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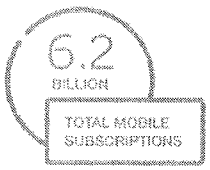
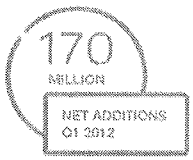
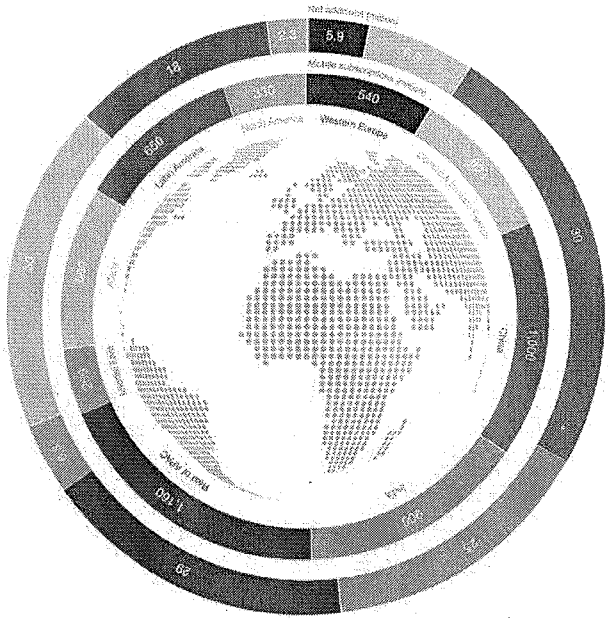
TRAFFIC FORECAST

MOBILE SUBSCRIPTIONS Q1 2012



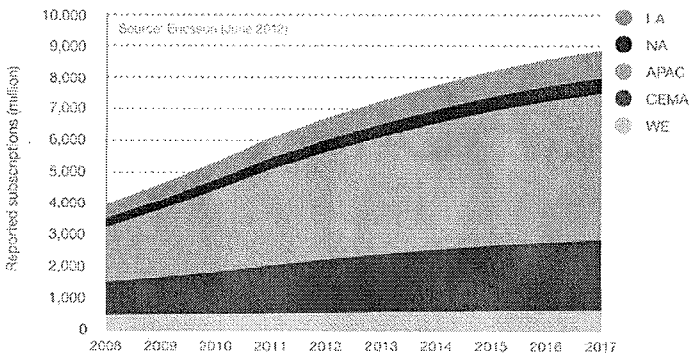




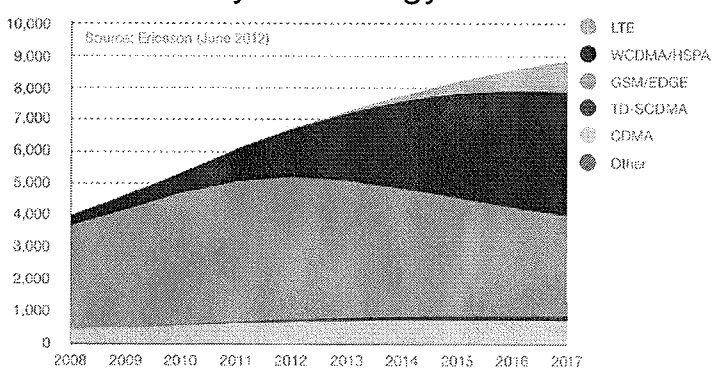
Source: Ericsson (2012)

