delivery applications

DASH: Dynamic Adaptive Streaming over HTTP
(ISO/IEC 23009-1 and 3GPP TS 26.247)

VIDEO QUALITY VS. VIDEO BITRATE
SMARTPHONE H.264 480P (864*480)

HEVC (H.265) VIDEO COMPRESSION
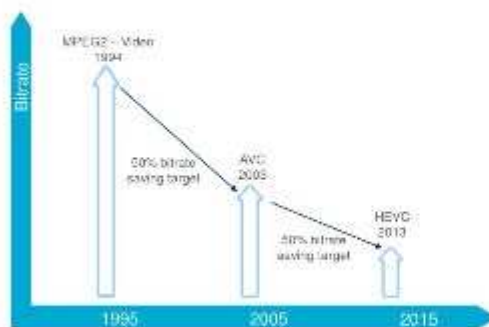
Twice the video quality or twice the amount of users

As important as the step between MPEG2 to H.264

HEVC being adopted for eMBMS

FREQUENCY LAYERS

› eMBMS can be used for operator specific services as well as general-interest TV.
› General-interest TV content could be accessible independent of MNO subscription.
› Unicast capacity on these carrier frequencies can be used for medium-small audience TV programs, as well as TV-associated non-linear services.
› Need to ensure UE is reachable in home network while receiving on TV carriers.

"TV"; MNC3
roaming; "carrier aggregation"
MNO2; MNC2
MNO1; MNC1
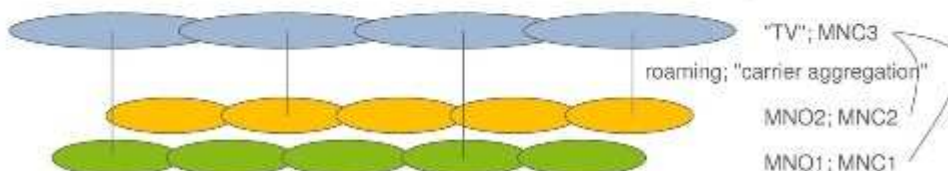
TV SPECTRUM REQUIREMENTS FOR GERMANY USING HYBRID BROADCAST/UNICAST

TV PROGRAM VIEWING SHARES

> 50% of viewing for 5 programs

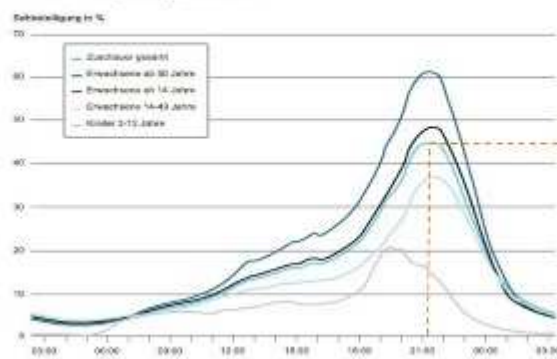> At any point in time, viewing is concentrated on even fewer programs

Figures are 5-day averages

SHARES VS COURSE OF A DAY

> Peak viewing:
> 45% of population
> (at 21:15 o'clock)

79

BANDWIDTH REQUIREMENTS

#people per cell (all MNOs)	BC viewing threshold %	#BC Prog		Bandwidth for SDTV HEVC [MHz]		Bandwidth for HDTV (720p) HEVC [MHz]	
				0.5Mb/s (low)	1.0Mb/s (high)	2.0Mb/s (low)	4.0Mb/s (high)
Scenario 1							
1440			UC total	10.8	21.5	43.1	86.1
	5	7	BC	2.2	4.4	8.8	17.5
			UC total + shared BC	13.0	25.9	51.8	103.6
Scenario 2							
720			UC total	8.55	17.1	34.2	68.4
	10	4	BC	1.3	2.5	5.0	10.0
			UC total + shared BC	9.8	19.6	39.2	78.4

- Disclaimer: Results very much depend on parameters, sensitivity analysis ongoing
- 25% viewing via terrestrial access (current localized peak DVB-T share)
- Spectral efficiency: UC: 2.4b/s/Hz; BC: 1.6b/s/Hz
- Broadcast program if # users per geographic cell exceeds 2
- Scenario 1: extremely dense city 20kpop/km², current network inter-site-distance of 500m
  - MBSFN configured for cell with most users
- Scenario 2: only 1/2 pop of scenario 1 in reference cell. Either due to densification or because more realistic to not configure MBSFN based on cell covering highest number of people

SUMMARY

LTE Broadcast is integrated in the LTE standard
No added hardware complexity in base station and device

State-of-the-art technology included:
H.265 and MPEG-DASH

Spectrum saving for TV distribution – small cell unicast complemented by top interest true SFN broadcast

