Advances in 1xEVDO and Wireless Broadband Access Networks

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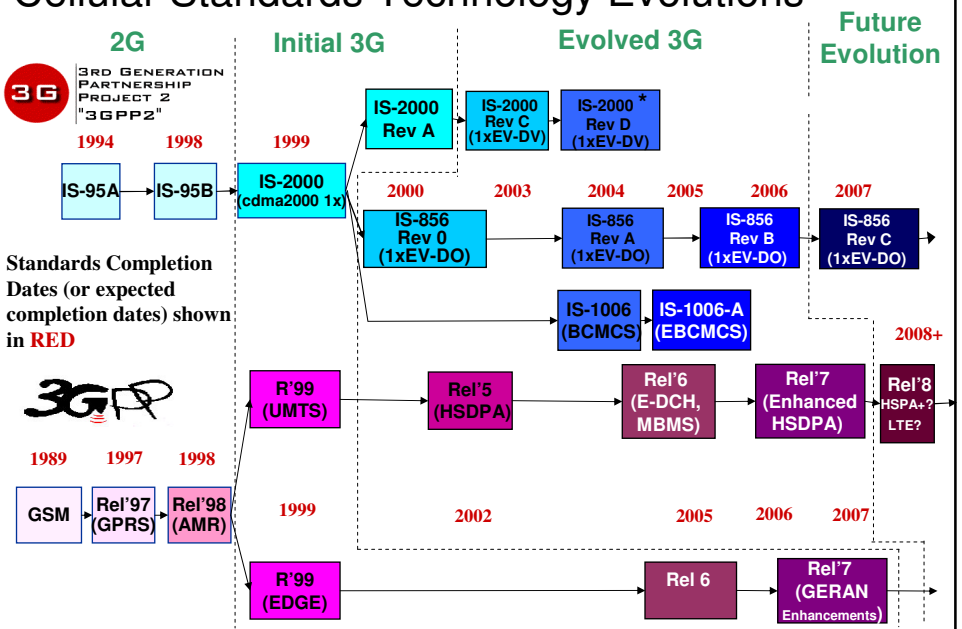
Outline

- Wireless Standards Overview and Systems Evolution
- Technology Trends and Drivers
- What is Next for CDMA 1xEV-DO?
- BSR for 3G Flat IP-networks
- Lucent's Vision on Converged Networks based on IMS
- Conclusion

Wireless Standards Overview and System Evolution

Cellular Standards Technology Evolutions



UMTS & CDMA Continue to Evolve to Meet Operator Needs

Worldwide 3G Deployments

Spread Spectrum is the Basis of all 3G Solutions

CDMA2000 is the dominant platform for IMT-2000 :

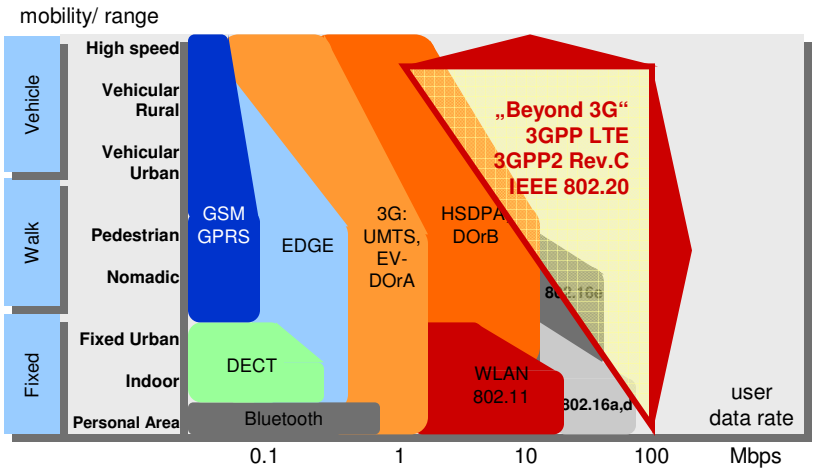
- Today, 149 operators have launched 146 CDMA2000 1X and 31 1xEV-DO commercial networks supporting >275 M subs (Mar 06) across Asia, the Americas and Europe. 29 additional CDMA2000 1X and 40 1xEV-DO networks are scheduled to be deployed in the next year, as of February 16, 2006
- More than 982 devices are available in the market with color displays, cameras and GPS capabilities, as of February 16, 2006.