MOBILE SUBSCRIPTIONS 2008-2017

by region

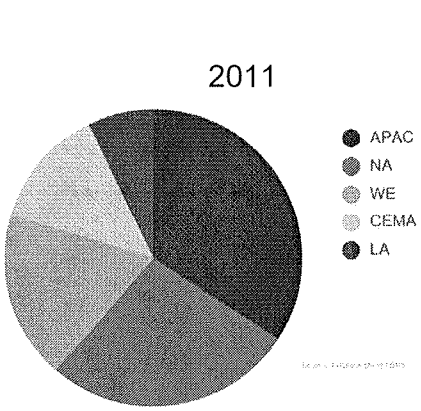


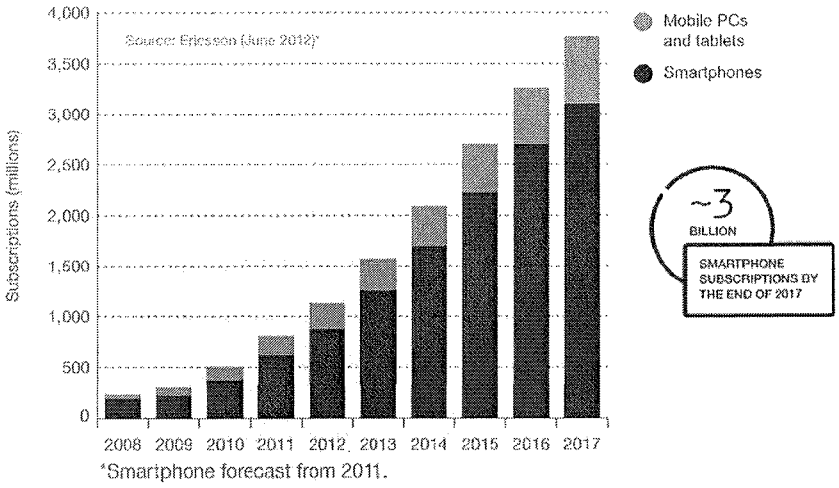
by technology



M2M subscriptions not included

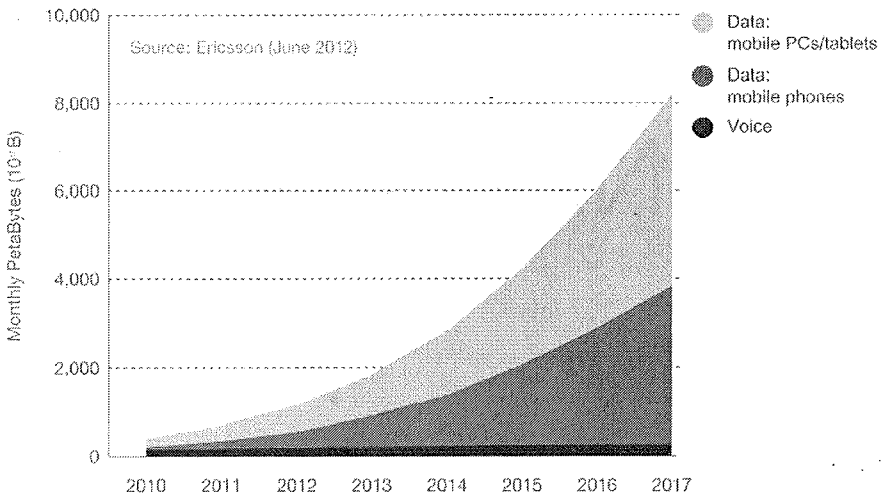
MBB SUBSCRIPTIONS





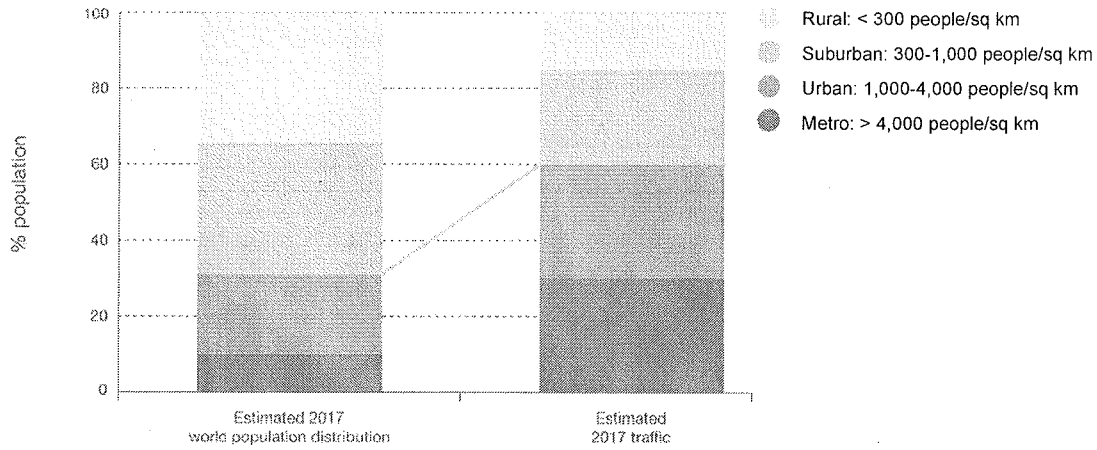
Mobile broadband is defined as CDMA2000 EV-DO, HSPA, LTE, Mobile WiMAX and TD-SCDMA. M2M subscriptions not included in figure.

MOBILE DATA TRAFFIC



'Traffic' refers to aggregated traffic in mobile access networks. DVB-H and Mobile WiMax or WiFi traffic have not been included. M2M traffic not included.