LTE-BROADCAST DEMO KIOSK

3 programs including football, car racing and e-learning

Each program is broadcast for 5 minutes

附件九：「5G The next frontier」簡報

SMARTPHONES

Beginning of 2013, the number of smartphone subscriptions was

1.2
billion

By 2018 the number of smartphones will increase to

4.5
billion

MOBILE BROADBAND

Mobile broadband subscriptions in the beginning of 2013

1.7
billion

By 2018 the number of mobile broadband subscriptions will be

7.0
billion
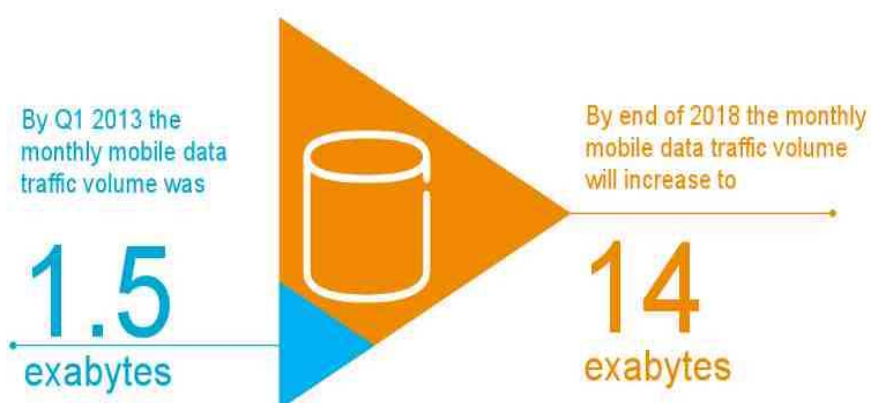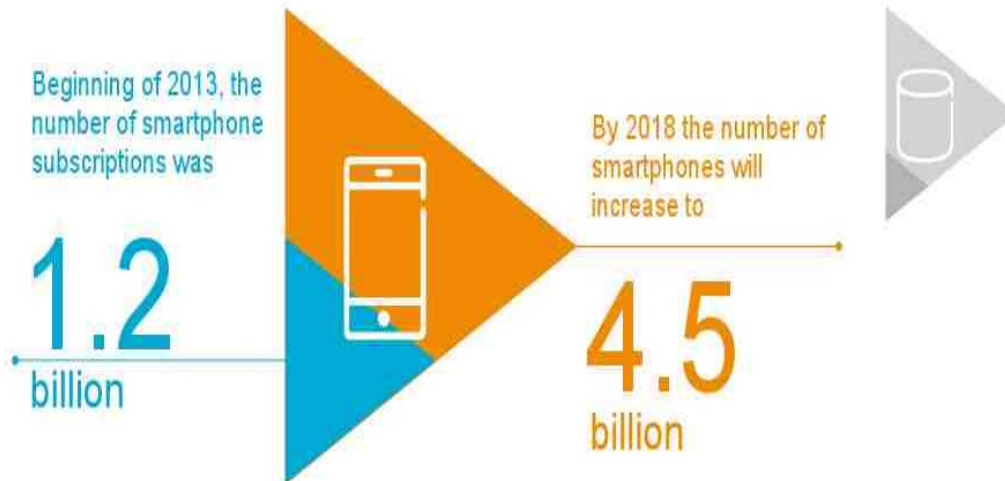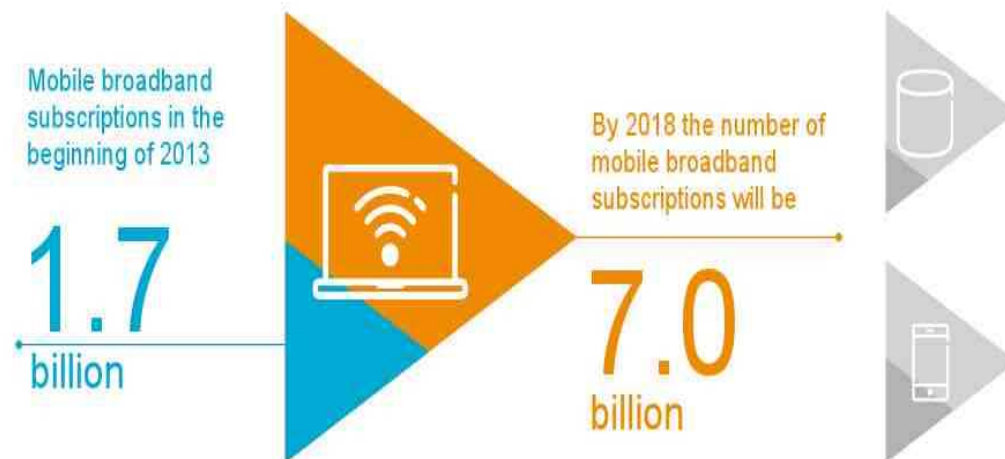
OPERATOR-CENTRIC TO USER-DRIVEN LANDSCAPE
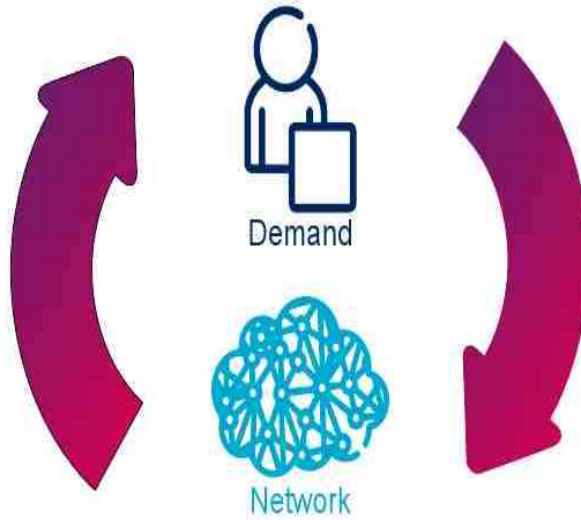
Demand

Network

THE NETWORKED SOCIETY

Devices
Services
Management
Security
Sustainability
Network
Cloud

Wireless Connectivity is key

KEY CHALLENGES

Massive growth in **Traffic Volume**	Massive growth in **Connected Devices**	Wide range of **Requirements & Characteristics**
>1000x		speed latency, power, coverage

Affordable and sustainable

DIVERSIFIED WIRELESS ACCESSES

Spectrum toolbox
Licensed
Controlled sharing
Unlicensed

300 MHz	3 GHz	30 GHz	300 GHz

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5G WIRELESS ACCESS

5G
=

evolution of existing standards

+

complementary new technologies

1990   2000   2010   2020

GSM

Wi-Fi

3G

4G

New wireless technologies

5G

COMPONENTS AND ASPECTS

Small cell technologies & Ultra Dense Networks

Power consumption and sustainability

Antenna Technologies

Resilience, security and privacy

Management

Spectrum

5G RESEARCH

› METIS
  – large EU project, 29 partners, 80 FTE
  – 2012 – 2015
  – initiated and led by Ericsson

› Lay the foundation for 5G through exploring fundamentals, develop system concepts and test beds

› Alignment of the industry and regulatory bodies

METIS CONSORTIUM

Five vendors
Alcatel-Lucent, Ericsson, Huawei, Nokia, NSN

Five operators
Deutsche Telekom, DOCOMO, Orange, Telecom Italia, Telefonica

Thirteen academic organizations
AAU, Aalto, CTH, HHI, KTH, NKUA, Oulu, PUT, RWTH, TB, UB, UKL, UPV

Automotive Industry
BMW
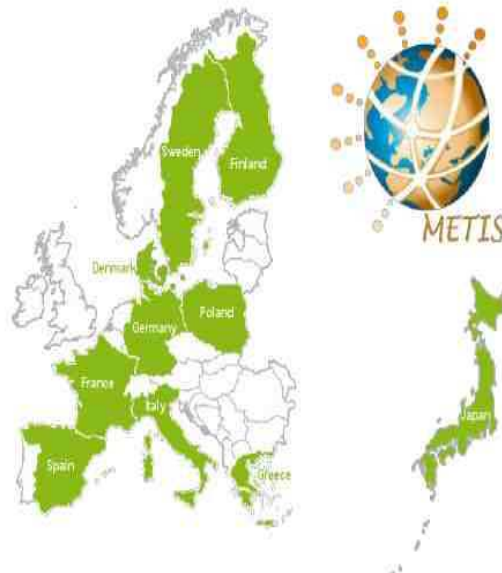
FIVE CHALLENGES

Amazingly fast — **Very high data rate**

Great service in a crowd — **Very dense crowds of users**

Super real-time and reliable connections — **Very low latency**

Ubiquitous things communicating — **Very low energy, cost, and massive number of, devices**