UMTS/WCDMA

- 95 operators in 43 countries operate UMTS networks supporting >75 M subs (~20 M in Japan)
- 22 Operators in 16 Countries are conducting HSDPA Trials (Oct 05)
- The UMTS Forum web site lists:
  - 14 Manufacturers offering UMTS devices:
    - With over 150 Models from PC Card to Handsets
  - Commercial HSDPA handsets not expected before 2006
    - PCMCIA or Data Only Devices expected 4Q05

Sources: www.cdg.org, www.3gtoday.com
www.umts-forum.org as of Feb, 2006

Wireless Technologies „Beyond 3G“: the mobility challenge



Technology Trends and Drivers

Wireless Broadband….Society needs

Last mile solutions:

- A tool for economic and social developments (WTDC, 1994)
- Residential access: Anytime and Anywhere
- Business Access: ability to conduct professional and personal business anytime and anywhere through Universal High Speed Mobile Data Access
- to increase quality of life
- Low cost and mass internet
- Fast complement to/or replacement of copper network

Increase productivity (corporations and government):

- Optimization of resources and customer service

Rural reach:

- Increase teledensity in sub-urban and rural areas

Wireless Technology Innovations - Research Drivers Today

Related Innovations

Radio Technology
- Higher data performance, throughput/data rates
- Lower latency
- Lower cost per MB

OFDM
MIMO + SDMA

System Architecture
- Less complex architecture, flat like IP
- Easy-to-deploy
- Unified network elements
- Converged networks..IMS

BSR
distributed RF
more compact HW

Services & Applications
- VoIP over wireless
- Multimedia broadcast/multicast
- Truely converged services, mobile-TV

miViewTV,
Mobile TV

3GPP Long Term Evolution (LTE) and System Architecture Evolution (SAE)

New OFDM Technology

3GPP Standards study item since Dec 2004,
Feasibility Study to be completed mid 2006,
Standardization as a Rel'8 or later feature

LTE is a 3GPP initiative to develop a new RAN/air-interface to
- Support high efficiency OFDMA carriers with scalable bandwidths of 1.25-20 MHz
- Provide significantly improved peak and cell edge data throughputs:
- Towards 100 Mb/s Downlink, 50 Mb/s Uplink,
- 2-4 times better spectral efficiency over HSDPA/HSUPA (in bits/s/Hz/cell)
- Support smaller frame durations in order to achieve reduced latencies less than 10 ms
- Support for advanced antenna schemes (e.g. SDMA) and MIMO
- Support for wide range of QoS and Mobility

SAE is a 3GPP initiative to develop a new flat(ter) network architecture (…..2008)
- Simpler system (than UMTS), purely packet-oriented
- Reduced number/type of nodes for lower transport delay….BSR is a major step towards flat IP
- Scalability to support the high data rates required for LTE

Goal of 3GPP LTE/SAE is to Define a New RAN/Air-Interface to Better Deliver Broadband and Real Time Packet Switched Services over a New Flat(ter) Network Architecture

3GPP2: DO Rev.C Update

Proposal recently introduced to 3GPP2 jointly by Lucent, Nortel, Samsung (LNS)

Hybrid OFDMA and CDMA Wideband (up to 20 MHz) Radio Interface

- Strictly Backwards Compatible Mode
  - Based on 1.25 MHz multi-carrier
  - Provides full backwards compatibility with Rev. 0/A/B
- Loosely Backwards Compatible Mode
  - New 1.25-20 MHz OFDMA/CDMA carriers (can do a mix of broadband and multi-carrier)
  - TDD, FDD and Flex FDD duplexing

Hybrid OFDM / WCDMA Technology

Multi-Antenna Technology Support

- Spatial Division Multiple Access (SDMA) provides near doubling of spectral efficiency with 4-branch Tx/Rx
- Spatial Multiplexing MIMO on the FL for hot spots/indoor deployment provides peak rate improvement proportional to the number of Tx/Rx antennas.