TRAFFIC GENERATION 2017



Source: Ericsson (2012)

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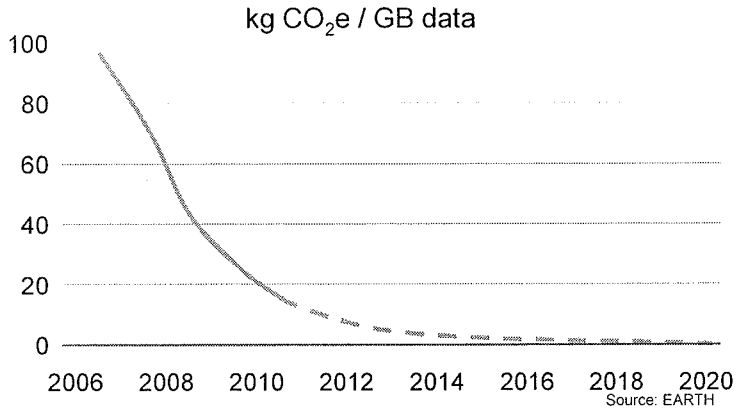
SUSTAINABILITY

INCREASING ENERGY EFFICIENCY

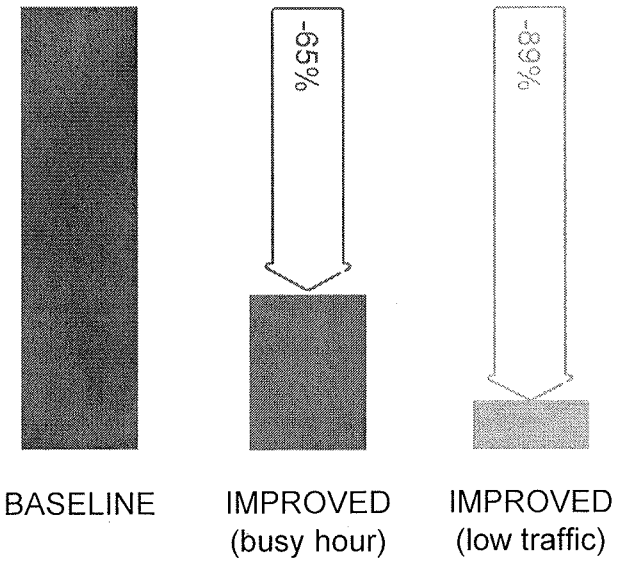
- Base station design improvements
- New solutions for system information broadcast, mobility, paging etc. with an energy focus



COPING WITH TRAFFIC INCREASE WITHOUT INCREASING CO_2 EMISSIONS

IMPROVED BASE STATION DESIGN

- Integrated solution including
  - improved macro-cell Hardware (H)
  - cell micro DTX (D)
  - Antenna muting (A)
  - Low loss antennas (L)
  - adaptive Sectorization (S)
- Evaluations using the EARTH evaluation framework (E^3F)
  - energy savings up to 60-70% seem possible, only minor impact on QoS



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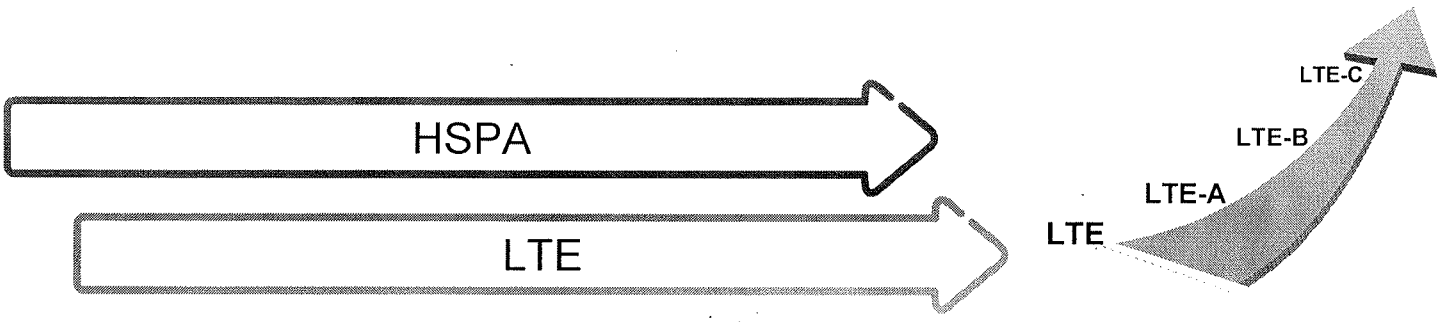
3GPP EVOLUTION

A GLOBAL INITIATIVE

3GPP EVOLUTION

› LTE and HSPA will continue to exist in parallel
  - the evolution continues
  - constraints and requirements are different for the two technologies



REL-12 FOCUS AREAS

› Local-area enhancements ("Soft Cell")

› Stand-alone new carrier type ("Lean Carrier")

› Beam forming enhancements

› Machine-type communication enhancements

› D2D – network-assisted device discovery

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SPECTRUM NEEDS FOR DENSE NETWORKS