Best experience follows you — **Mobility**

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CROWD OF USERS

› Extreme traffic densities
› Very dense urban environments
  – stadiums, festivals
› Unexpected gatherings both in location and time
  – traffic jams
  – disasters

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SUPER REAL-TIME AND RELIABLE

› Low delay and reliable communication enabling critical machine-type applications

› Empowering industries to embrace new technologies in their processes

Very high data rate

Very dense crowds of users

Very low energy, cost, and massive number of devices

Very low latency

Mobility

METIS OBJECTIVES

1000x higher mobile data volumes

10-100x higher number of connected devices

10-100x typical end-user data rates

5x lower latency

10x longer battery life for low-power devices
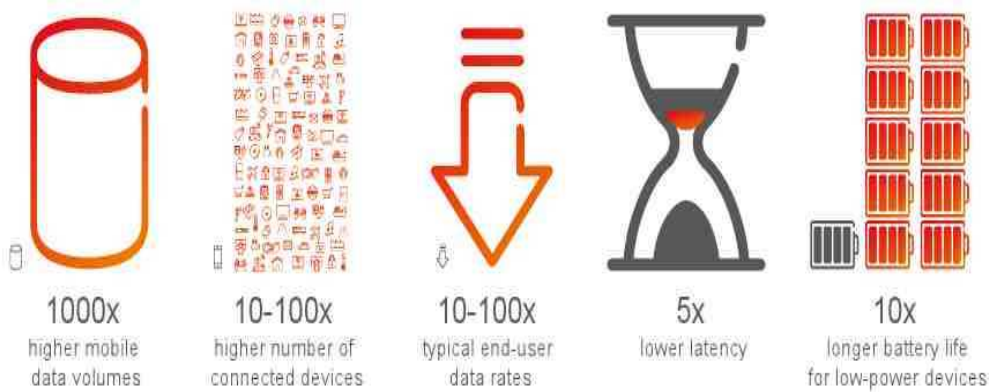
Develop a concept for future mobile and wireless communications system that supports the connected information society

SUMMARY

Tremendous growth in Mobile Broadband
The world is transforming to the Networked Society
Research activities for the 5G technologies have already started

附件十：「PTS recent and coming licensing of spectrum」簡報

The PTS spectrum policy
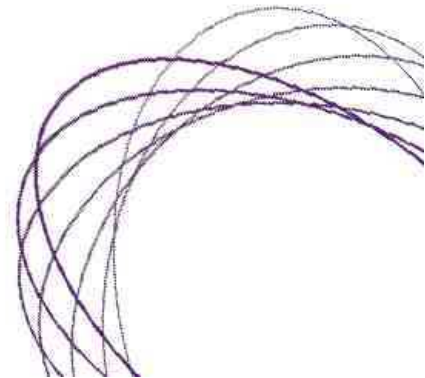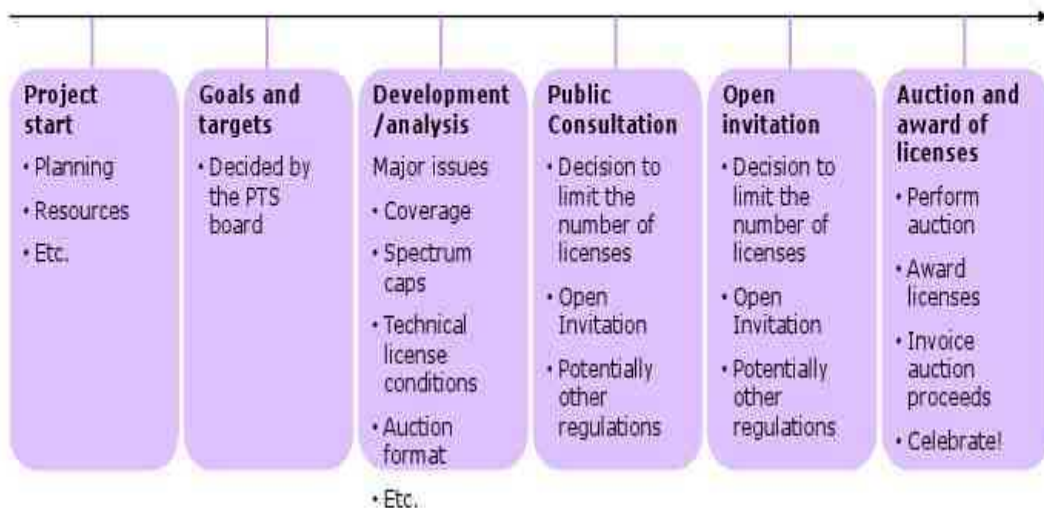
- Licences to use radio transmitters shall be as **technology and service neutral** as possible

- When selection procedures are required, an **auction** should be applied in the first instance

- **Second-hand trading** (transfer of licences) shall be promoted

- **Licence exemption** should be introduced where there is little risk of harmful interference and there are no other impediments

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The overall auction process

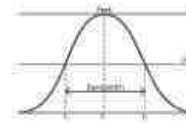| Project start	Goals and targets	Development /analysis	Public Consultation	Open invitation	Auction and award of licenses
• Planning • Resources • Etc.	• Decided by the PTS board	Major issues • Coverage • Spectrum caps • Technical license conditions • Auction format • Etc.	• Decision to limit the number of licenses • Open Invitation • Potentially other regulations	• Decision to limit the number of licenses • Open Invitation • Potentially other regulations	• Perform auction • Award licenses • Invoice auction proceeds • Celebrate!

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Auction Design

Spectrum Caps

Bandwidth FDD/TDD

Technical License Conditions
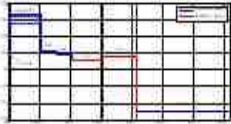
License Duration

Open Invitation Decision to limit the number of licenses Regulations

Coverage Obligations

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Generic Auction Plan

Year 1

Project start	Hearing 1	Goals and targets by PTS Board	Hearing 2	Public consultation and survey of interest
January	April	June	September	October

Year 2

Hearing 3	Public consultation of Open Invitation	Decision on Public Invitation	Auction
March	May	September	November

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10 Auctions to date in Sweden

• 2005	450 MHz	SRSB
• 2007	3.6-3.8 GHz	SMRA with switching
• 2008	2.6 GHz	SMRA with switching
• 2008	1900-1905 MHz	SRSB
• 2009	3.6-3.8 GHz	Combinatorial SRSB
• 2009	28 GHz	Combinatorial Clock
• 2011	800 MHz	SMRA with switching
• 2011	1800 MHz	Clock auction + SRSB
• 2011	3.5 GHz	SRSB
• 2011	10.5 GHz	Combinatorial SRSB

