NSN LTEソリューション ご紹介

28th March, 2011

Hiroshi Kojima
Nokia Siemens Networks

Content

- LTE Drivers & Trends
- Standardization & Industry forums
- LTE/SAE Technology Overview
- Solution & Products
- Operator Business Case
- LTE-Advanced
- Summary & Next Steps

Nokia Siemens Networks

Trends & Drivers

Our market vision 2015 – The World connected

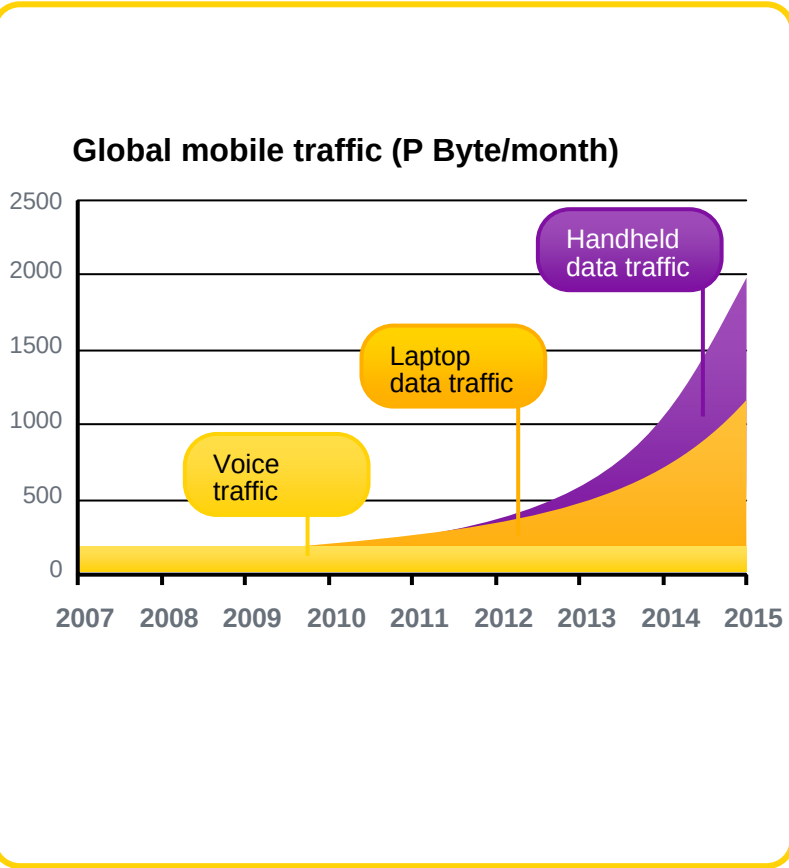
Applications predominantly in internet

Multitude of business models

Broadband everywhere

Challenges and Opportunities

The recipe for Gbytes



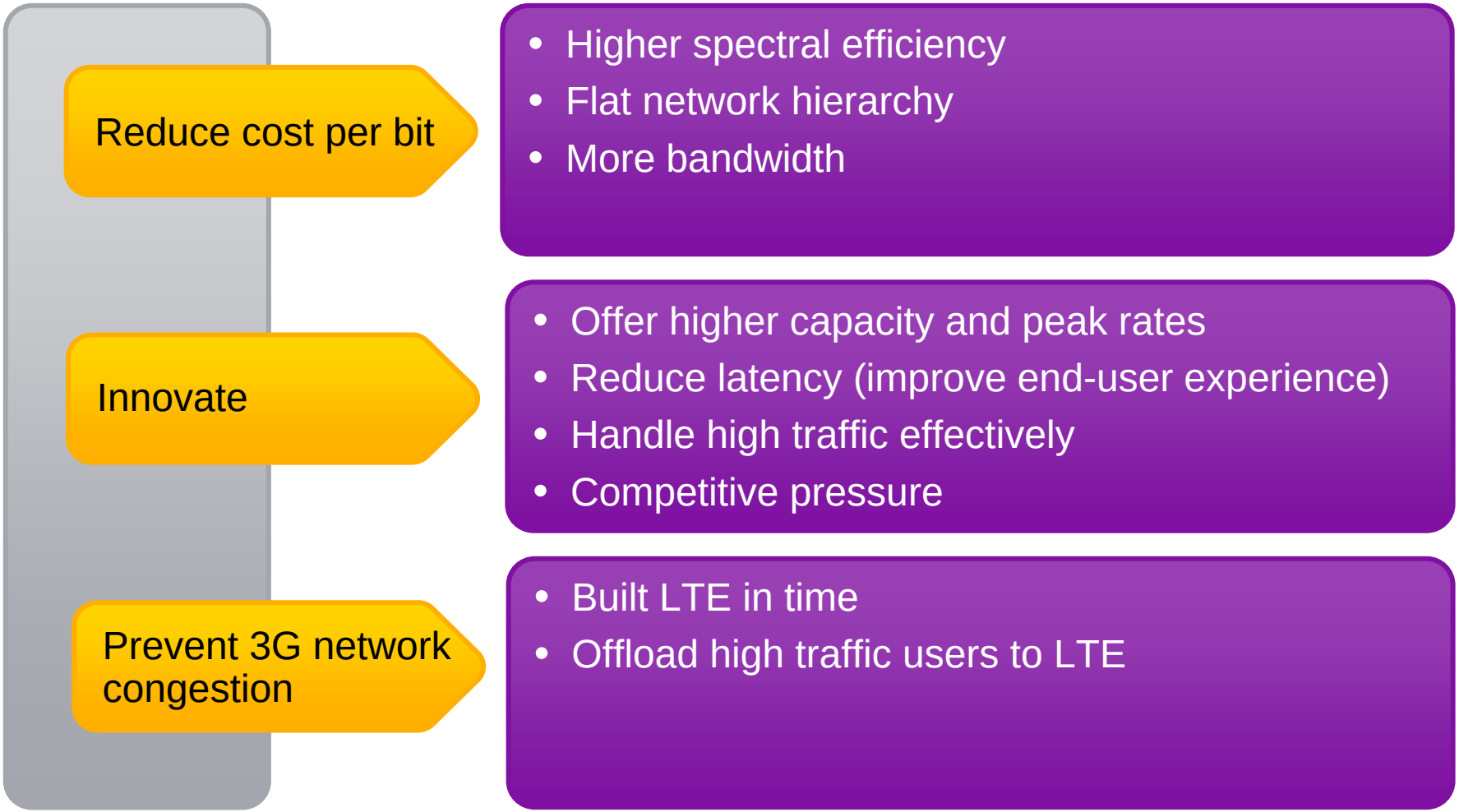
Global Traffic growth:

30x fixed broadband

300x mobile data

Growth in traffic is not matched by a corresponding growth in ARPU!

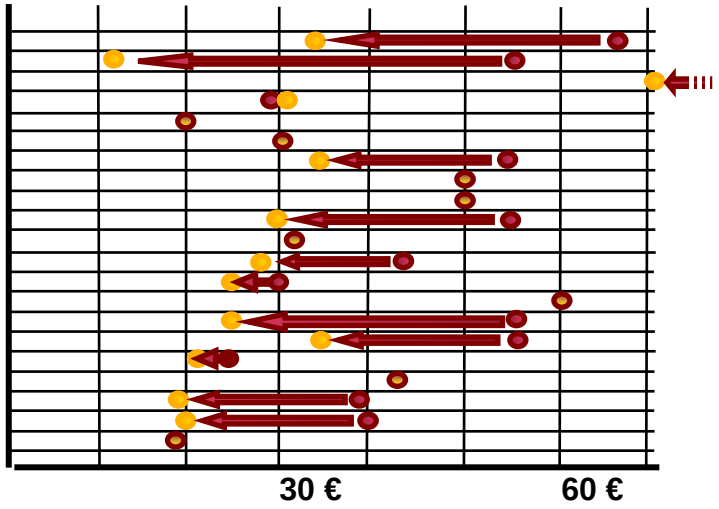
Why move to LTE?



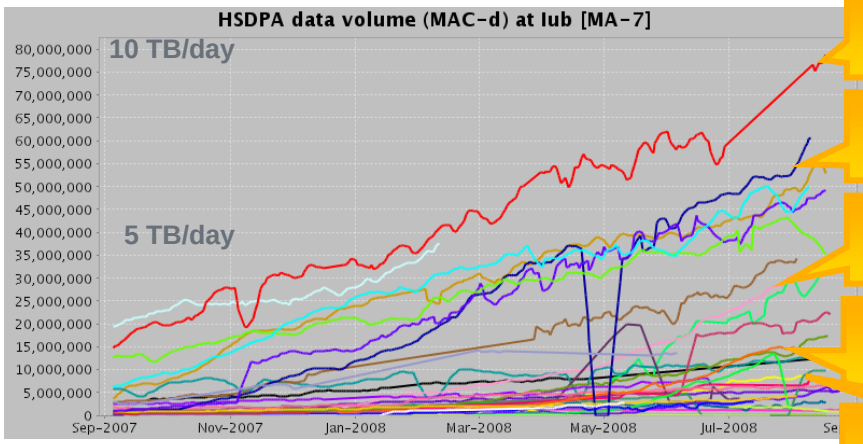
Mobile Broadband market today

HSDPA delivers traffic growth – and Revenues !

Mobile Broadband Flat-rate tariffs



Mobile-data traffic growth



- **Operator in Europe: Data Revenue +27%**
- **Operator in APAC: Data Revenue +29%**
- **Operator in APAC: Data Revenue +31%**
- **Operator in Europe: Data Revenue +12%**
- **Operator in APAC: Data Revenue +18%**