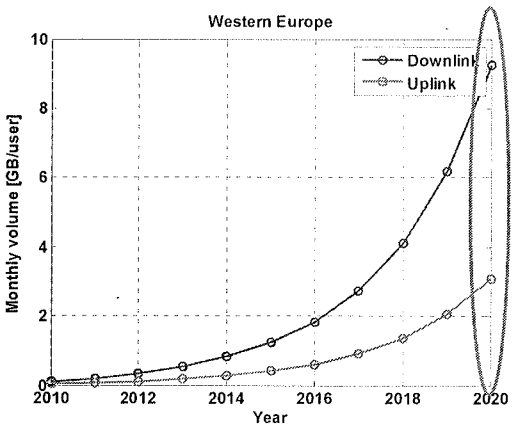
TARGET

› Meet future expectations on data rates
  - 100Mbps in downlink
  - 10Mbps in uplink

FCC Aims for 100Mbps Internet Speed by 2020 with New Broadband Plan

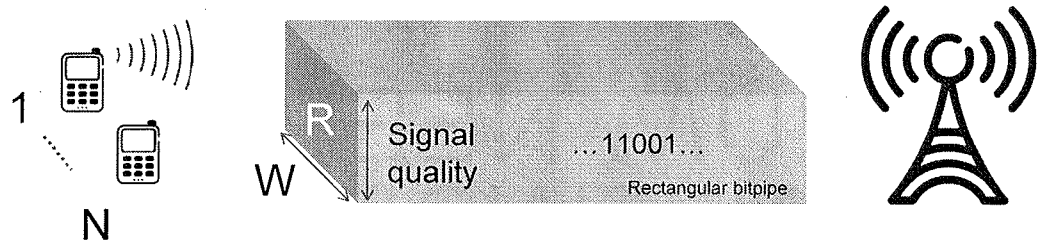
The FCC's National Broadband Plan Seeks100Mbps Broadband Speed in the US by 2020

› Meet future demands on traffic volume; for example 2020:
  - 10GB/month in downlink
  - 3GB/month in uplink

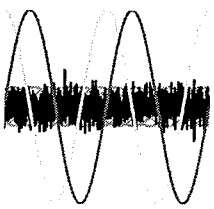


1GB/month ~ 5kbps during busy hour

WHAT DETERMINES THE SIZE OF THE BIT PIPE?

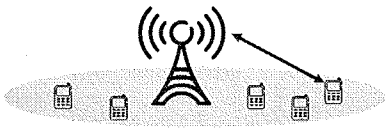


1. Number of co-scheduled users (N)
2. Bandwidth or spectrum (W)
3. Signal quality (SNR)



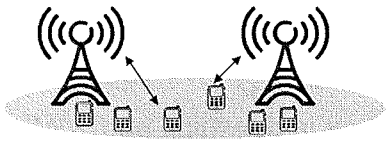
$$\text{Datarate } R = W \cdot \log_2(1+SNR) / N$$

HOW REACH 100MBPS FOR ALL?



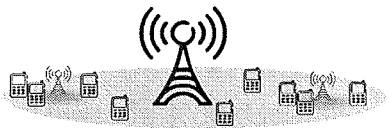
Improved Macro 2 3

More spectrum, antennas, advanced processing, management and coordination



Densified macro 1 3

Additional macro sites

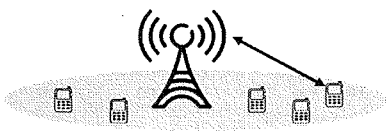


Small Cells 1 3

Picos, relays (radio backhaul)

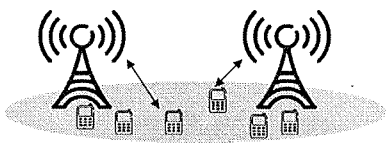
The Radio Network Toolbox

HOW REACH 100MBPS FOR ALL? EXAMPLE



Improved Macro

2x20MHz → 2x200MHz per operator



Densified macro

Two to sixteen times more macro base stations

Small Cells

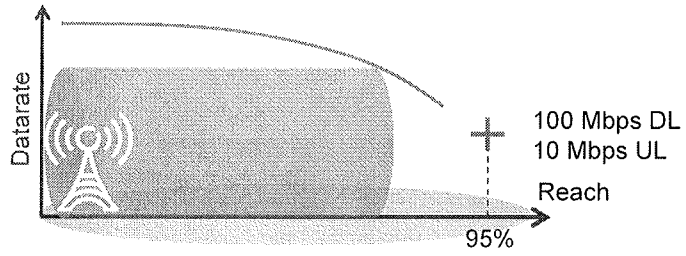
Add 3-24 pico base stations (2W) per macro site

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

PERFORMANCE EVALUATIONS

› Stockholm-like scenario, urban propagation
  - population density 20 000/km^2, 90% penetration, 30% market share
  - heterogeneous traffic, 80% of users located in clusters (all indoor)
  - traffic load set to expectation for 2020 (10GB and 3GB/user/month in DL and UL)