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The 2,6 GHz auction - 2008

- A total of 190 MHz was licensed (2500-2690 MHz)
- 14 lots of paired spectrum (2*5 MHz)
- 1 lot of unpaired spectrum (50 MHz)
- Service and technology neutral
- Spectrum cap of 140 MHz
- No roll-out obligation
- Anonymous bidding
- Online SMRA with switching
- Sweden first in the EU (Norway beat us to it…)

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The 2,6 GHz auction

- Auction ended after 112 rounds on May 8
- Total amount SEK 2.1 billion (EUR 226 million)
- Five bidders applied to the auction
- The following bidders won licenses in the auction (auction proceeds):
  - HI3G Access AB (SEK 296,600,000)

    Intel Capital Corporation (SEK 159,250,000)

    Tele2 Sverige AB (SEK 548,100,000)

    Telenor Sverige AB (SEK 533,050,000)

    TeliaSonera Mobile Networks AB (SEK 562,450,000)

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Development during the auction

Sum of Standing High Bids per Bidding Round - auction end
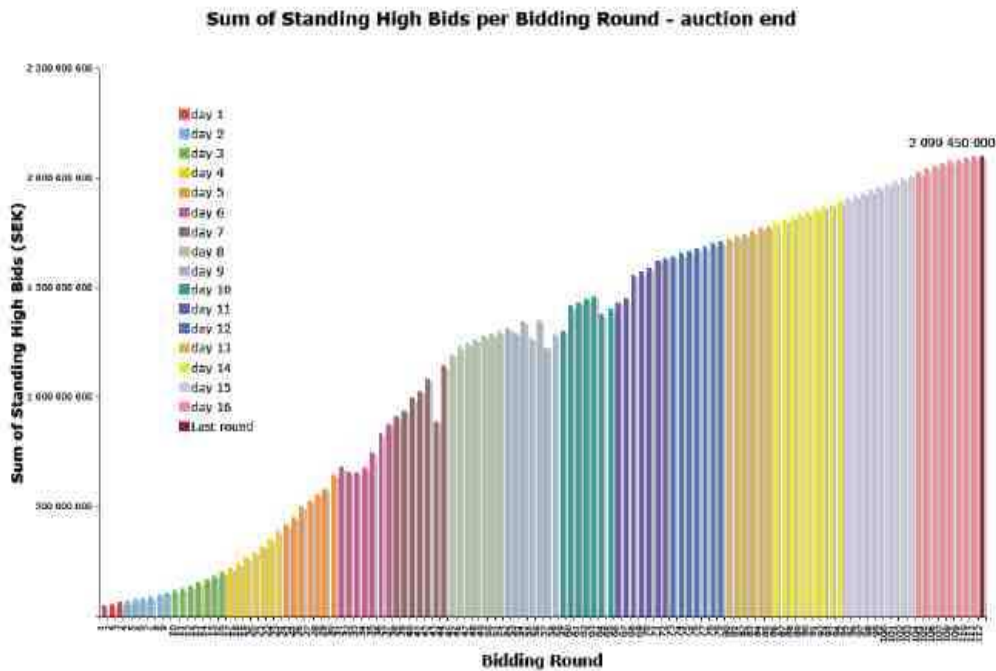
The 800 award in Sweden - 2011

- National licenses
- Six licenses (2x5 MHz)
- Duration of licenses: 25 years
- Service and technology neutral license conditions
- A maximum of two licenses per license holder
- Technical conditions in line with international harmonisation
- License conditions to not cause interference to reception of terrestrial TV under 790 MHz

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The 800 award in Sweden

- Auction format similar to the Swedish 2.6 GHz auction (SMRA with switching)
- Starting bid was SEK 150 M per license
- Coverage obligations for one of the licenses:
  - License holder shall cover households and working places that do not today have basic possibilities for broadband (today approx. 1100)
  - License holder promises to invest in coverage up to a certain level (in the range SEK 150 – 300 M)

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The 800 award in Sweden

Sum of Standing High Bids per Bidding Round
Day 5 - Auction End
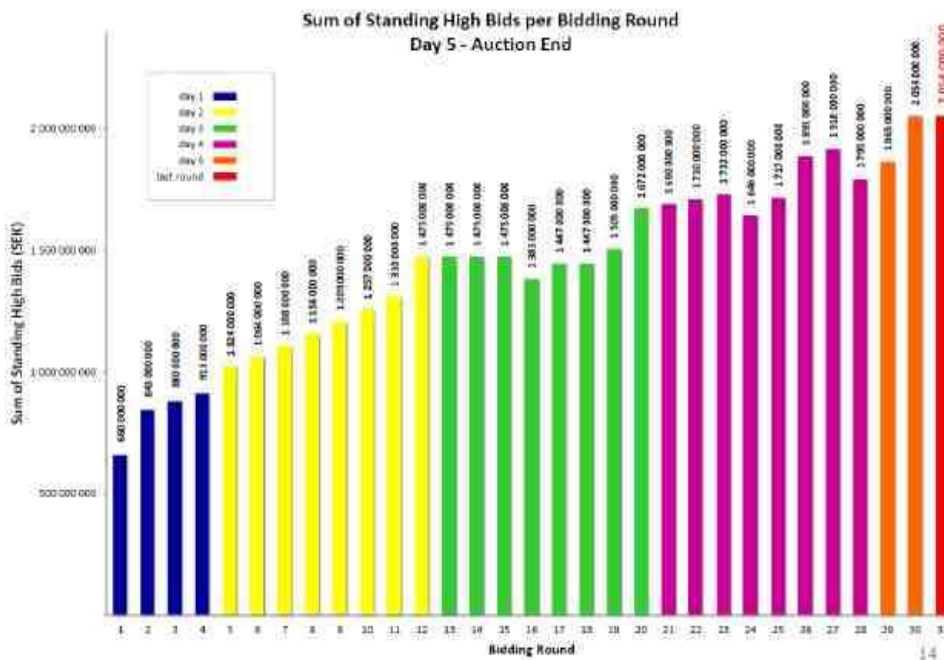
The 1800 award in Sweden - 2011

- Fragmented (2*67 MHz licensed to 4 operators. 2*8 MHz empty)

- 2*35 MHz prolonged (3 operators 2*10 MHz and one 2*5 MHz)

- 2*35 MHz auction (7 blocks 2*5 MHz)

- 2*5 MHz license exempted

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The 1800 award in Sweden - 2011

- License start by January 2013
- No spectrum cap, service and technology neutral, no coverage obligation
- 25 years duration
- Auction to assign spectrum of 2×35 MHz, license holders in the band 2x35 MHz
- 2x5 MHz to be license exempt
- Clock auction in two stages
  - During the first stage 2×35 MHz will be split between auction participants
  - Placement determined during second stage (comprises 2×70 MHz)
    - Winning bidders from first stage and previous license holders
- Consecutive spectrum guaranteed