Inter-cell co-ordination for further improvements in cell-edge user performance

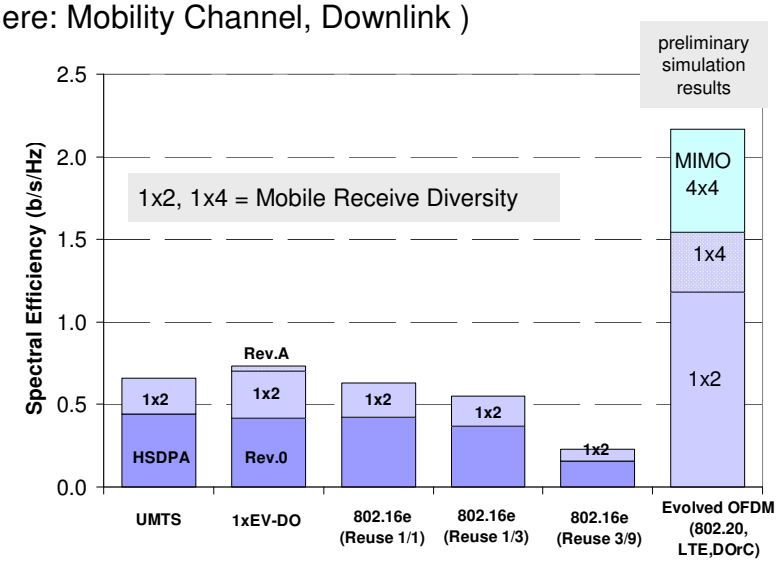
Standardized technology-agnostic Flat IP architecture
(Pre-standardization support from Lucent)

Target Standards Completion March 2007

Rev. C Integrates the Best Technical Innovations from OFDMA & CDMA to Enable Mass-Market Real-time Broadband Data Services

Comparative Spectral Efficiency

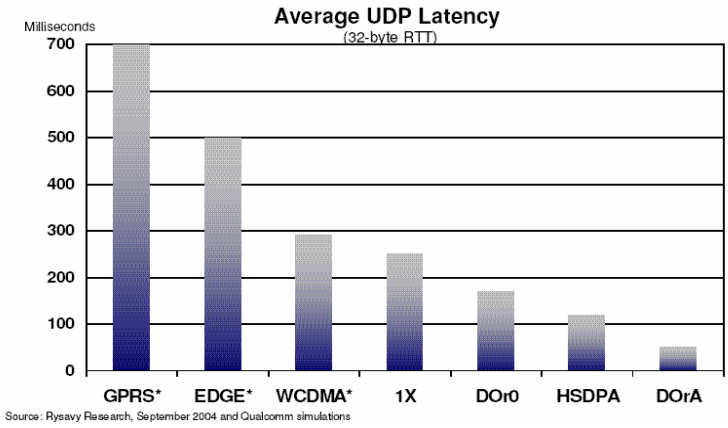
(here: Mobility Channel, Downlink)



DL Spectral Efficiencies Possible with HSDPA, DO and 802.16e, are All Similar – Will increase with evolved OFDM

Wireless Systems Latency Comparison

Low latency will enable wireless systems carry delay-sensitive Applications such as voice, interactive gaming, TV video…



IEEE 802.16 Standards Update

Existing OFDM Technology

802.16 (Dec 2001)
- Original fixed wireless broadband air Interface for 10 – 66 GHz
- Line-of-sight only, Point-to-Multi-Point applications

802.16c (2002)

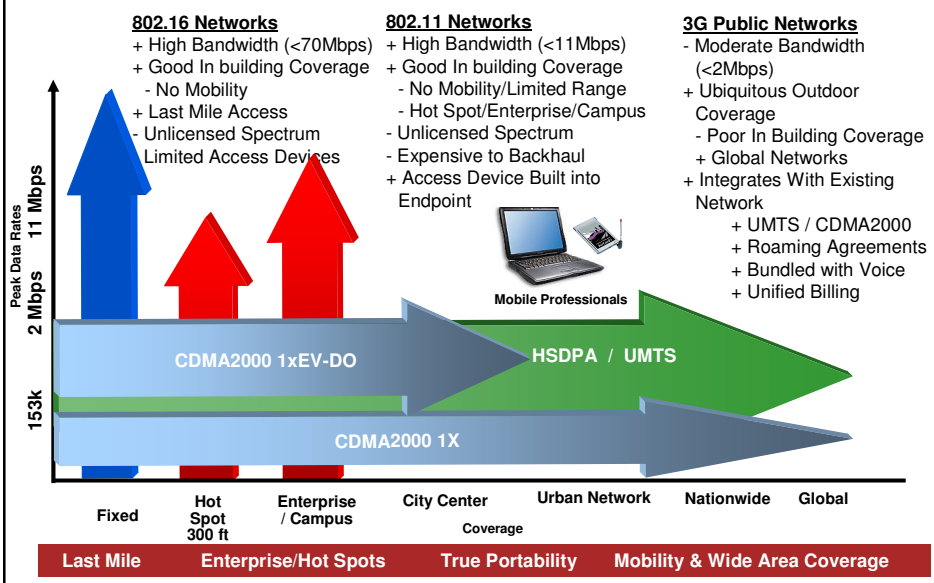
802.16 Amendment WiMAX System Profiles 10 - 66 GHz