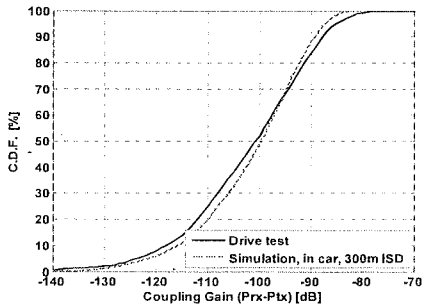
› Target +
  - reach 95% of users with 100Mbps in downlink and 10Mbps in uplink

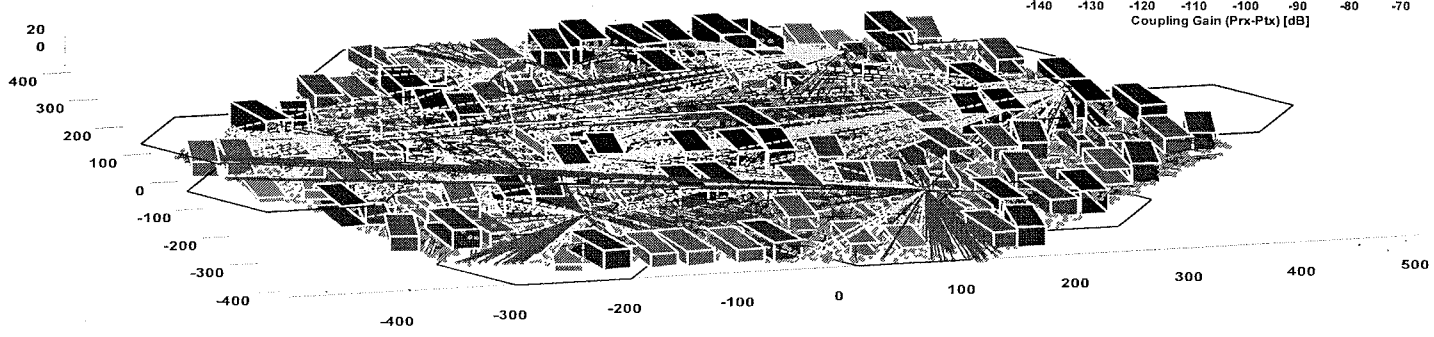


A STOCKHOLM-LIKE SCENARIO

› Environment and propagation calibrated to drive tests in Stockholm (300m ISD) – a very dense network

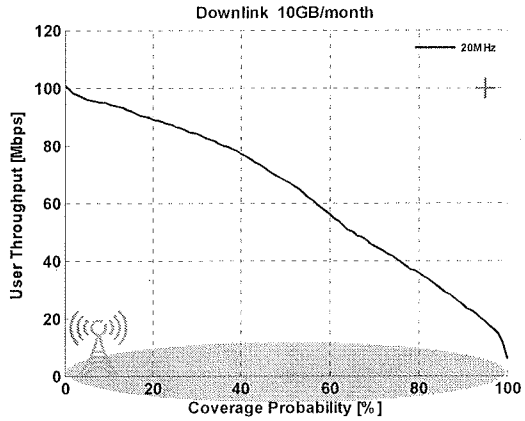
› 80% indoor users in evaluations

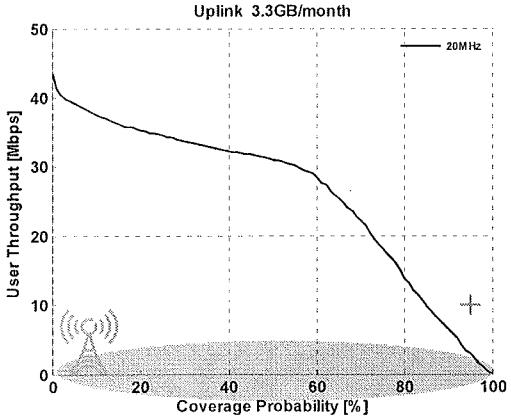




REFERENCE CASE
2x20MHZ

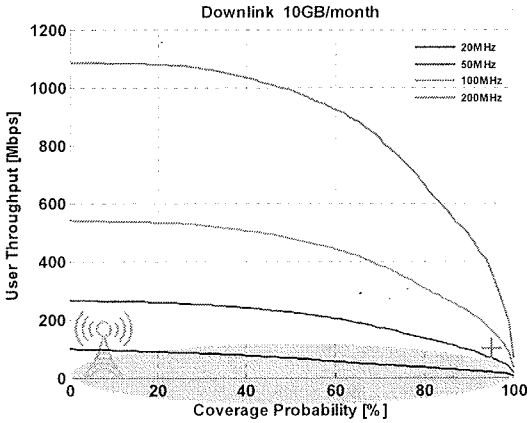
› Can handle expected traffic volume in 2020 (~40% load)
› Very high median data rates – 50 / 20Mbps in DL / UL
› …but not 100Mbps for all