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The 1800 award in Sweden
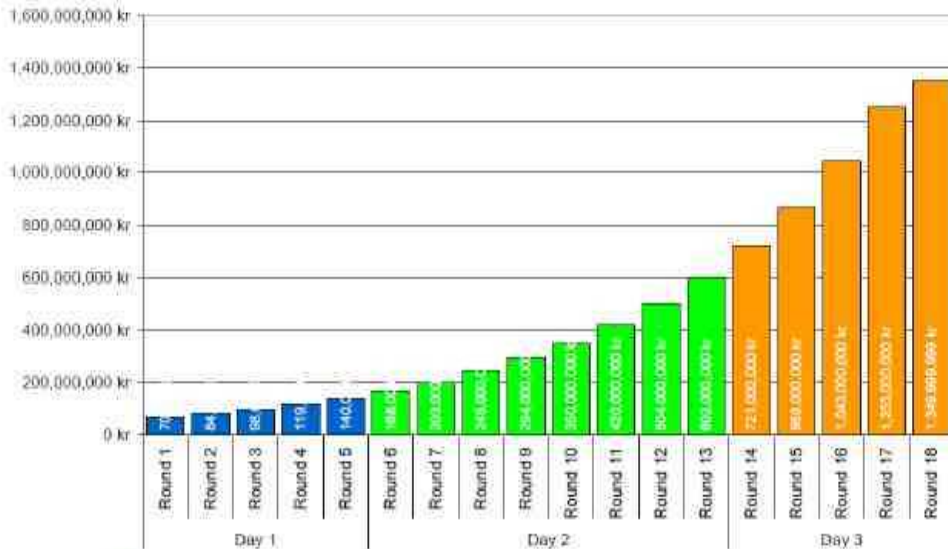
Current LTE coverage in Sweden
(800 MHz, 900 MHz, 1800 MHz & 2.6 GHz)

- First LTE network in the world launched in Stockholm Dec 2009
- First transmission over the LTE 800 band in June-11
- 93 % population coverage (Oct 2012)
- Operators have promised 99% population and 90% area coverage in LTE (not a license condition)
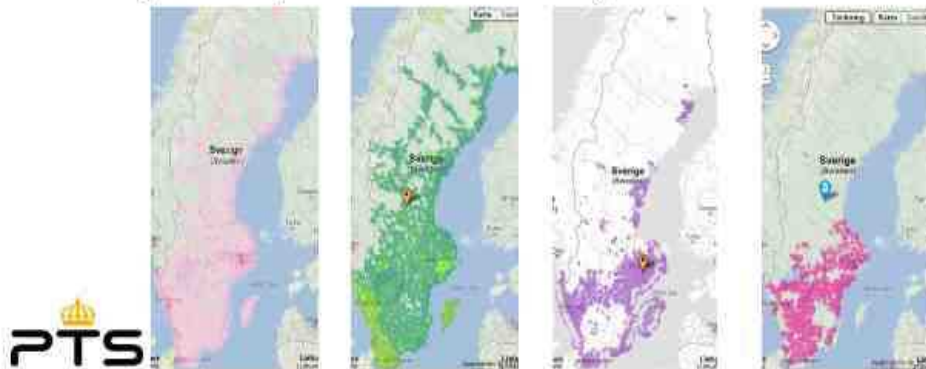
Frequency bands for block licenses, existing and planned

附件十一：「PTS long term spectrum strategy work」簡報

Spectrum seminar by PTS

PTS long term spectrum strategy work

Ylva Mälarstig
Chief adviser, Spectrum Department

PTS
Swedish Post and Telecom Authority
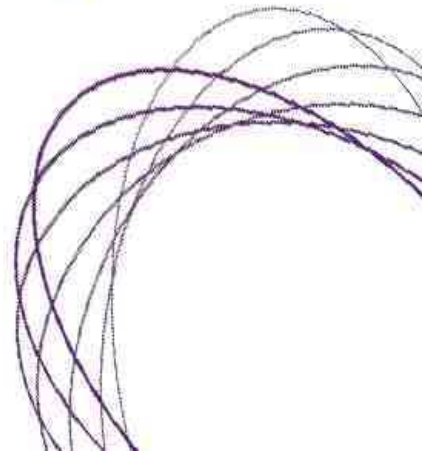
PTS' Goals

- Everyone should have access to good telephony, broadband and postal services
- Efficient utilisation of limited resources, such as frequencies and numbers
- Functioning competition in the market, resulting in a good range of options and low prices for consumers
- Networks and services are reliable and secure.

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Explosion in mobile broadband use

- Cisco (2013): "13 times until 2017"
- UMTS Forum (2012): "13 times until 2020"
- Ericsson (2012): "12 times until 2018"
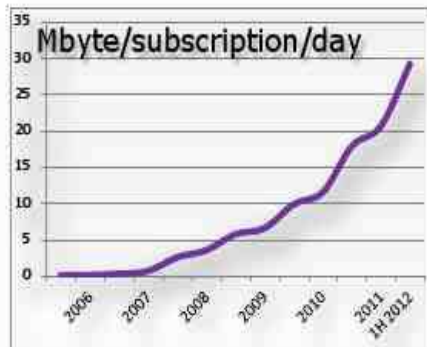
PTS

3
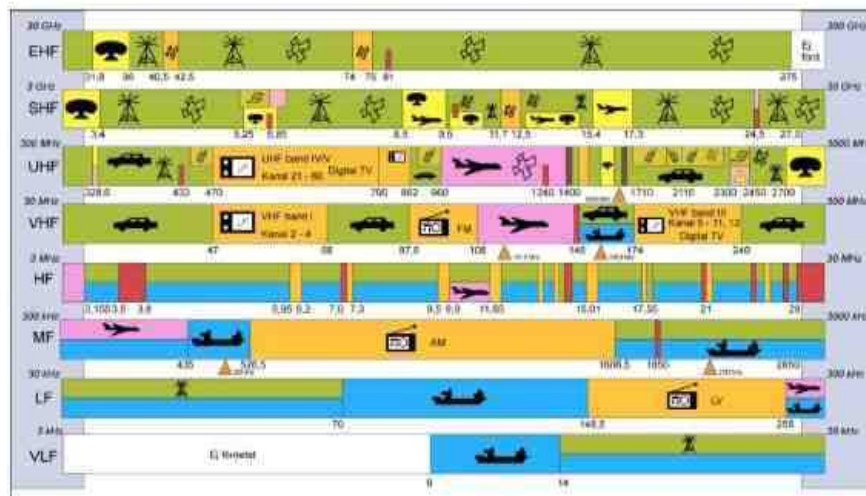
Challenges
- Radio spectrum is a scarce resource
- Increased demand for wireless services and spectrum
- Allocation a result of our heritage
- Technical development – will not solve all problems

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A Spectrum Strategy will help PTS to act long term and transparent