802.16a (Jan 2003)
- Extension for 2-11 GHz
- Targeted for non line of sight, Point-to-Multi-Point applications like “last mile” broadband access

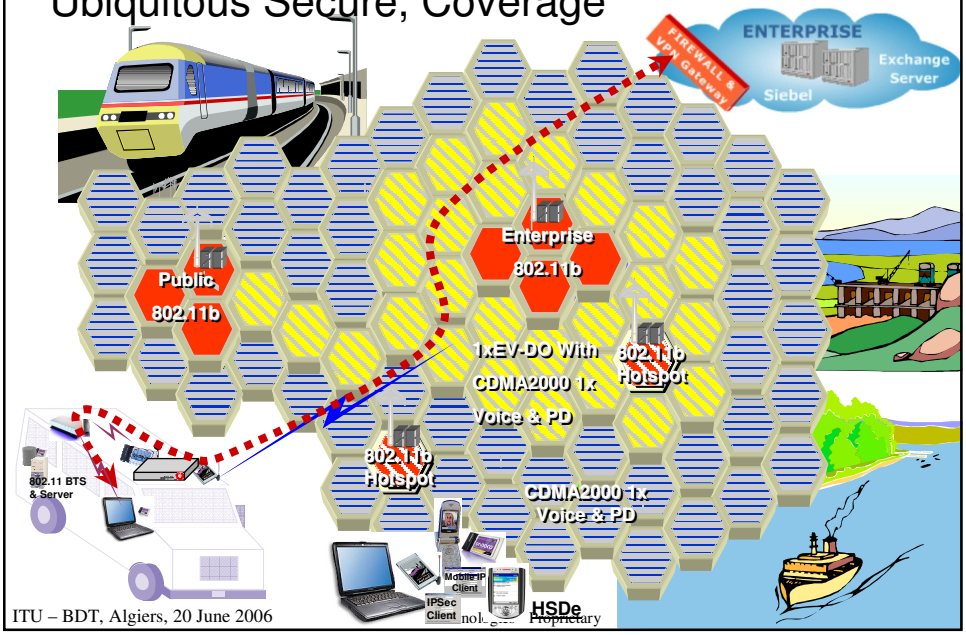
802.16REVd (802.16-2004) (Q3 2004)
- 802.16 Revision PAR for 802.16 & 802.16a to add WiMAX System Profiles and Errata for 2-11 GHz in support of 802.16e requirements

802.16e (802.16-2005) (Q4 2005)
- Amendment for Mobile wireless broadband up to vehicular speeds in licensed bands < 6 GHz
- MAC/PHY Enhancements to support subscribers moving at vehicular speeds

High Speed Wireless Data Scenario



HSDe Integrates Complementary Services for Ubiquitous Secure, Coverage



Can WiMAX Supplant 3G?

	WIMAX	3G
TIME TO MARKET	• Fixed - 2006-07 • Mobile: 2008 (Tentative)	• NOW
KEY BOOSTERS	• INTEL, Wireless Broadband vendors • Some major infrastructure vendors	• All infrastructure suppliers, most mobile service providers
MAIN ATTRIBUTES	• Uses OFDM technology, better potential for higher data speeds • Standardized technology	• Cellular-based • 384kbps - 2Mbps • Supports voice
MAIN CHALLENGES	• Not yet here • Economies of scale • Major carriers are sceptical	• Throughput still limited, depending on application • Roadmap beyond HSDPA

Source: Pyramid Research

Summary: Evolution of Wireless Technologies

- Initial 3G systems (EDGE, R'99 UMTS, 3G1x) focused on voice, yielding modest data performance benefits
- Evolved 3G or 3G+ systems (HSDPA/E-DCH, 1xEV-DO/DV) provided significant data performance benefits
- HSDPA, 1xEV-DO and 802.16 downlink have similar spectral efficiency performance
- For MIMO systems:
  - SM/BLAST offers the best peak data rates,
  - SDMA offers the best spectral efficiency.
- We see Strong potential of OFDM influencing where WiMAX goes
- Time-to-market advantage of 3G will make WiFi / WiMAX **complementary**
  - for coverage complement / backhaul applications
- the potential of mobile WiMAX hinges on the success of existing 3G technologies
- We anticipate Mobile broadband Access will be cellular based

What is Next for CDMA 1xEV-DO?