Median flatrate tariff today 28€ / month

Source: NSN analysis, Jul'07 -> Jan '08

Total data revenues increased up to 30% Traffic growing by 350%

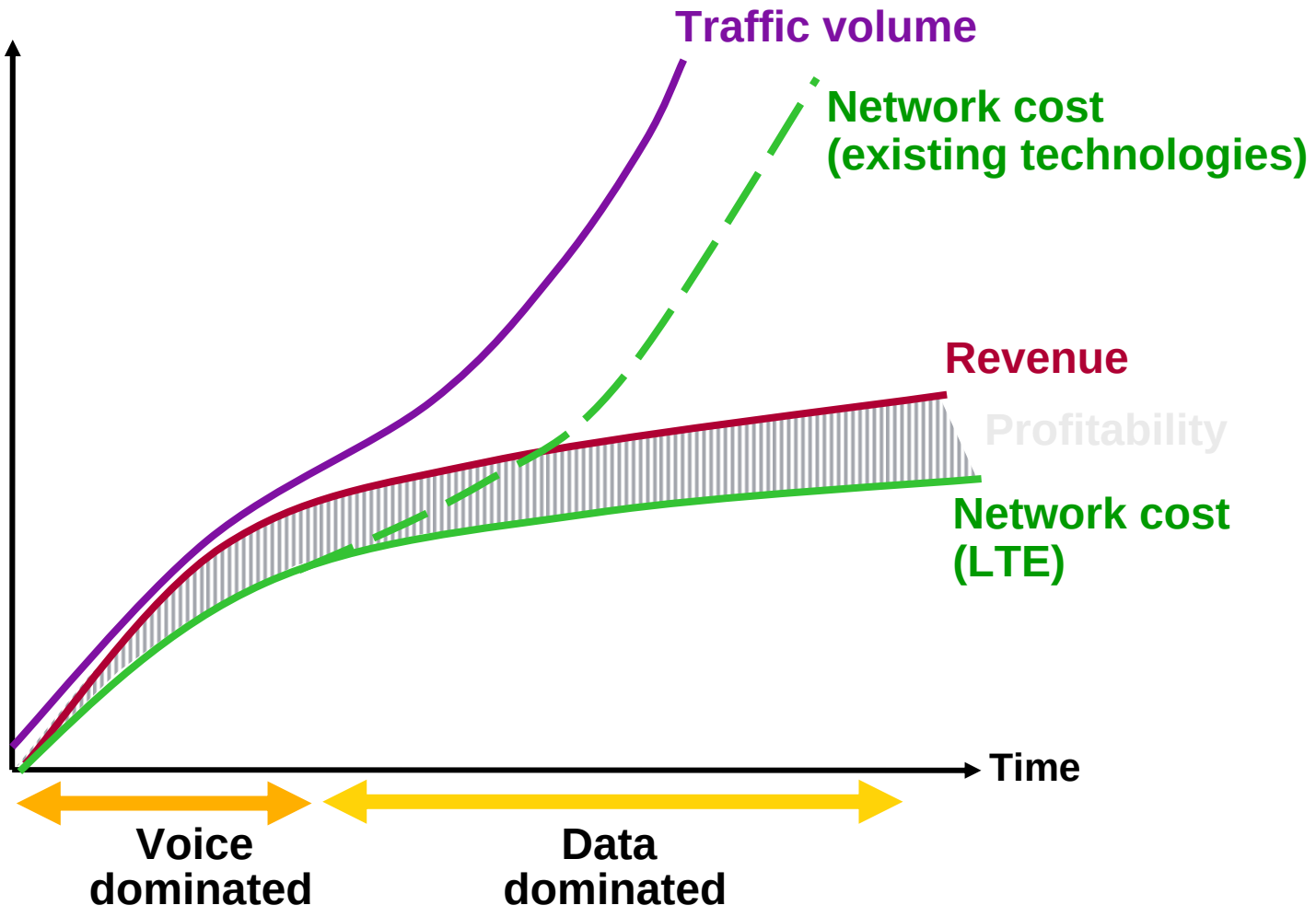
Source: Merill Lynch Global Wireless Matrix. Sep06-Sep07. Local Currencies.

Data revenues increased due to HSDPA and data flat rates

But traffic grows much faster

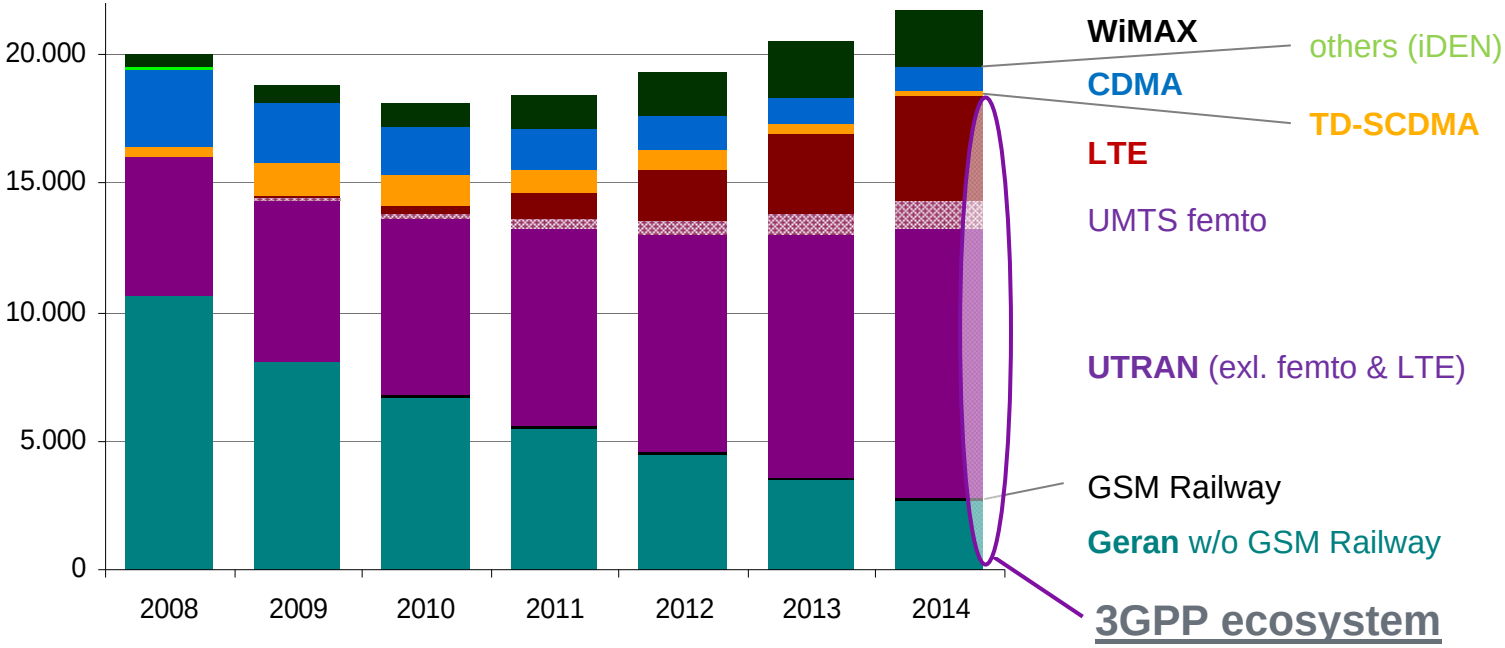
➔ Networks must become more efficient

Traffic increase requires low cost/bit technologies

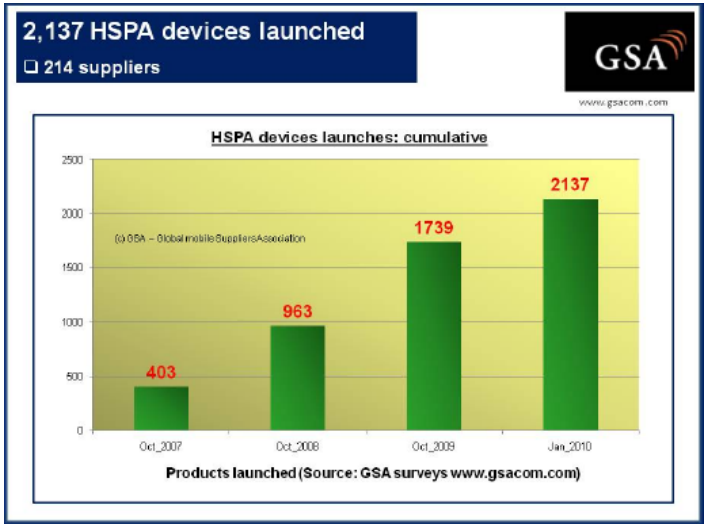


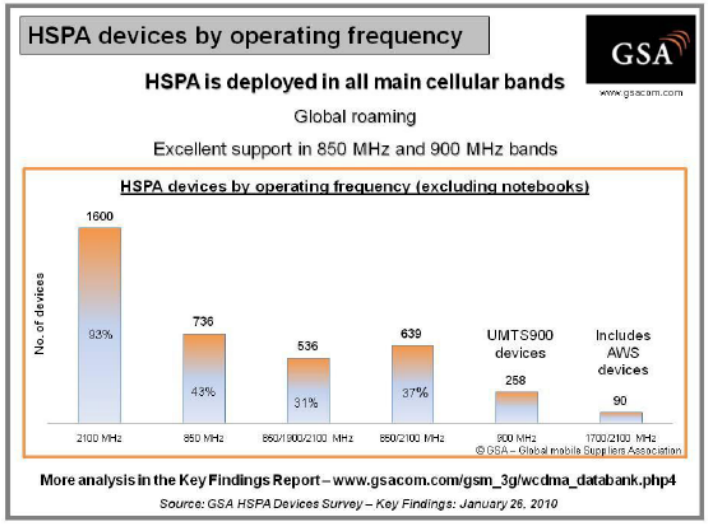
Price per MByte has to be reduced to remain profitable

Technology considerations:
3GPP ecosystem is mainstream



Source:
NSN Market
Report 07/2009





Source:
GSA March 2010

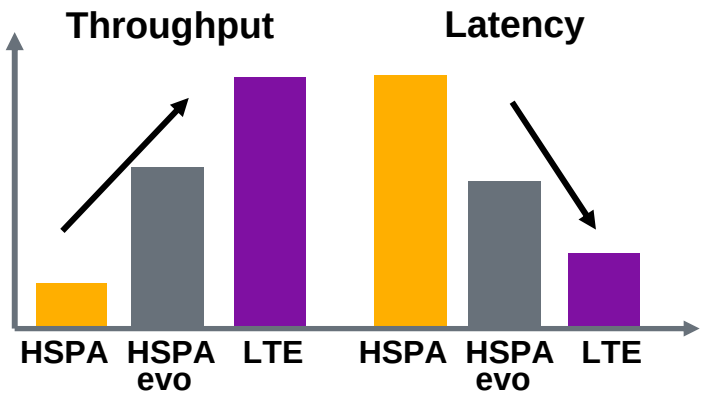
Key benefits for operators and end-user

Investment Protection

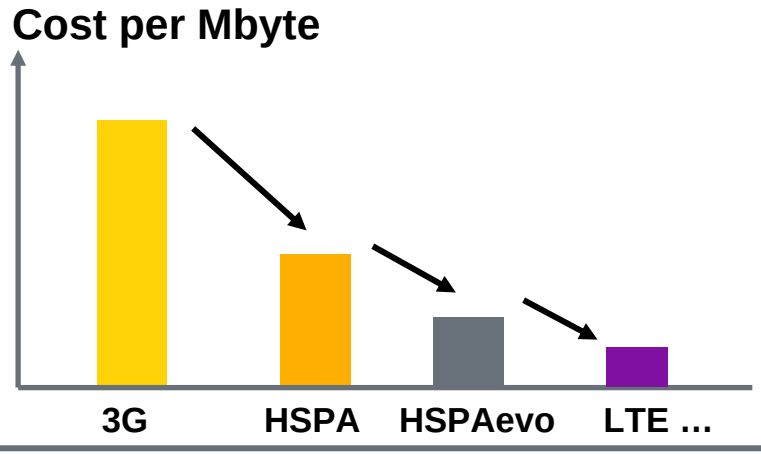
Re-use of

- Sites and infrastructure
- Backhauling
- Frequency bands

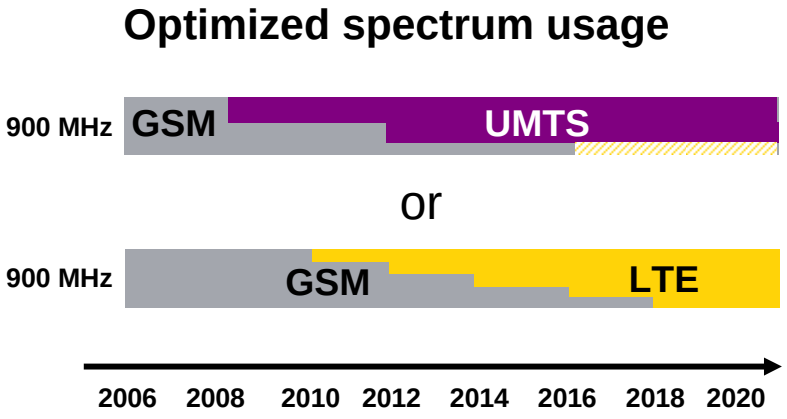
User experience → ARPU



Low Costs



Scalable bandwidth



Standardization & Industry forums

- **NGMN Ltd.**
- **LTE/SAE Trial Initiative**
- **3GPP**

Nokia Siemens Networks

LTE-Standardization in 3GPP:
Further releases in preparation

- 3GPP Rel 8 was only the initial LTE release
- Further releases follow:
  - Rel 9: work in progress (additional features)
  - Rel 10 (LTE-A): work started (enhanced performance, IMT-2000 compliant)