- Make spectrum available
- Use spectrum efficiently
- Adapt spectrum to its purpose and thus maximise the benefit for society
- Give the market better chances to fulfill the increasing demand for wireless services
- Meet the needs of society, e.g. defense and safety-of-life services

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5

The Strategy Work

- Inventory of spectrum usage today and in 2022
- Principles and tools to optimize the socio-economic benefits of spectrum
- Review the instruments for spectrum management and
- Review the technical rules for licensees so that they become as effective as possible

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6

PTS inventory
300 MHz - 6 GHz

Primary or exclusive use
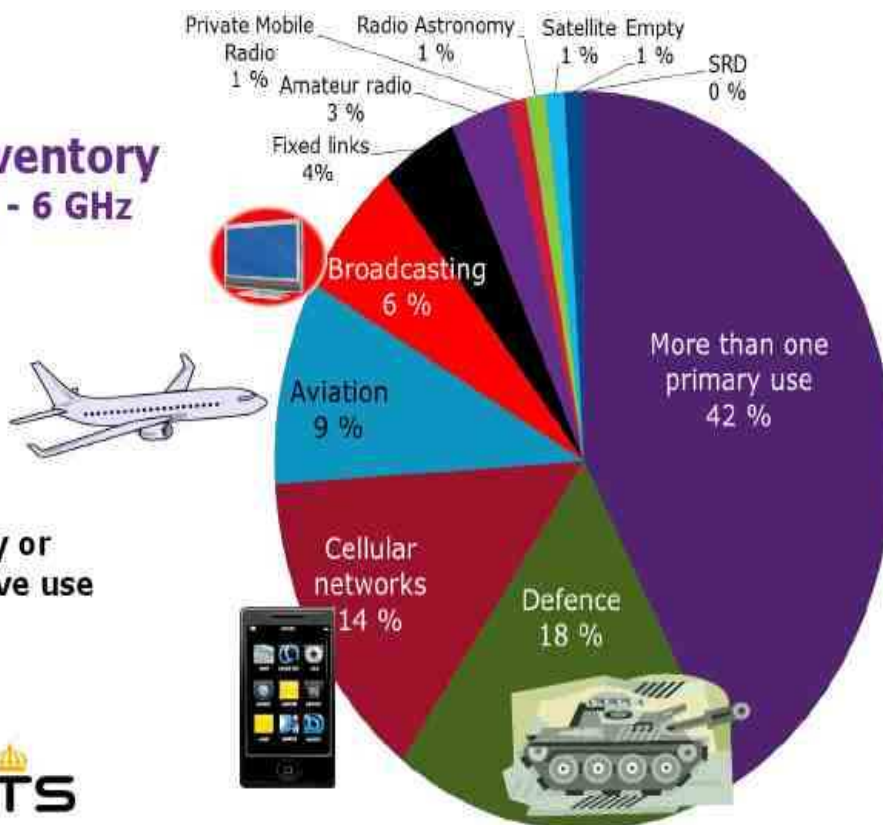
Pie chart segments:
- Private Mobile Radio 1 %
- Radio Astronomy 1 %
- Satellite 1 %
- Empty 1 %
- SRD 0 %
- Amateur radio 3 %
- Fixed links 4%
- Broadcasting 6 %
- Aviation 9 %
- Cellular networks 14 %
- Defence 18 %
- More than one primary use 42 %

PTS vision – Maximize the socio-economic efficiency of radio spectrum over time

- Socio-economic efficiency implicates the aggregated welfare changes for citizens in the society
- The benefits and costs are valued in monetary terms, even regarding aspects that isn't a part of a market

Costs

Benefits

PTS vision – Maximize the socio-economic efficiency of radio spectrum over time

Socio-economic efficiency

Σ 4 100 Mdkr

30 MHz   300 MHz

PTS

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PTS vision – Maximize the socio-economic efficiency of radio spectrum over time

Socio-economic efficiency

Σ 4 100 Mdkr

Σ 7 450 Mdkr

30 MHz   300 MHz

PTS

10

104
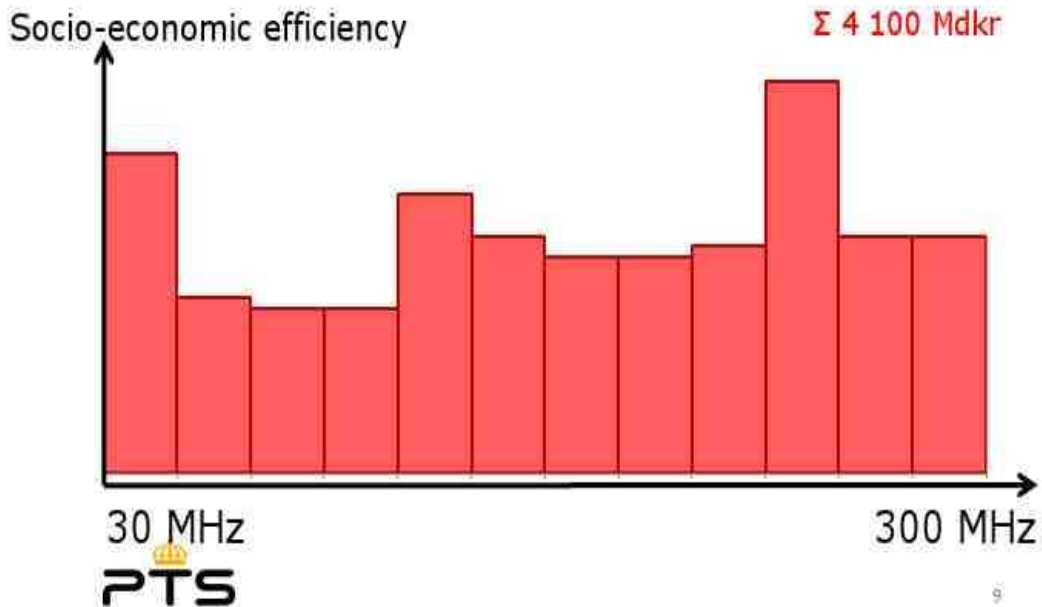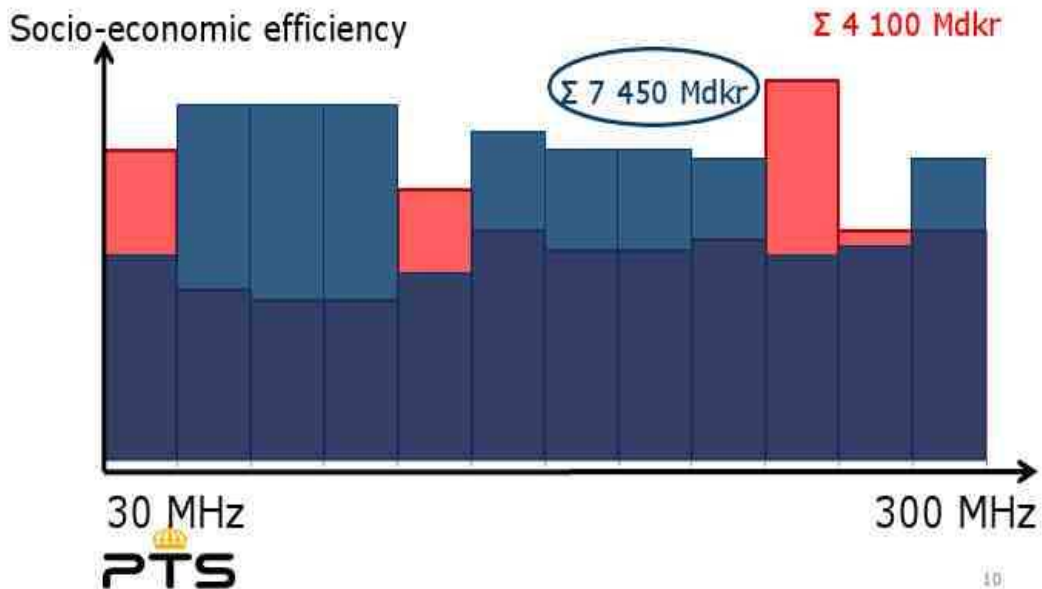
Efficient use of resources – socio-economic efficiency

```
┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│  Inventory of   │─────▶│ Identify spectrum│────▶│ Evaluating       │
│   needs and     │      │  for revision    │     │ alternative      │
│  spectrum use   │      │                  │     │ use, cost-benefit│
└─────────────────┘      └─────────────────┘      │ analysis         │
                                                   └─────────────────┘
```