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Key Performance Data of 1xEV-DO Rev. A

Increased Peak data rates

- 3.1 Mbps (2.4 Mps with Rev 0) FL Peak
  - 600 – 1 Mbps Individual User Experience
  - 630 – 1.05 Mbps AAT depending on Mobility per sector
- 1.8 Mbps (~153 kbps with Rev 0) RL Peak data rate
  - 80 – 500 kbps Individual User Experience
  - ~ 400kbps AAT (~240 kb/s with Rev 0) per sector

Increased RL capacity (3GPP2 methodology)

- Utilize HARQ to increase RL capacity
- Improved Latency
  - ~118 ms (~200+ ms Mobile to Mobile)

1xEV-DO Rev A Benefits

Improved Forward Link
- Larger payloads drive data rates to 3.1Mbps
- Improved MAC
- Packet Division Multiplexing improves performance in good channel conditions
- New Channel enabling Increased Forward Throughput

Improved Reverse Link
- Up to 1.8 Mbps data rate
- Throughput and latency gains with hybrid ARQ
- Improved MAC Layers on RL

QoS
- Inter-User – Priority by User
- Intra-User – Priority by Application
- Requirements for VoIP/PTT applications

Broadcast/ Multicast (BC-MCS)
- Multimedia content to multiple users
- Higher Data Rates than Rev 0

Improved support for real-time packet applications, including VoIP, Gaming, Push-to-Speak

Can leverage advanced all-IP architectures to further improve performance and deployment flexibility

Enhanced capabilities to enable service flexibility and new revenue generating features

Network Upgrades for 1xEV-DO Rev. A

New Mobiles
- New Device (with MSM6800)

Base Station
- New EVM (with CSM6800)
- New software release

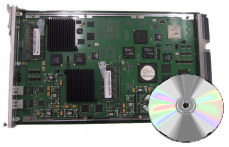
Radio Network Controller
- New software release
  - Can reuse R1SR-based RNC

PDSN
- New software release
  - Can reuse existing PDSN

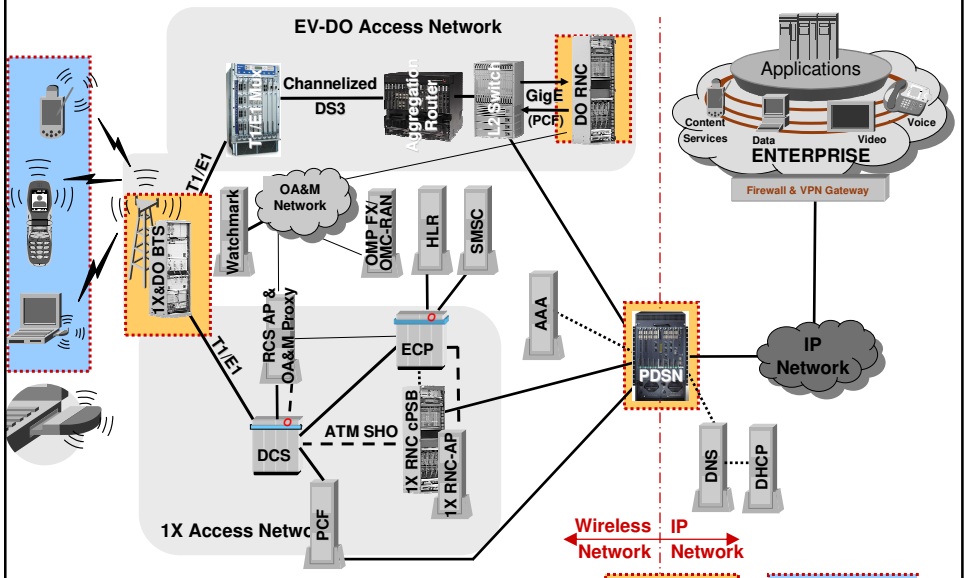

Novatel 720


Sierra 595


Levono Thinkpad



1xEV-DO Rev A Architecture



What is Next for EV-DO?