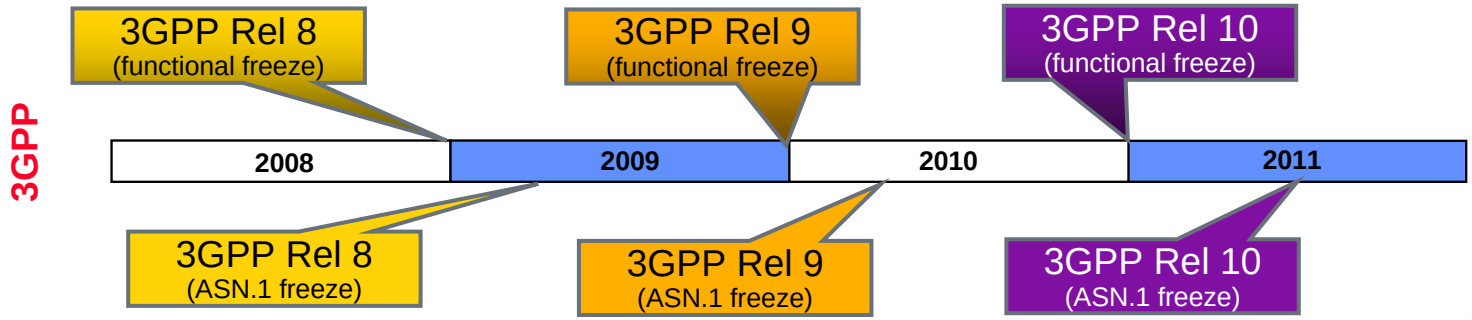
3GPP Rel 9 features:

- MBMS support in EPS
- HeNB Enhancements
- SON enhancements
- LTE Positioning
- Network-Based Positioning Support for LTE
- Enhanced Dual-Layer Transmission for LTE
- LTE TDD Home eNodeB RF Requirements
- Public Warning System (PWS)
- LTE Pico NodeB RF Requirements
- Multi-standard radio (MSR) RF requirements
- LTE/UMTS 800 MHz (Europe)

3GPP Rel 10 feature candidates:

- Carrier Aggregation for LTE
- Enhanced DL Multiple Antenna Transmission for LTE (incl. MIMO enhancements)
- UL Multiple Antenna Transmission for LTE (incl. Mimo enhancements)
- Relays for LTE
- Latency reductions for LTE
- Minimization of Drive Tests

Under discussion: HeNB / HNB, SON, eMBMS



LTE/SAE Technology Overview

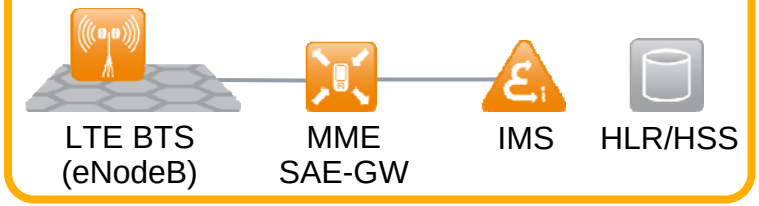
Nokia Siemens Networks

Basic Concepts / Architecture

LTE / SAE introduces the mechanism to fulfill the requirements of a next generation mobile network

Flat Overall Architecture

- 2-node architecture
- IP routable transport architecture

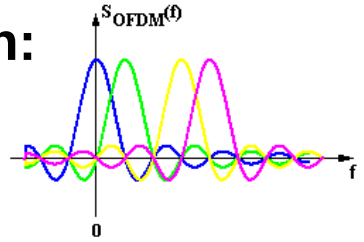


Improved Radio Principles

- peak data rates [Mbps] 173 DL , 58 UL
- Scalable BW: 1.4, 3, 5, 10, 15, 20 MHz
- Short latency: 10 – 20 ms

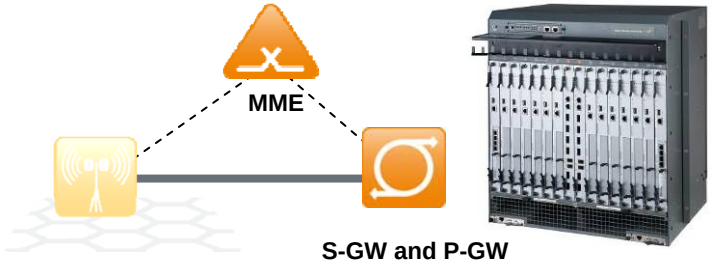
RF Modulation:

- OFDMA in DL
- SC-FDMA in UL



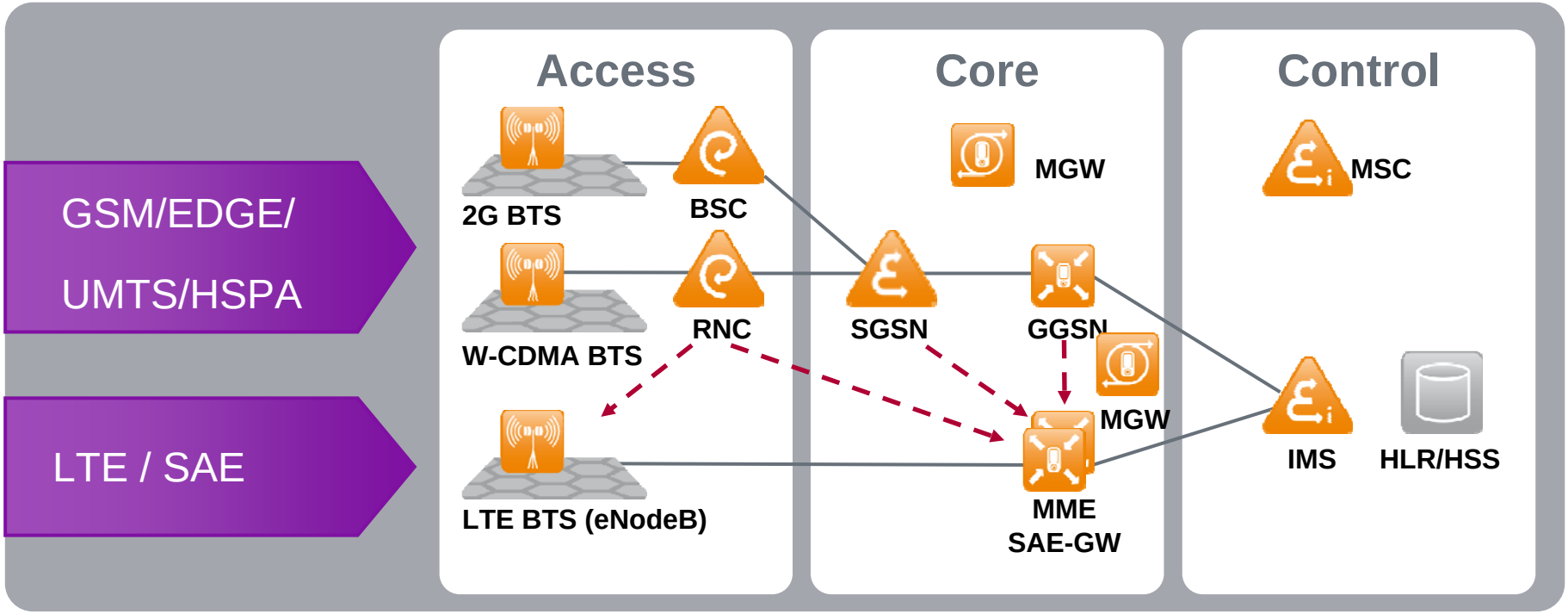
New Core Architecture

- Simplified Protocol Stack
- Simple, more efficient QoS
- UMTS backward compatible security



Key architectural concept.

Flat and cost effective Mobile Network



Improved flexible radio technology

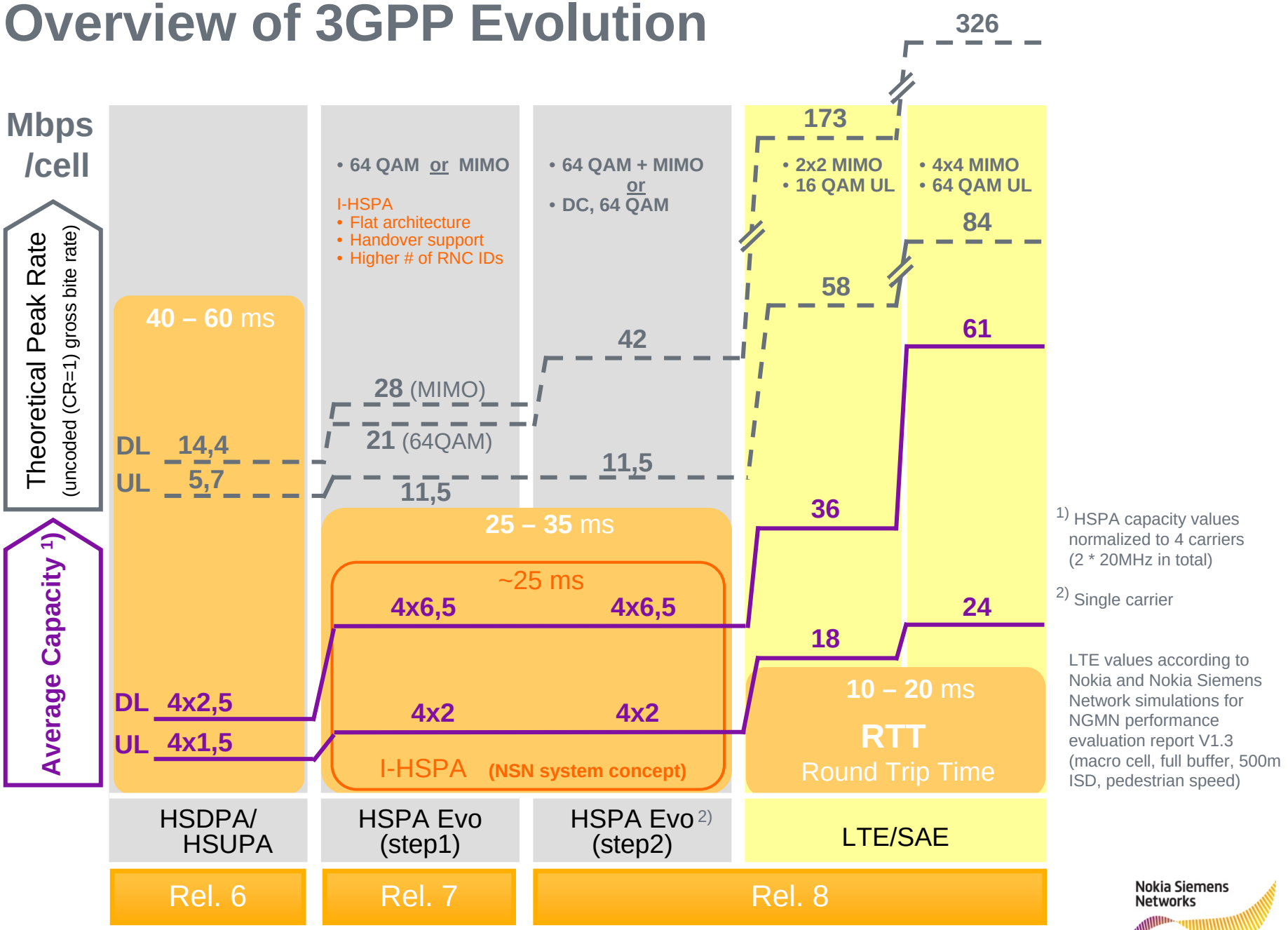
- New air I/F providing higher data throughputs
- LTE provides flexibility for spectrum re-farming and new spectrum
- LTE can operate in a number of different frequency bands