┌──────────────┐   ┌──────────────┐
│ Market   │   │ Market   │
│ mechanisms   │   │ lacking   │
│ works   │   │   │
└──────────────┘   └──────────────┘

• "First-come-first served" ┐ ┌─────────────────┐   ┌─────────────────┐
• License exemption   ├ │ Users controls │   │ Assignment   │
• Auctions   ┘ │ The results of │   │ through   │
                                │ assignments   │   │ administrative │
                                └─────────────────┘   │ desicion   │
                                                        └─────────────────┘

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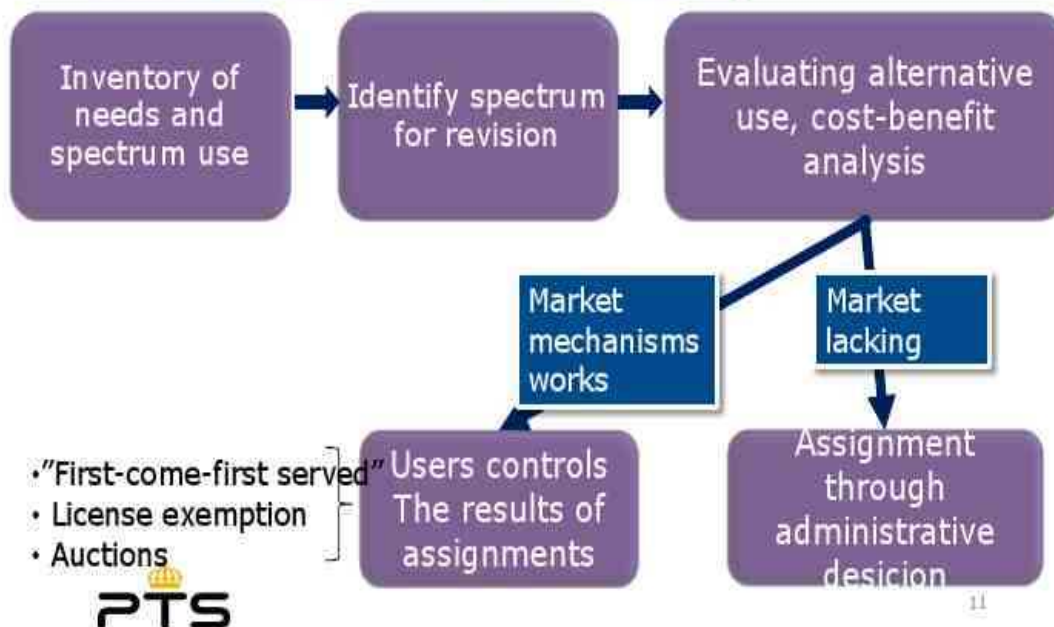
Future-proofing the spectrum strategy

- Spectrum sharing as the main rule – to avoid spectrum scarcity
- Least restrictive conditions – allowing technical development
- Market mechanisms as a tool to assess socio-economic efficiency where applicable (but doesn't work adequately for all uses e.g. collective goods)
- A diverse availability of spectrum (block/individual transmitter licenses/unlicensed, high/low power etc) allowing a diversity of network logics and business models
- Analyzing needs in terms of capacity, coverage, sensitivity to interference etc. – not MHz.

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Least restrictive conditions
Shared use

Least restrictive conditions
Exclusive use

Shared use

Dedicated Spectrum
Exclusive use

Least restrictive conditions
Shared use

Least restrictive conditions
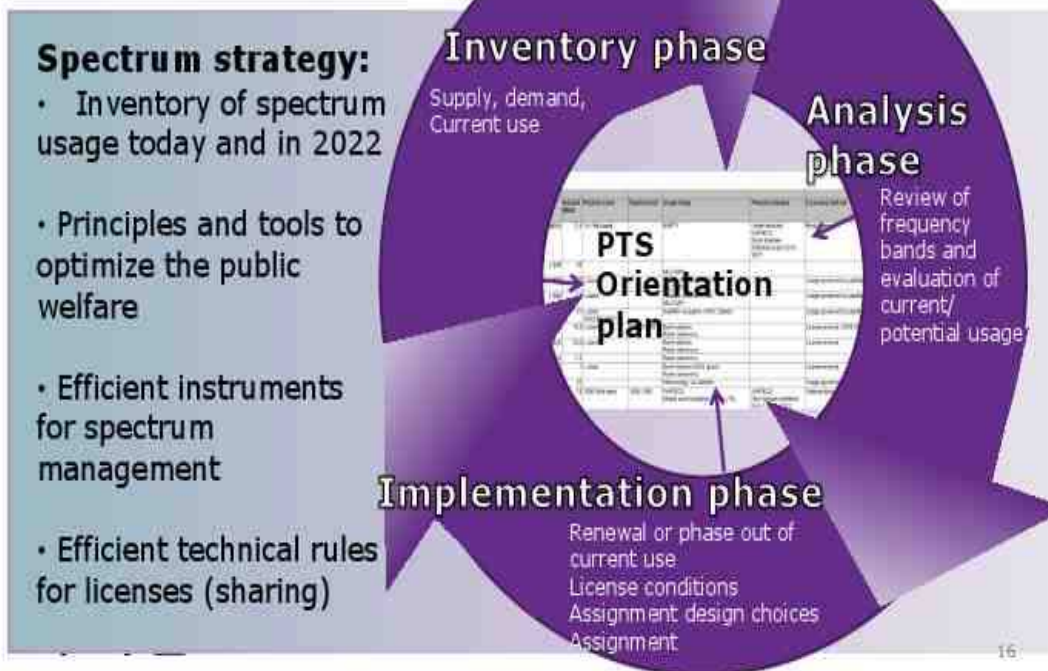Exclusive use