EV-DO Rev B and Interference Cancellation techniques

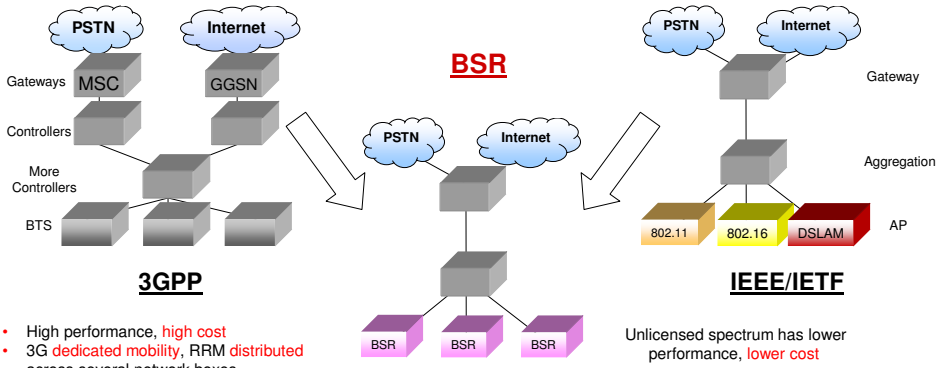
- EV-DO Rev B
  - ➢Designed for wider frequency blocks (up to 20 MHz)*
  - ➢Aggregates up to fifteen 1.25 MHz carriers (2x, …, 15x)
  - ➢Peak rates increase linearly with bandwidth
    - o For 3xEV-DO Peak Rates: FL = 9.3 Mbps, RL = 5.4 Mbps
    - o15xEV-DO Peak Rates: FL = 46.5 Mbps, RL = 27 Mbps
  - ➢Operates in Other Freq Bands (2 – 3.5 GHz)
  - ➢ Higher peak rates (73.5 Mbps in 20 MHz)
  - ➢ Higher spectral efficiency

- Advanced Interference Cancellation techniques increase RL spectral efficiency

* Note: Concept can be applied to bandwidths wider than 20 MHz as well

BSR for 3G Flat IP-networks

The BSR Idea



- High performance, high cost
- 3G dedicated mobility, RRM distributed across several network boxes
- Closed architecture with slow innovation through standards
- Can limit innovation as the world moves more quickly

Unlicensed spectrum has lower performance, lower cost

Control localized at access point

Open architecture with fast technology shifts towards new applications

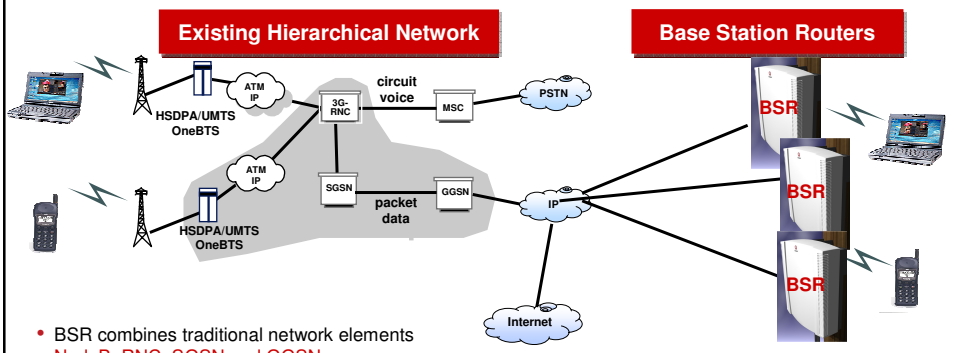
The BSR combines the best of both worlds!

Low-latency micro mobility
Pico through macro deployments
High-speed data oriented

Future proof
Unified RRM
Brings in the access points concept, but uses UMTS

Lucent's BSR Solution Simplifies System Architecture for Today's and Future Wireless Technologies

Base Station Router Concept: Collapse the 3G Network to one single access node



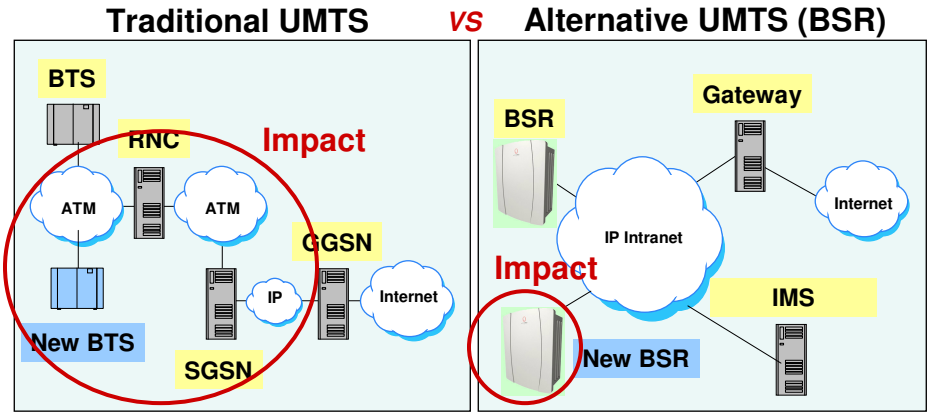
- BSR combines traditional network elements NodeB, RNC, SGSN and GGSN
- End-to-End QoS support
- Enhanced VoIP support (header compression, etc.)
- Reduced latency
- Improved mobility management for data applications (shared packet data channels)
- Improved scheduling
- Interworking at IP level, simple