Simpler architecture for reduced OPEX

- Simplified, flat network architecture based on IP reduces operators' cost per bit significantly
- Interworking with legacy systems is an integral part of service continuity
- Re-use of existing equipment as much as possible

Performance Overview

Overview of 3GPP Evolution



1) HSPA capacity values normalized to 4 carriers (2 * 20MHz in total)

2) Single carrier

LTE values according to Nokia and Nokia Siemens Network simulations for NGMN performance evaluation report V1.3 (macro cell, full buffer, 500m ISD, pedestrian speed)

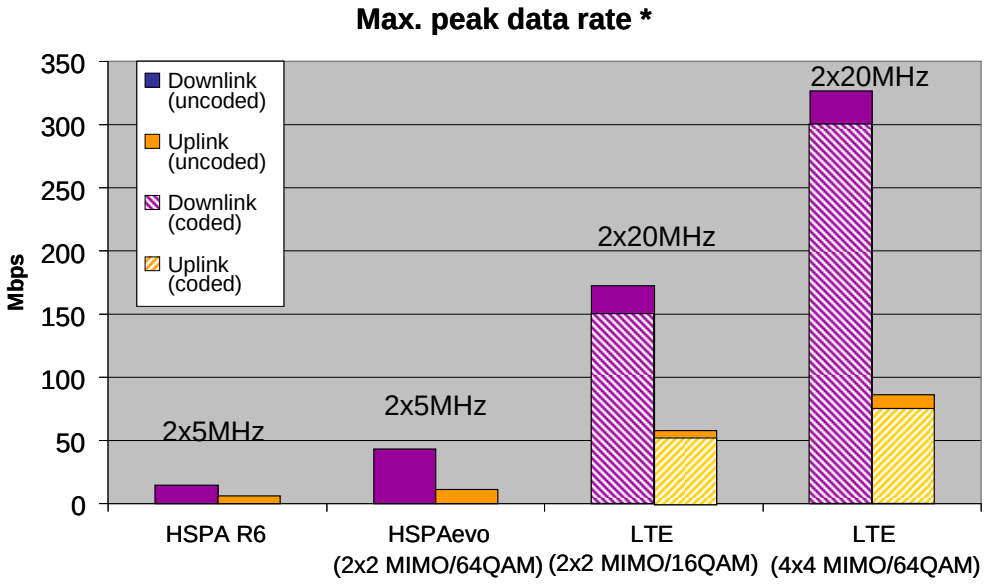
Performance: Overview of 3GPP Evolution

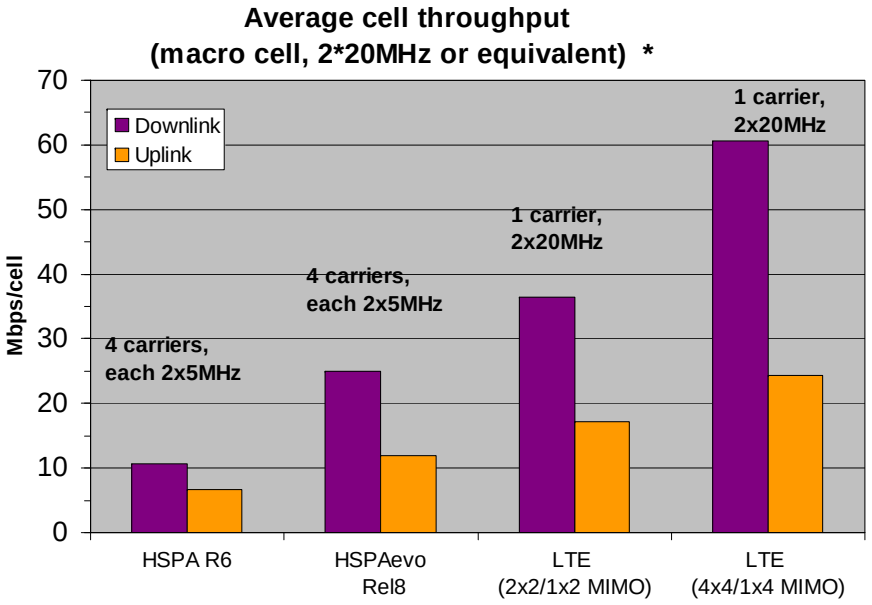
3GPP Rel. 6	3GPP Rel. 7	3GPP Rel. 8		3GPP Rel. 9
HSDPA/HSUPA	**HSPA Evo** (step1)	**HSPA Evo** (step2)	**LTE/SAE** 2x2 MIMO UL:16 QAM	**LTE/SAE** 4x4 MIMO (Rel8) UL:16 QAM (Rel8)
	I-HSPA (Nokia Siemens Networks system concept)			
• High speed DL/UL • 16 QAM • HARQ • 10/2 ms TTI	• Direct Tunnel • 64 QAM (exor) • MIMO • Flat architecture • Handover support • Higher # of RNC IDs	• 64 QAM+MIMO or • DC + 64 QAM	• OFDM based • SC-FDMA in UL • Dynamic LA • Flat architecture • IP backhauling	• SON enhancements • Emergency Call • Positioning support • Home eNB (Femto) • MBMS (tbd)
Peak data rates (Mbps) 1)	DL: 14.4 UL: 5.7	DL: 28 UL: 11.5	DL: 42 UL: 11.5	DL: 173 UL: 58	DL: 326 UL: 84
Average capacity (Mbps/cell) 2)	DL: 4 * 2.5 UL: 4 * 1.5	DL: 4 * 6.5 UL: 4 * 2	DL: 4 * 6.5 UL: 4 * 2	DL: 36 UL: 18	DL: 61 UL: 24
Round Trip Time (RTT: ms)	**40-60**	**25-35** 25	**25-35** 25	**10-20**	**10-20**

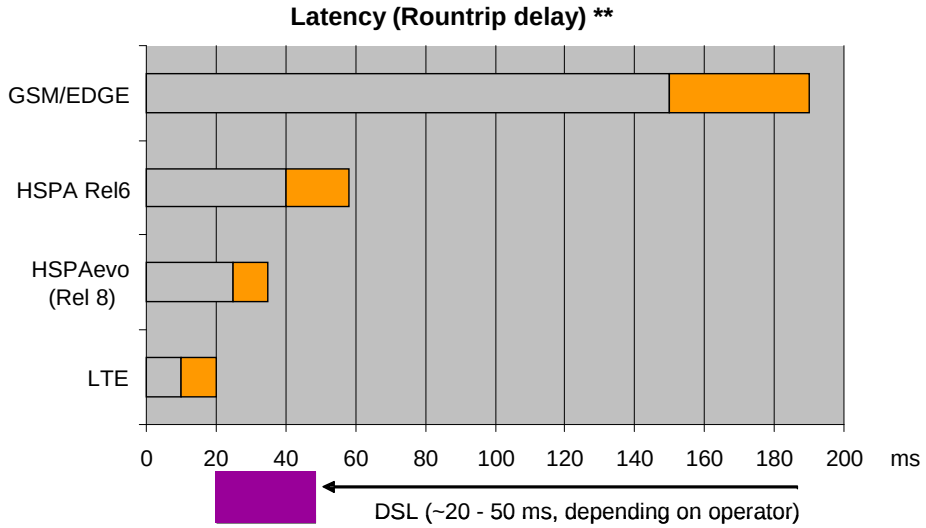
1) Uncoded (CR=1) gross bit rate at air I/F
2) HSPA capacity values normalized to 4 carriers (2 * 20MHz in total), LTE capacity according to Nokia and Nokia Siemens Network simulations for NGMN performance evaluation report V1.3 (macro cell, full buffer, 500m ISD, pedestrian speed)

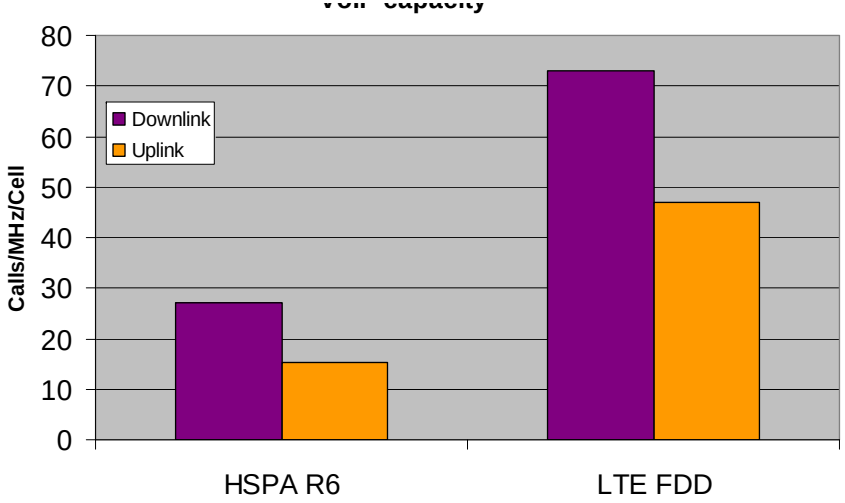
Comparison of Throughput and Latency

LTE shows excellent performance









* LTE values according to Nokia and Nokia Siemens Network simulations for NGMN performance evaluation report V1.3 (macro cell, full buffer, 500m ISD, pedestrian speed)