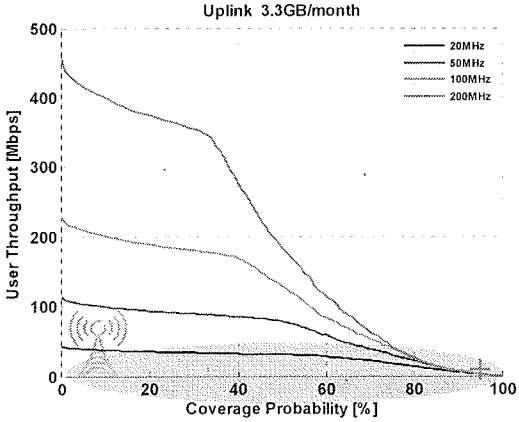




MORE SPECTRUM
2x20, 2x50, 2x100, AND 2x200MHZ

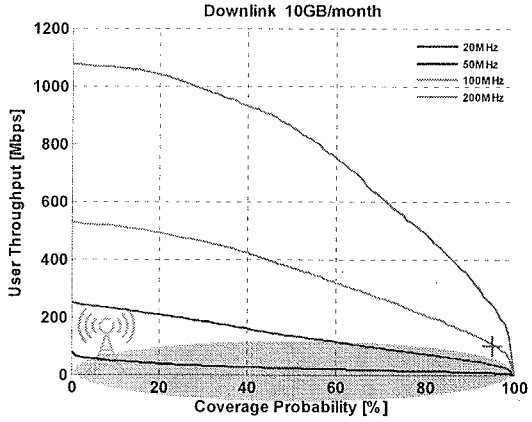
› Data rate proportional to spectrum
› 100Mbps in downlink reached with 2x100MHz
› 10Mbps in uplink not reached – power limitation

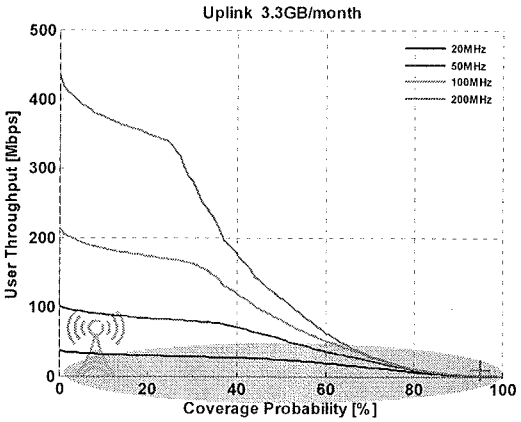




MORE SPECTRUM
2x20, 2x50, 2x100, AND 2x200MHZ – ISD 425M

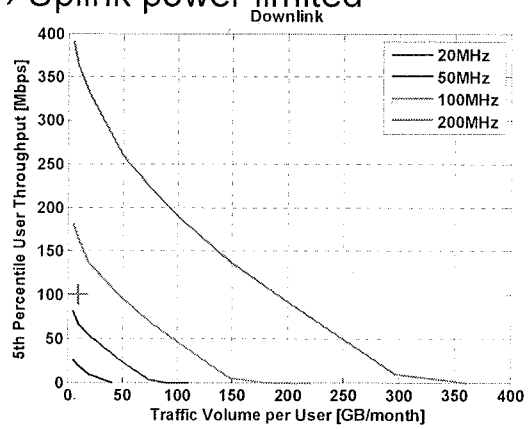
› Lower data rates
› 100Mbps in downlink reached with 2x100MHz
› 10Mbps in uplink not reached – power limitation

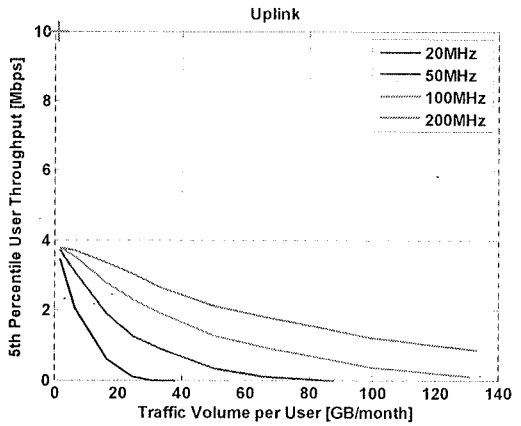




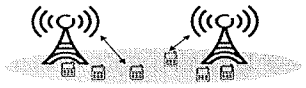
MORE SPECTRUM
2x20, 2x50, 2x100, AND 2x200MHZ