The BSR lowers CAPEX/OPEX and reduces latency by combining network elements: BTS RNC, SGSN and GGSN

The BSR will initially be developed for UMTS/HSDPA, but can be developed for other technologies

Lucent's BSR Solution Collapses the 3G Network (NodeB, RNC, SGSN, GGSN) to One Single Access Node

BSR dramatically improves Scalability



Adding a new BTS requires RNC configuration changes and potentially a new RNC. This would lead to SGSN configuration changes/upgrade

Adding a new BSRs has limited impact to other nodes due to removal of network hierarchy

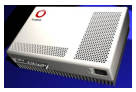
BSR: BSR Configuration

Micro BSR:

- Limited scale hot-spot deployment, e.g. business parks, shopping malls, airports
- Low cost wide area coverage (city centres)
- Support either interal or external antenna
- Indoor /Outdoor…Pole or Wall mounted
- Dimensions: (550x 580 x 223 mm) (H, W, D)
- Total volume: Approx. 70 litters
- Weight: Approx <37 kg

Pico BSR:

- For enterprise and Residential
- Integrated antenna
- HSDPA support, EUDCH upgradeable; HW can support EV/DO Rev.A for CDMA
- Support IPv4 and IPv6, VDSL and Ethernet interfaces
- Dimensions: 332mm x 214mm x 91mm
- Total volume: Approx. 6.5 L
- Weight: Approx. 4Kg



Lucent Flat-IP Mobile Architecture Solution

Key Value Proposition

Lower cost wireless network

- leverages fewer wireless-specific elements (CapEx reduction).
  - reduce CapEx spend by approximately 30% compared to a traditional UMTS network
- consolidates many functions into BSR (BTS, RNC, SGSN & GGSN)
- Investment protection through increasing use of IP protocols and technologies that makes it future proof for IMS network

Higher capacity wireless network

- high capacity backhaul
- Leverages low cost of ethernet switching
- air interface performance enhancements (UMTS/HSDPA & HSUPA)

Architecture simplicity and operations savings

- consistent architecture for macro/micro/WiMax/WiFi access
- fewer wireless-specific elements & interfaces to deploy, manage

Converged services enabling

- limits extent of wireless specific infrastructure to access
- promotes consistency of multiple wireless & wireline access types, and convergence via access-agnostic IMS services

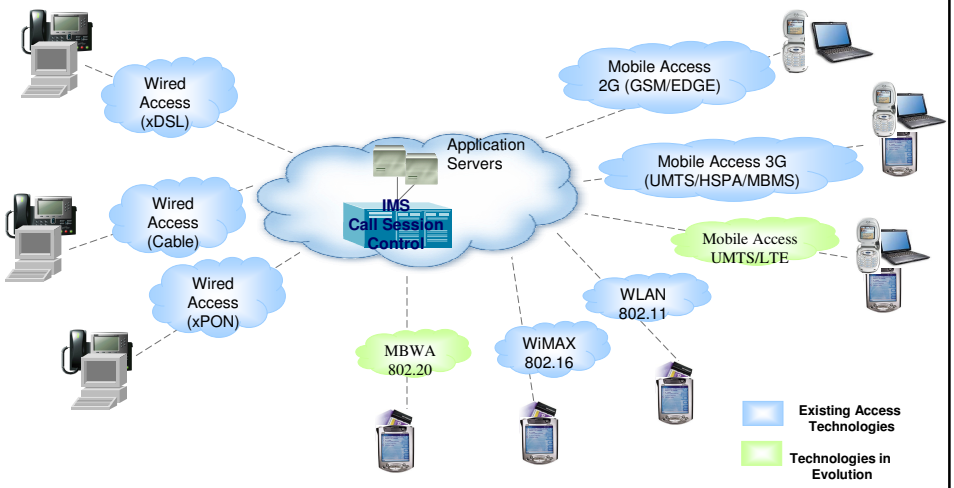
Lucent's innovative flat BSR-based Access Architecture

has the potential to host today's and future heterogeneous, converged wireline/wireless