** Server near RAN

LTE UE Classes

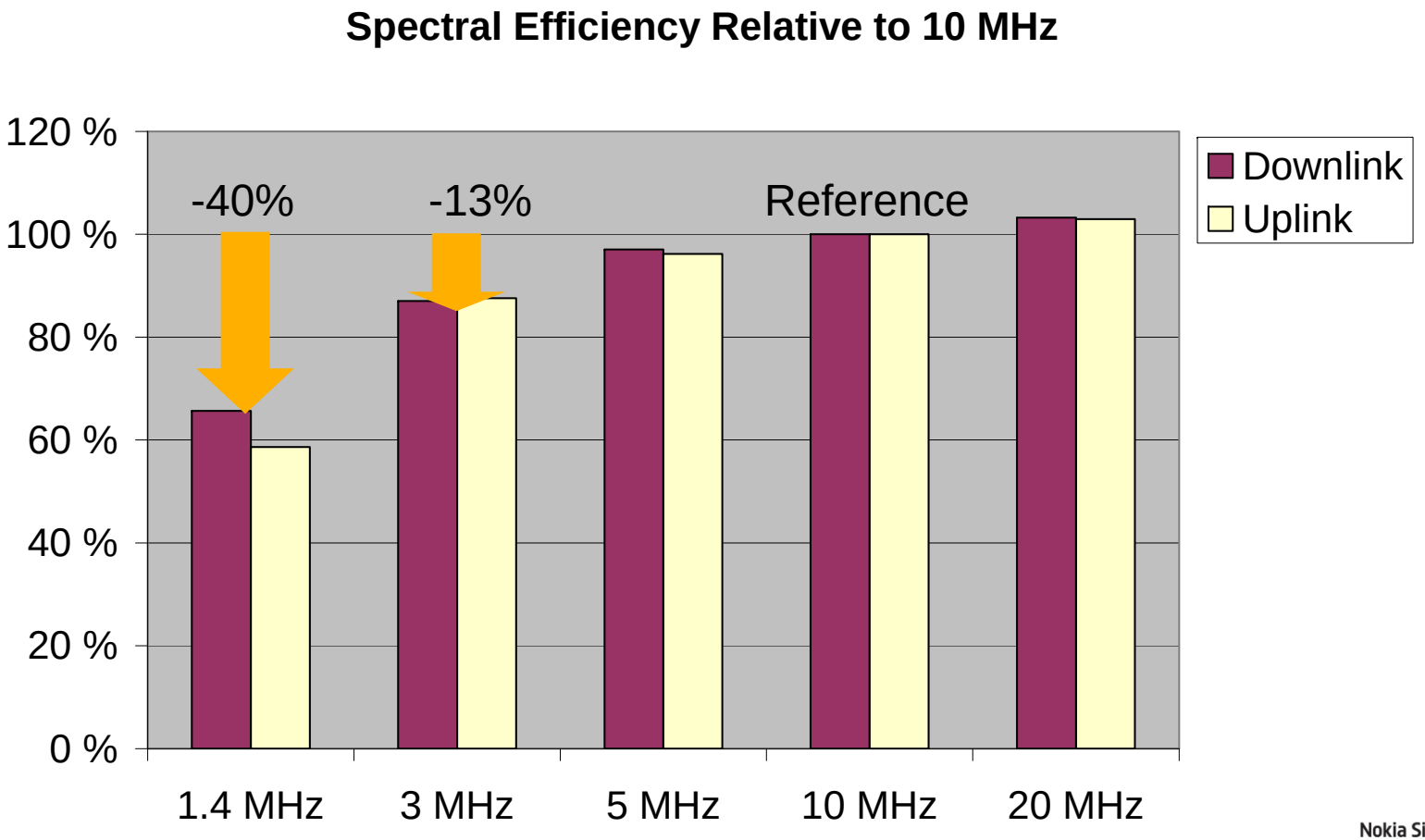
- All classes support 20 MHz, 64QAM downlink and receive antenna diversity
- All known LTE device chipsets support at least class 3 (also in the first phase with bit rates up to 100 Mbps)

	Class 1	Class 2	Class 3	Class 4	Class 5
Peak rate DL/UL	10/5 Mbps	50/25 Mbps	100/50 Mbps	150/50 Mbps	300/75 Mbps
RF bandwidth	20 MHz	20 MHz	20 MHz	20 MHz	20 MHz
Modulation DL	64QAM	64QAM	64QAM	64QAM	64QAM
Modulation UL	16QAM	16QAM	16QAM	16QAM	64QAM
Rx diversity	Yes	Yes	Yes	Yes	Yes
MIMO DL	Optional	2x2	2x2	2x2	4x4

All LTE devices expected to support MIMO 2x2

LTE also efficient with small bandwidth

- LTE maintains high efficiency with bandwidth down to 3.0 MHz, e.g. for low frequency band refarming scenarios
- The differences between bandwidths come from frequency scheduling gain and different overheads



Spectrum Considerations

3GPP frequency bands

(Source: TS 36.104)

Band	MHz	Uplinks MHz	Downlink MHz		Region
1	2x60	1920-1980	2110-2170	FDD	UMTS core
2	2x60	1850-1910	1930-1990	FDD	US PCS
3	2x75	1710-1785	1805-1880	FDD	1800
4	2x45	1710-1755	2110-2155	FDD	US AWS
5	2x25	824-849	869-894	FDD	US 850
6	2x10	830-840	875-885	FDD	Japan 800 (currently n/a)
7	2x70	2500-2570	2620-2690	FDD	2600
8	2x35	880-915	925-960	FDD	GSM 900
9	2x35	1749-1784	1844-1879	FDD	Japan 1700
10	2x60	1710-1770	2110-2170	FDD	Extended AWS
11	2x25	1427-1452	1475-1500	FDD	Japan 1500
12	2x18	698-716	728-746	FDD	US 700 MHz Lower (Band A,B,C)
13	2x10	777-787	746-756	FDD	US 700 MHz Upper (Band C)
14	2x10	788-798	758-768	FDD	US 700 MHz Upper (Band D+)
17	2x12	704-716	734-746	FDD	US 700 MHz Lower (Band B, C)
18	2x15	815-830	860-875	FDD	New
19	2x15	830-845	875-890	FDD	New
20	2x30	832-862	791-821	FDD	New
21	2x15	1448-1463	1496-1511	FDD	New
33	1x20	1900-1920	1900-1920	TDD	UMTS core TDD
34	1x15	2010-2025	2010-2025	TDD	UMTS core TDD
35	1x60	1850-1910	1850-1910	TDD	US (TDD alternative to FDD)
36	1x60	1930-1990	1930-1990	TDD	US (TDD alternative to FDD)
37	1x20	1910-1930	1910-1930	TDD	US
38	1x50	2570-2620	2570-2620	TDD	2600 TDD part
39	1x40	1880-1920	1880-1920	TDD	China UMTS TDD
40	1x100	2300-2400	2300-2400	TDD	China TDD

New spectrums in WSE – 2010/2011

Status 27.04.2010

UK

Frequency	Year
790-862 MHz	2010
2.6 GHz* (14paired/ 1 unpaired)	2010

Belgium

Frequency	Year
2.1 GHz (4th 3G mobile operator)	Sept.2010
2.6 GHz*(5 paired / 1 unpaired)	Sept/Oct.2010

France

Frequency	Year
2.1 GHz	May 2010
2.6 GHz* (14paired/10 unpaired)	late 2010

Portugal

Frequency	Year
800MHz/2.6GHz (auction)	late 2010

Spain

Frequency	Year
800 MHz./ 2.6 GHz (auction)	2010

Switzerland

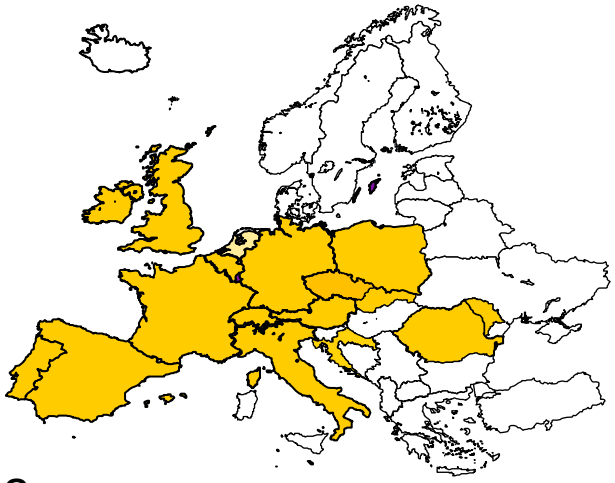
Frequency	Year
800/900 MHz./1.8/2.1/2.6 GHz (re-auction)	Q1 2011

Ireland

Frequency	Year
470-862 MHz/2.3/2.4 GHz	open

Netherlands

Frequency	Year
2.01 GHz (1 unpaired)	Apr. 2010
2.6 GHz (13 paired/10 unpaired)	Apr. 2010
900/1800 MHz	2012



Germany

Frequency	Year
800 MHz (6 paired)	Apr. 2010
1.8 GHz (5 paired)	Apr. 2010
2.0 GHz (4 paired/ 2 unpaired)	Apr. 2010
2.6 GHz (14paired/10 unpaired)	Apr. 2010

Poland

Frequency	Year
800/2300 MHz	late 2010
2.6GHz	open

Austria

Frequency	Year
2.6 GHz (14paired/10 unpaired)	Sept. 2010

Romania

Frequency	Year
3G UMTS	2010
2.5 GHz	2011

Czech Republic

Frequency	Year
1800 MHz	late 2010
2/3 x 2.6 GHz (WIMAX or LTE)	mid2010

Greece

Frequency	Year
2.6 GHz	2010

Italy

Frequency	Year
900 MHz (refarming)	2010
2.6 GHz* (14paired/9 unpaired)	2010

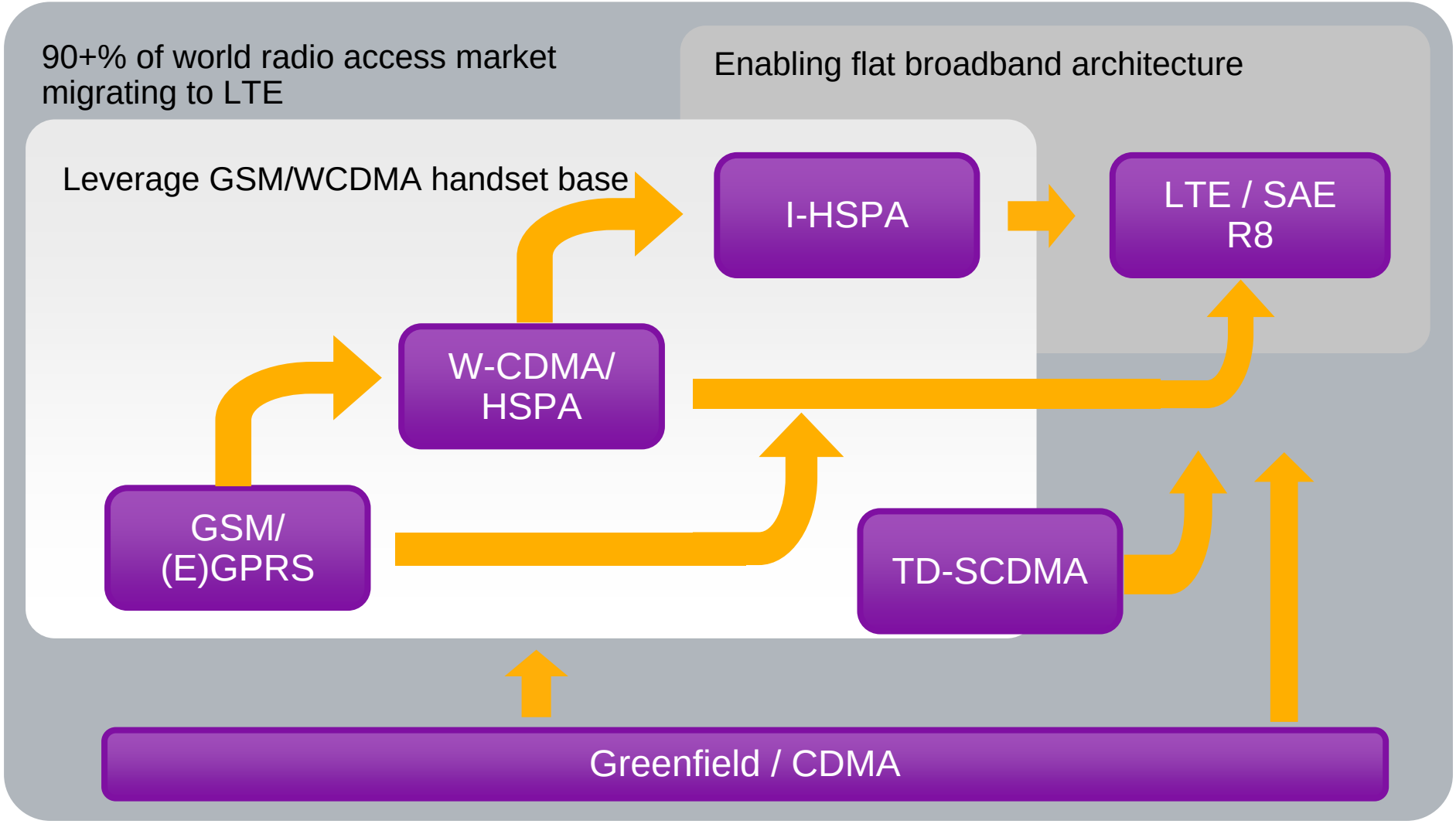
* Under discussion

Source: WCIS; Analysis Mason; regulatories; CO NWS WSE GSM & MBB Sales Team; NSN MCA WSE SM & MS