Shared use

Dedicated Spectrum
Exclusive use
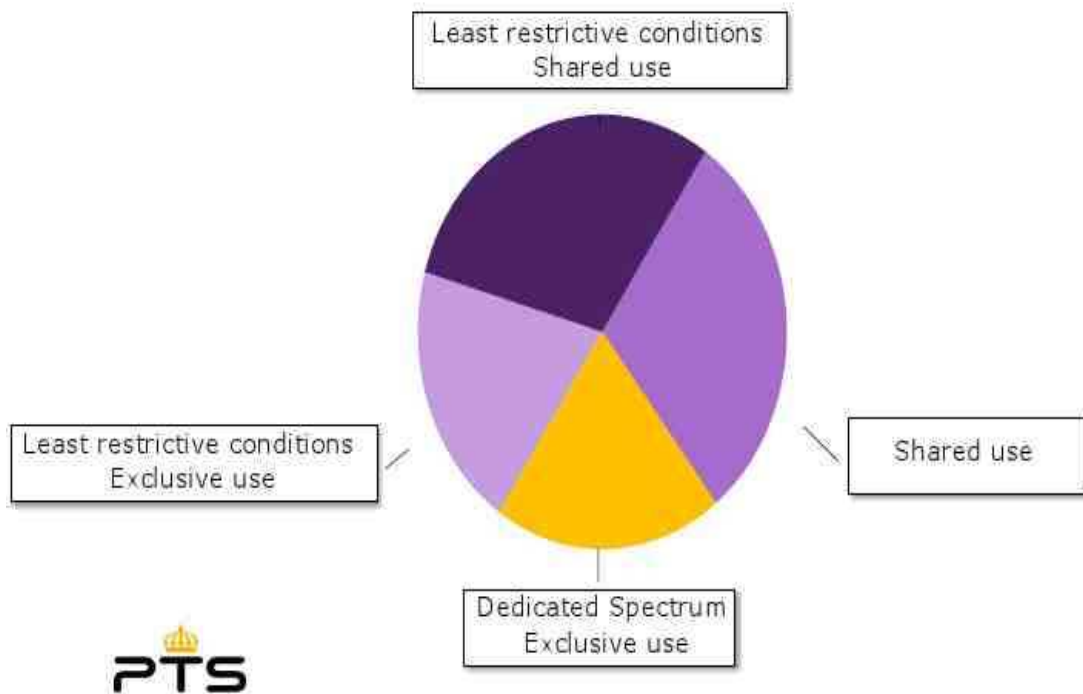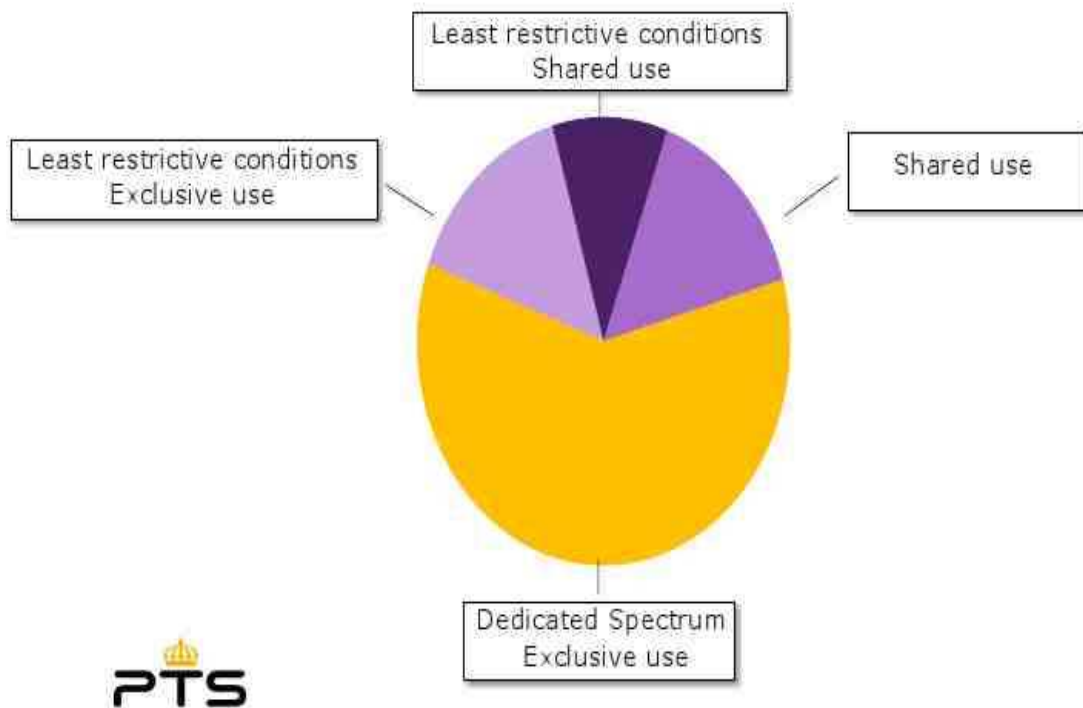
Spectrum sharing as the main rule

- Unused spectrum in all bands
- Less exclusive licenses
  - "The license holder has priority regarding the assigned frequencies, but there may be cases where radio equipment with dynamic spectrum access is used by another party."
- Time, geography, sub bands
- LSA

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A continuous process

Spectrum strategy:
- Inventory of spectrum usage today and in 2022

- Principles and tools to optimize the public welfare

- Efficient instruments for spectrum management

- Efficient technical rules for licenses (sharing)

Inventory phase
Supply, demand, Current use

PTS Orientation plan

Analysis phase
Review of frequency bands and evaluation of current/ potential usage

Implementation phase
Renewal or phase out of current use
License conditions
Assignment design choices
Assignment

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Thank you!

- Consultation of the PTS Spectrum Strategy is planned in autum 2013

- Desicion by the PTS board planned in autum 2013

- Please contact us for discussions or questions:

  ylva.malarstig@pts.se / Phone. +46 8-678 58 55

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