› Data rates decrease with increasing load
  – higher interference and more queuing
› More spectrum required at higher load
› Uplink power limited

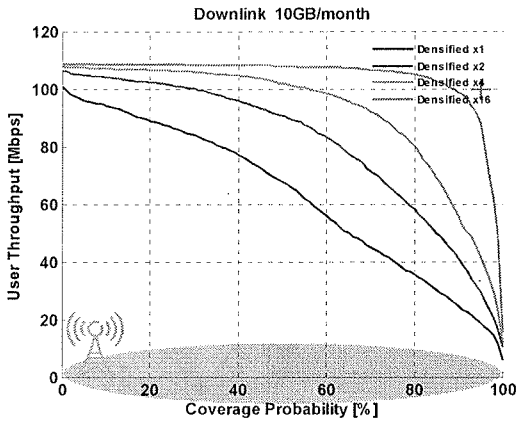


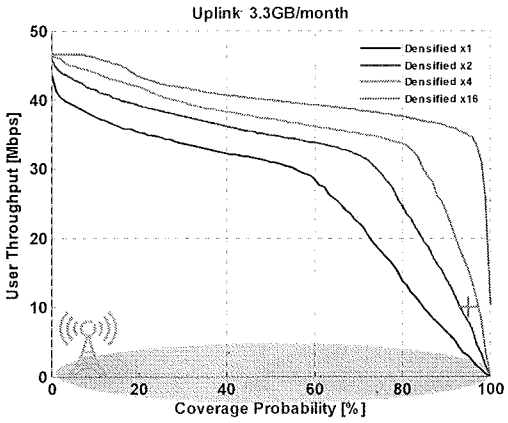


DENSIFIED MACRO, 2x20MHZ
TWO, FOUR, OR SIXTEEN TIMES MORE



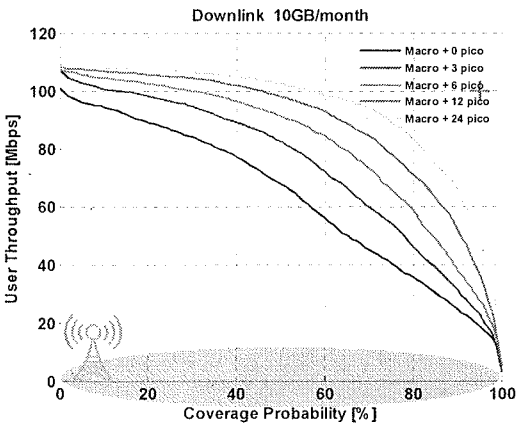
› Downlink – 100Mbps not reached
› Uplink – 10Mbps reachable with ~2x densification

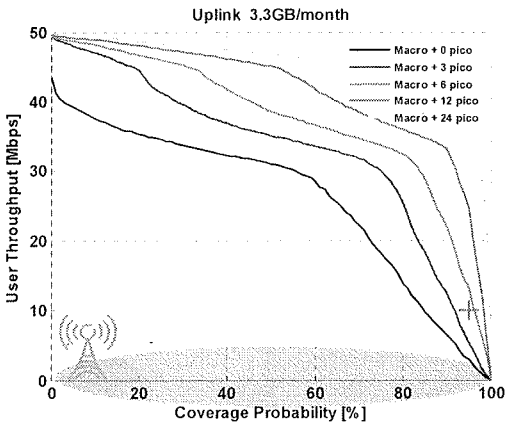




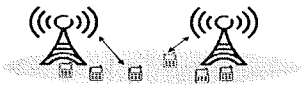
SMALL CELLS, 2x20MHZ
3, 6, 12, 24 PICOS PER MACRO SITE

› Downlink – 100Mbps not reached
› Uplink – target reached with 6 picos per macro