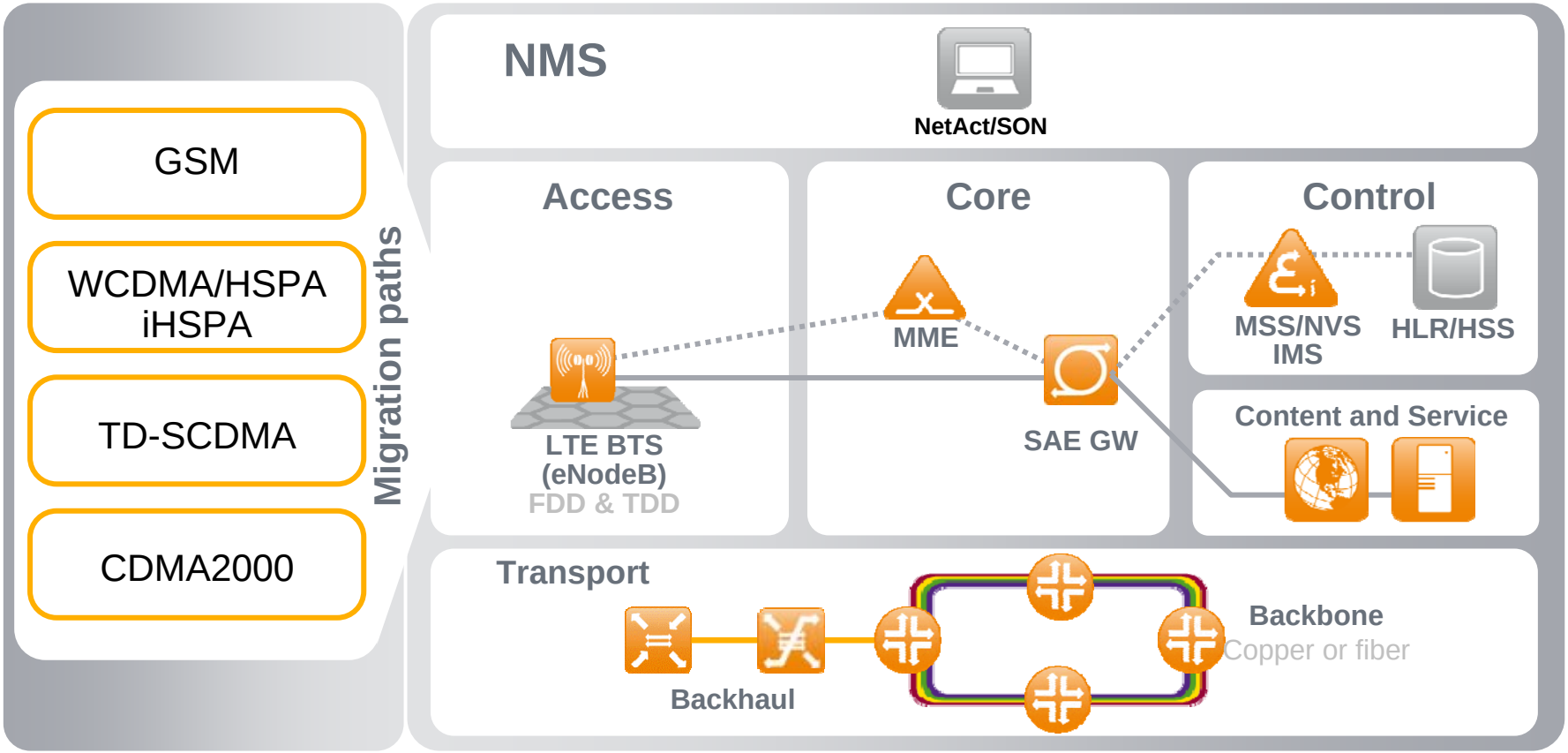
Solution & Products

Evolution Path to LTE

Opens up future service perspectives for new entrants and CDMA operators



Benefit from our complete LTE/SAE solution for each migration path



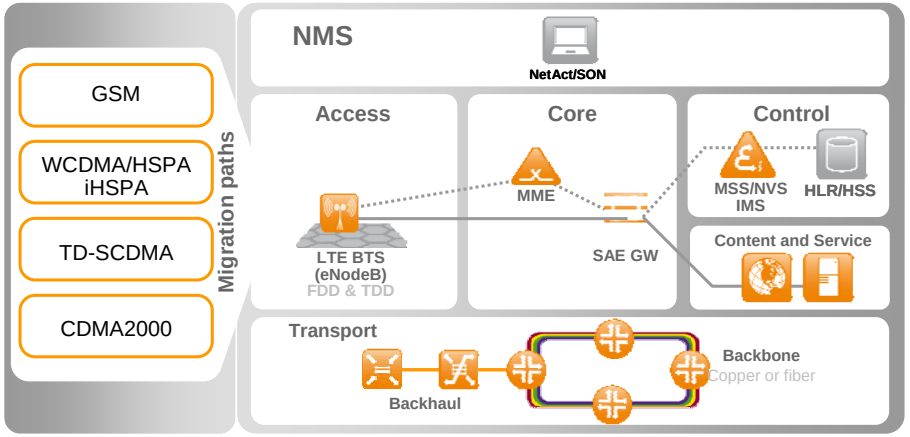
NSN provides a complete LTE solution

World Greenest and most Energy Efficient Multi-Radio BTS

Unique NetAct OSS system for multi-technology management

Unparalleled subscription management and charging systems

Smooth Evolution from GSM / WCDMA / HSPA to LTE with SW upgrade only



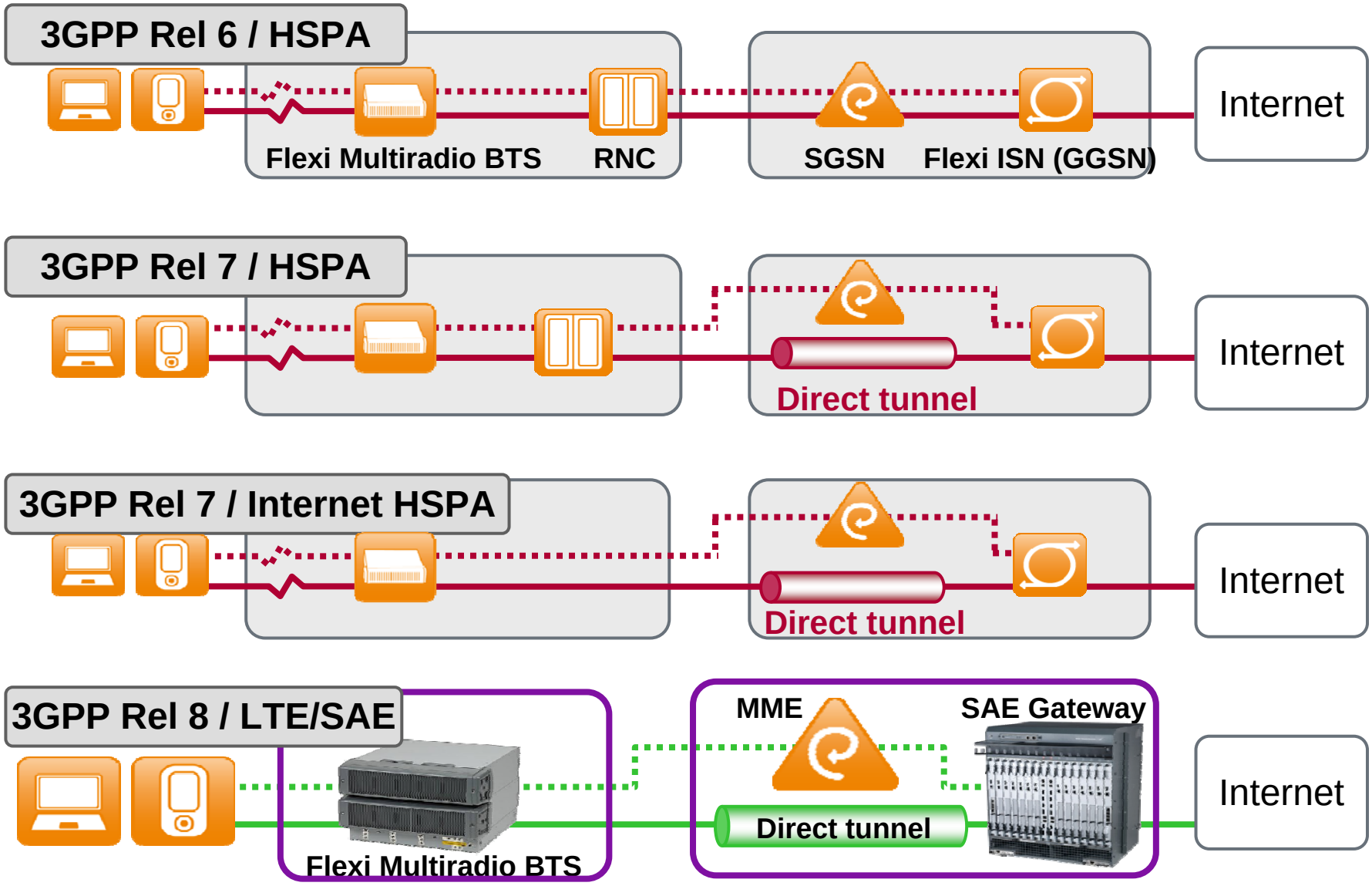
Market leading MSS/IMS

Proven managed services, consulting, and implementation support

Mobile backhaul solution LTE available today

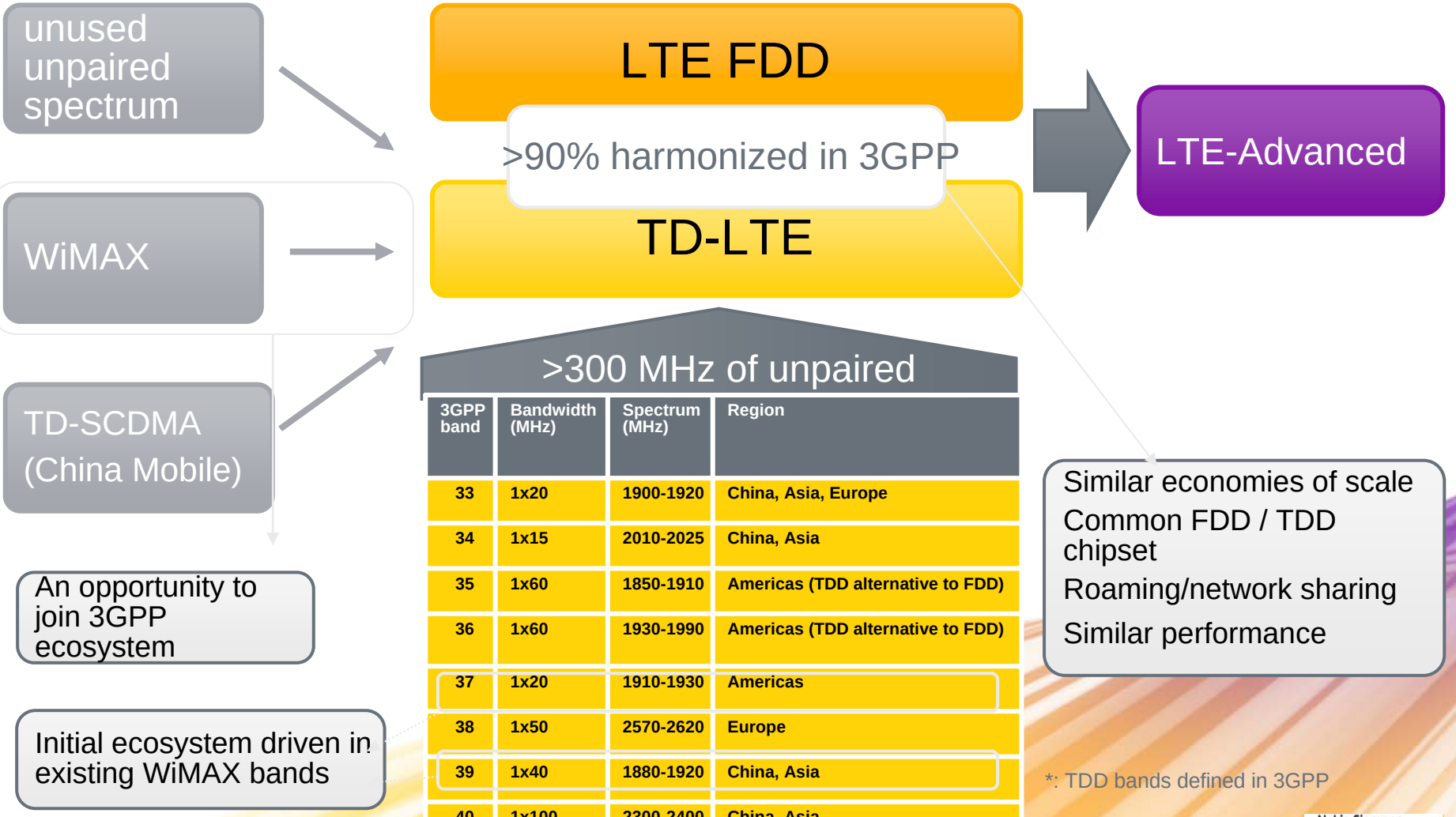
Flat network architecture of LTE available today

Start today preparing for tomorrow!



Simple upgrade to end-to-end LTE/SAE solution

Nokia Siemens Networks TD-LTE
Evolution path for mobile broadband in unpaired spectrum



3GPP band	Bandwidth (MHz)	Spectrum (MHz)	Region
33	1x20	1900-1920	China, Asia, Europe
34	1x15	2010-2025	China, Asia
35	1x60	1850-1910	Americas (TDD alternative to FDD)
36	1x60	1930-1990	Americas (TDD alternative to FDD)
37	1x20	1910-1930	Americas
38	1x50	2570-2620	Europe
39	1x40	1880-1920	China, Asia
40	1x100	2300-2400	China, Asia

Different FDD & TDD bands defined by 3GPP

Status: 3GPP R9, Dec. 2009

Band	MHz	Uplinks MHz	Downlink MHz		Region
1	2x60	1920-1980	2110-2170	FDD	UMTS core
2	2x60	1850-1910	1930-1990	FDD	US PCS
3	2x75	1710-1785	1805-1880	FDD	1800
4	2x45	1710-1755	2110-2155	FDD	US AWS
5	2x25	824-849	869-894	FDD	US 850
6	2x10	830-840	875-885	FDD	Japan 800 (currently n/a)
7	2x70	2500-2570	2620-2690	FDD	2600
8	2x35	880-915	925-960	FDD	GSM 900
9	2x35	1749-1784	1844-1879	FDD	Japan 1700
10	2x60	1710-1770	2110-2170	FDD	Extended AWS
11	2x25	1427-1452	1475-1500	FDD	Japan 1500
12	2x18	698-716	728-746	FDD	US 700 MHz Lower (Band A,B,C)
13	2x10	777-787	746-756	FDD	US 700 MHz Upper (Band C)
14	2x10	788-798	758-768	FDD	US 700 MHz Upper (Band D+)
17	2x12	704-716	734-746	FDD	US 700 MHz Lower (Band B, C)
18	2x15	815-830	860-875	FDD	New
19	2x15	830-845	875-890	FDD	New
20	2x30	832-862	791-821	FDD	New
21	2x15	1448-1463	1496-1511	FDD	New
33	1x20	1900-1920	1900-1920	TDD	UMTS core TDD
34	1x15	2010-2025	2010-2025	TDD	UMTS core TDD
35	1x60	1850-1910	1850-1910	TDD	US (TDD alternative to FDD)
36	1x60	1930-1990	1930-1990	TDD	US (TDD alternative to FDD)
37	1x20	1910-1930	1910-1930	TDD	US
38	1x50	2570-2620	2570-2620	TDD	2600 TDD part
39	1x40	1880-1920	1880-1920	TDD	China UMTS TDD
40	1x100	2300-2400	2300-2400	TDD	China TDD

19 FDD

8 TDD

Additional 2600 MHz band proposed by Clearwire expected to be included in 3GPP Rel.10 (March 2011)

Nokia Siemens Networks is commited to all TDD & FDD frequency bands

Radio Products and Upgrade Solutions

Flexi Multiradio Base Station

70% less HW, 25% less site costs, 55% energy savings*

- Easy to install, small, modular, weatherproof
- **SW-defined**: 1+1+1 LTE@ 20MHz, 4+4+4 WCDMA, 6+6+6 GSM