solutions, including simplified support for multimedia multicast solutions

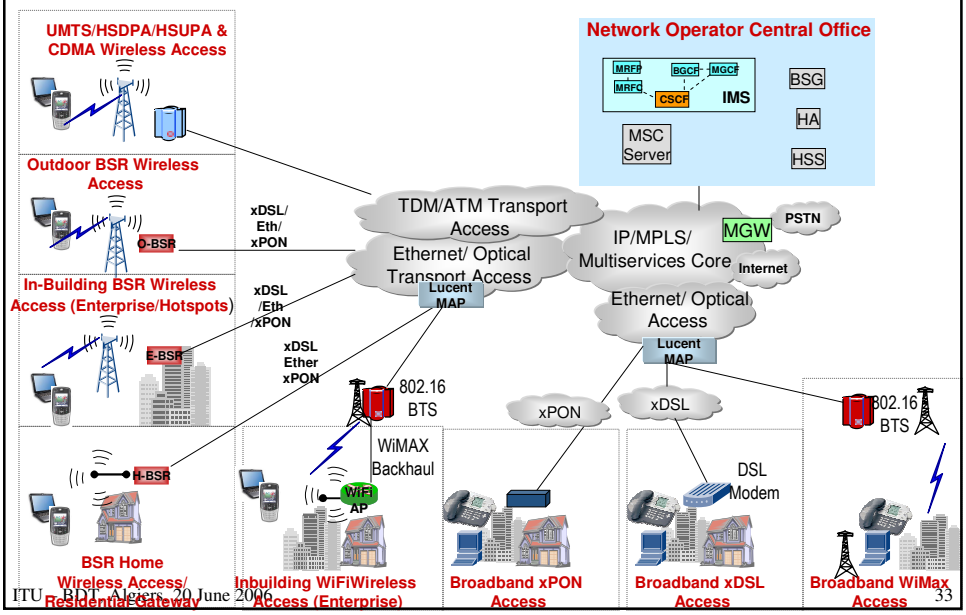
Lucent's Vision on Converged Networks based on IMS

Fixed Mobile Converged Network
Multi-Access-Independent, Services-Enabled Network



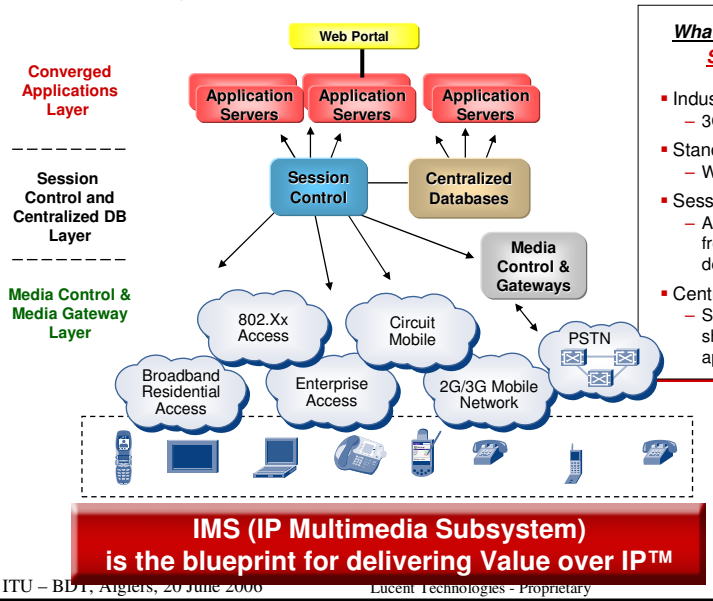
Fixed Mobile Converged Network Based on
IMS Service-Enabling Core and Multi-Standards Access

Future Converged Access Solution: Overview



IMS: Next Generation Network Model

Industry Standard Services Architecture



What is the IP Multi-media Subsystem (IMS)?

- Industry Standard
  - 3G Partnership Project(s)
- Standard Interfaces
  - Within and Between Layers
- Session Control
  - Access to any applications from any access network / device for any media type
- Centralized Database
  - Single User sign-on and shared profile for all applications

IMS (IP Multimedia Subsystem) is the blueprint for delivering Value over IP™

Conclusion

Driving Wireless Innovations:

- still more demand for wireless date rate and bandwidth
- flat IP-based system architecture
- enabling truely converged services, such as multimedia/multicast or mobile-TV

Wireless Standards will evolve in parallel and slowly converge in technology

- 3GPP (UMTS, HSPA+, LTE)
- 3GPP2 (EV-DO Rev.C)
- IEEE (802.16/WiMAX , 802.20)

Thank You

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