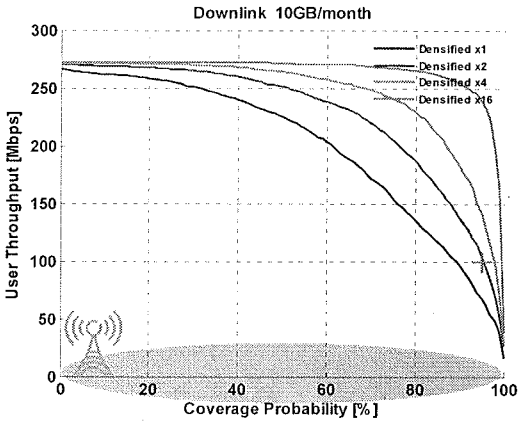


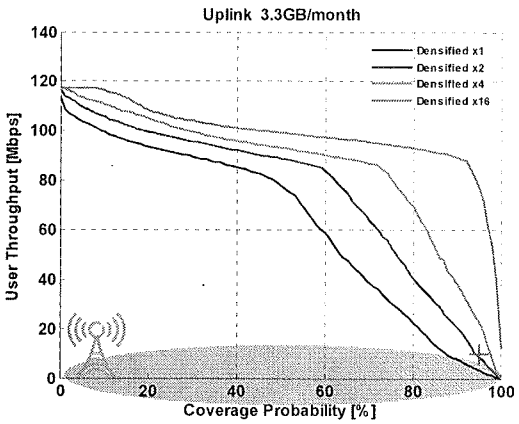


DENSIFIED MACRO, 2x50MHZ
TWO, FOUR, OR SIXTEEN TIMES



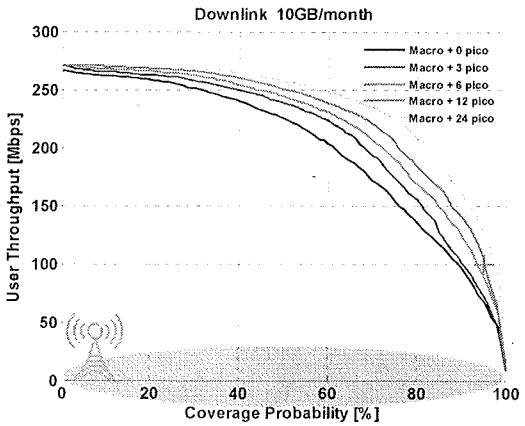
› Downlink – 100Mbps reached with 2x more base stations
› Uplink – 10Mbps reached with 2x more base stations

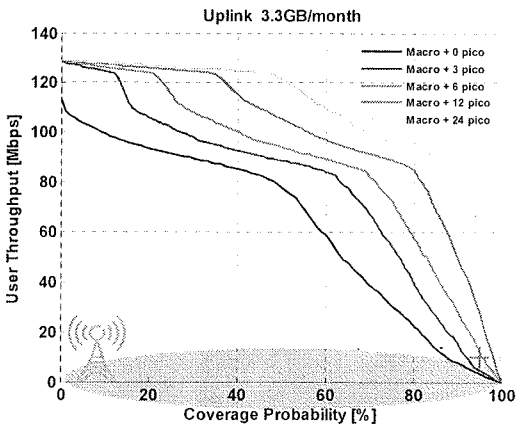




SMALL CELLS, 2x50MHZ
3, 6, 12, 24 PICOS PER MACRO SITE

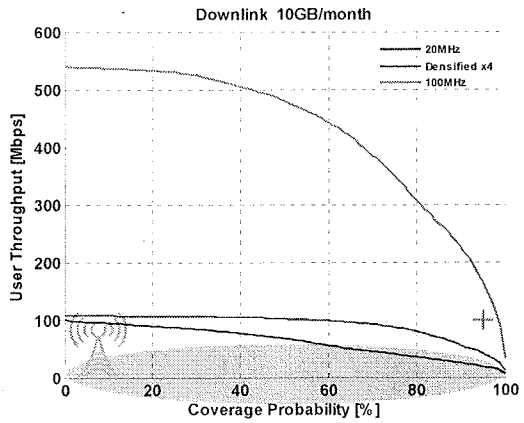
› Downlink – 100Mbps reached with 6 picos per macro
› Uplink – 10Mbps reached with 6 picos per macro

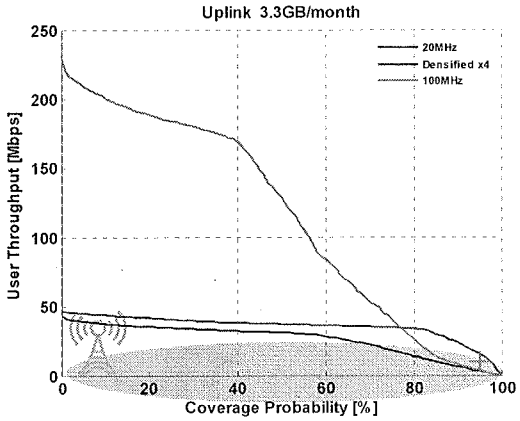




SPECTRUM AND DENSIFICATION
4X DENSIFICATION VS. 2x100MHZ

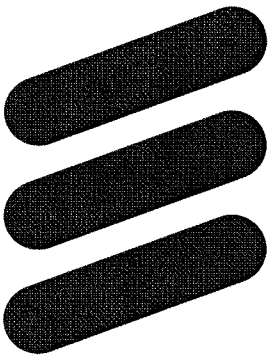
› Spectrum is very valuable





SUMMARY

- Traffic over wireless networks increases rapidly
- Advanced radio solutions stretches the technology limits
- More spectrum is needed to make wireless communication affordable and spur global growth
- 100Mbps requires 2 x 100-200MHz per operator



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