- Any **combination of the 3 technologies** – concurrently ; Plug-and-Play with SON
- **High output power**: 3 x 60 W RF
- **Leading energy efficiency**

Stacked on floor or shelf

Feeder-less sites

On wall or pole

Hidden sites

BTS or 19" cabinets

At base of mast or tower

On top of mast or tower

*compared to other vendors under same conditions

Nokia Siemens Networks

Flexibility in every dimension

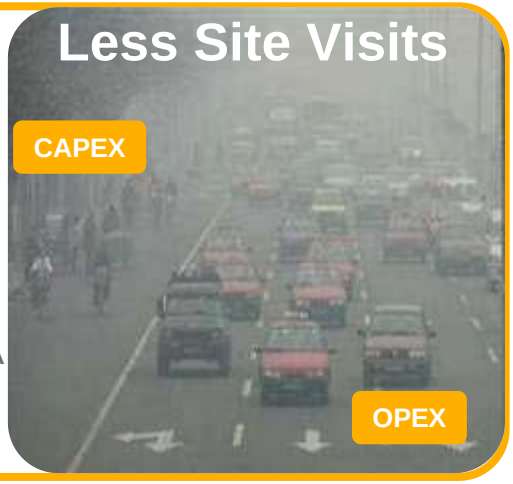
Light and Small

- One man operation
- One module is about 25 Kg
- Less logistic efforts
- Less road traffic

OPEX CAPEX

Less Site Visits

- Real software defined radio.
- No HW upgrade needed to support HSPA or LTE.



Reuse of existing infrastructure

CAPEX

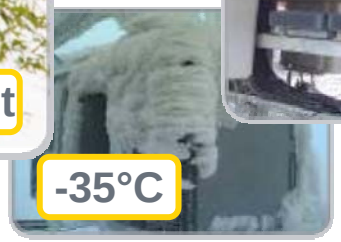
Power System
Any Cabinet

19” rack
Antenna line

Battery Backup

One design for in & out door

- Ingress protection IP65
- No need for active cooling



- Temperature range

Flexi BTS – deploy anywhere, everywhere

Nokia Siemens Networks

Technology Award + Green Network Award

Flexi Multiradio

same HW: 2G, 3G + LTE

70% less HW

25% less site costs

50% energy saved

GSMA GLOBAL MOBILE AWARDS 2009 WINNER

Best Technology Advance

Outstanding Environmental Contribution Winner

Green Network Hardware and Infrastructure Winner 2009

CTIA The Wireless Association®

Flexi Multiradio BTS
The winning base station for true Single RAN

GSMA GLOBAL MOBILE AWARDS 2009 WINNER

Winner:
Best Technology Advance 2009

- Software Defined Radio (same modules for all technologies)
- Smallest & most compact BTS
- Highest energy-efficiency → lowest power consumption
- weatherproof outdoor & indoor
- All-IP – all integrated

CTIA The Wireless Association®

Winner 2009:
Green Network Hardware and Infrastructure

Future Mobile Green Awards

Juniper Research

Gold Award Winner 2010:
Green Infrastructure

Nokia Siemens Networks

Flexi Multiradio BTS Site

- Three sector site solution 1+1+1
  - Multimode System Module
  - 3-sector RF Module
    3 x 60 W

➔ Multimode HW available since Q3/2008 and SW-upgradeable to LTE!

Complete Outdoor BTS (DC powered)
- Size: 6U high
- Volume: 50 liters
- Weight: < 50 kg

The most cost and size optimized 3-sector site

Multimode System Module

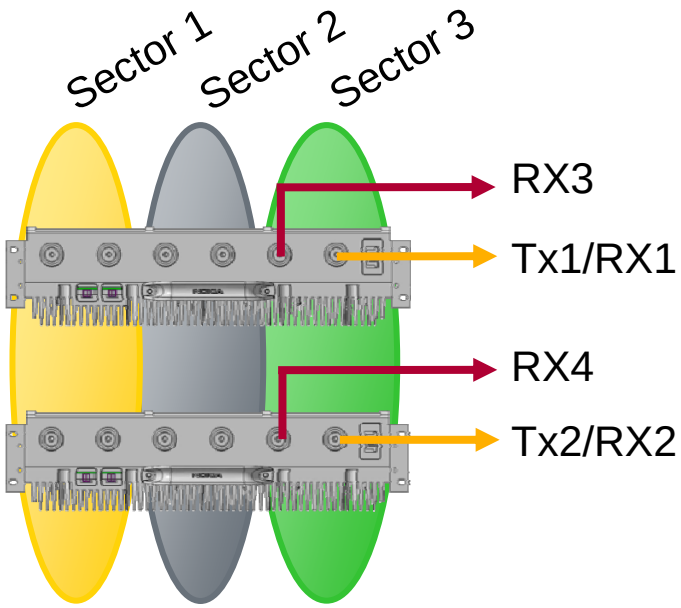
3-sector RF Module

Size Comparison

Nokia Siemens Networks

Flexi Multiradio BTS with MIMO (High Capacity Site)

- One System Module
- Two 3-sector RF Modules for 3 sectors
- 3 cells/sectors à 120W with 2x2 MIMO and 20MHz bandwidth
- RF Redundancy (implicitly)
- Optional 4 way UL diversity
- Optional TMA/MHAs



Ultimate capacity with 3x120W 2x2 MIMO and 20MHz bandwidth

Optional TMA/MHA

Multimode System Module

Two 3-sector RF Modules

Optional AC/DC + Battery

Nokia Siemens Networks

Example: 3-sectorized site evolution

Zero footprint migration to LTE, 2.1GHz refarming with LTE later

2.6 GHz		LTE
2.1 GHz	WCDMA/(I-)HSPA	LTE

Flexi 3-Sector RF Module
+ Flexi Multimode System Module
- WCDMA 2100 4+4+4

2 complete BTS in 12 HU stack

Flexi Multiradio BTS added:
- WCDMA 2100 4+4+4
- LTE 2600 1+1+1 (20MHz)

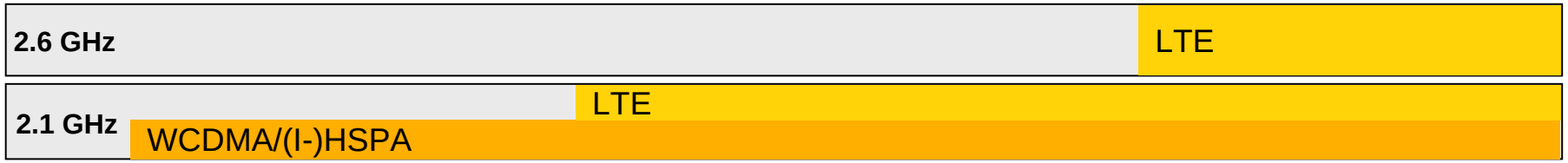
WCDMA/LTE usage controlled by SW only

No HW added: just SW upgrade
- WCDMA 2100 2+2+2
- LTE 2100 1+1+1 *) (10MHz)
- LTE 2600 1+1+1 (20MHz)

*) Concurrent operation in RF provided

Example: 3-sectorized site evolution

Fast LTE roll-out in 2.1 GHz by SW upgrade, 2.6 GHz later



Multimode

Multiband Multimode

Flexi 3-Sector RF Module
+ Flexi Multimode System Module
- WCDMA 2100 2+2+2

Flexi Multimode System Module LTE added
- WCDMA 2100 2+2+2
- LTE 2100 1+1+1 *) (10MHz)

*) Concurrent operation in SM and RF and 20MHz contiguous spectrum provided

Flexi 3-sector RF Module added
- WCDMA 2100 2+2+2
- LTE 2100 1+1+1 *) (10MHz)
- LTE 2600 1+1+1 (20MHz)

Example: 3-sectorized site evolution
LTE capacity rollout – higher bandwidth and MIMO

Bandwidth Upgrade

MIMO Upgrade

Flexi 3-Sector RF Module
+ Flexi Multimode System Module
- LTE 2600 1+1+1 (10MHz)

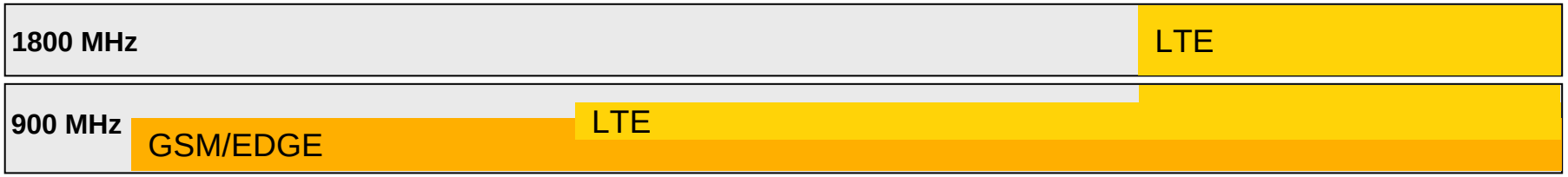
No HW changes:
just SW/configuration upgrade
- LTE 2600 1+1+1 (20MHz)

Flexi 3-Sector Multiradio RF Module added
- LTE 2600 1+1+1 (20MHz)
- 2x2 MIMO

Evolution shows an example of a conservative LTE capacity rollout.
Nevertheless, the complete described feature set is available in NSN's first LTE product release.

Example: 3-sectorized site evolution

GSM modernization and 900 MHz refarming, new LTE band later



Multimode

Multiband Multimode

Flexi 3-Sector Multiradio RF Module
+ Flexi EDGE System Module
- EDGE 900 6+6+6

Flexi Multimode System Module LTE added
- EDGE 900 4+4+4
- LTE 900 1+1+1 (3/5MHz) *)

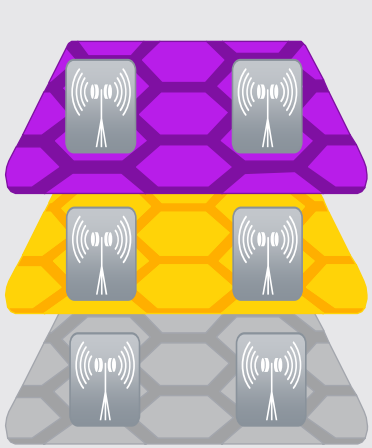
Flexi 3-sector RF Module added
- EDGE 900 3+3+3
- LTE 900 1+1+1 (10MHz)
- LTE 1800 1+1+1 (20MHz)

*) Concurrent operation in RF provided

Why do you need Single RAN?

Current model

- High Costs
- Difficult to manage
- Hard to maintain
- Complexity increasing over time



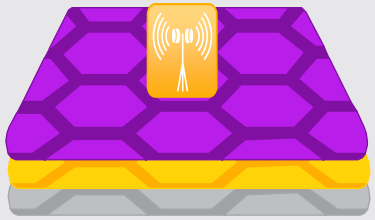
LTE/LTE-A

WCDMA / HSPA

GSM/EDGE

Network cost optimization increases profit

Single RAN makes it simpler



All 3GPP Technologies

One efficient, simple and adaptive network.

Summary - LTE & Radio Products

Flat & most cost efficient technology

- Cutting-edge performance
- Investment protection, re-farming
- Cellular broadband evolution path

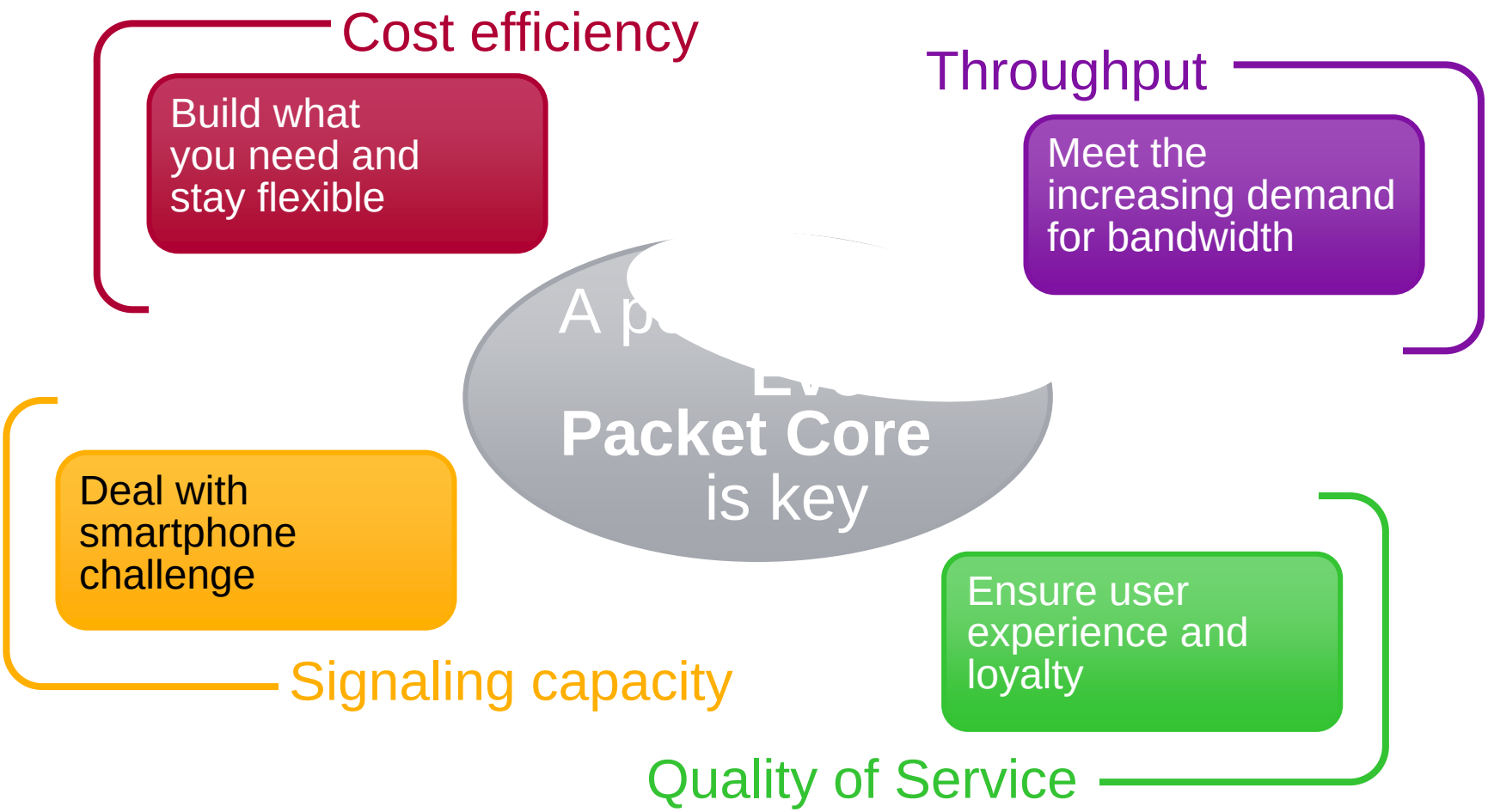
GLOBAL MOBILE AWARDS 2009
WINNER
Best Technology Advance Winner 2009

Best-in-class eNB: Flexi Multiradio

- Up to 120W / sector
- Lowest power consumption, Green BTS
- Ethernet transport
- HW since Q3/08, SW load only
- Concurrent mode GSM-HSPA-LTE, Flexible capacity split, spectrum usage
- Deployability .. fits everywhere

Core Network Products and Solutions

…to build an efficient network.



You need the right solution …

Flat architecture

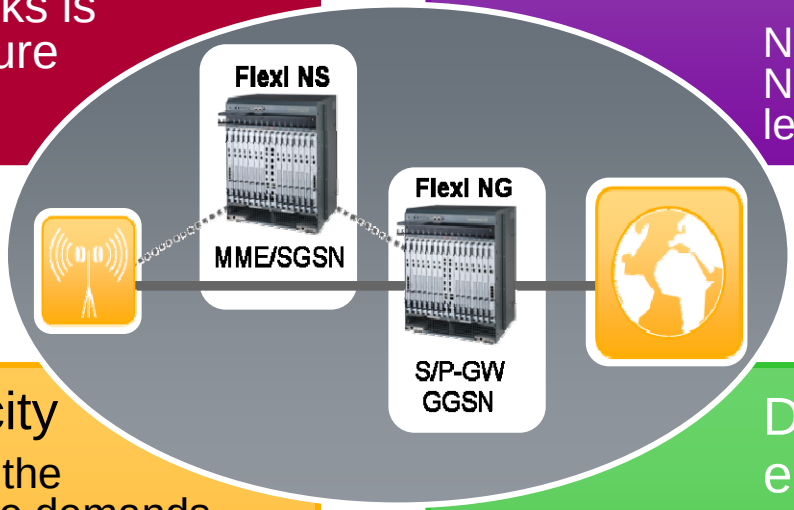
Scalability and flexibility from decoupling throughput and signaling allow cost efficient deployment

Nokia Siemens Networks is leading in flat architecture

Efficient gateway (S/P-GW)

The right balance of throughput, signaling capacity and session density is key to gateway performance and efficiency

Nokia Siemens Networks gateway is leading in efficiency



High signaling capacity

High signaling capacity is the main factor to deal with the demands generated by smartphones and applications

Nokia Siemens Networks is leading in signaling capacity

Data policy enforcement

Fair-sharing of network resources and data charging policies optimize user experience and return of investment

…with the best products …

Flexi NG

- GGSN & S/P-GW
- Highest efficiency with 4D scaling:
  - Leading throughput: 360 Gbit/s *)
  - Leading session density: 21.6M
  - Leading signaling capacity: 108k trs/s
  - Leading service awareness

Flexi NS

- SGSN & MME
- Evolution of field proven SGSN
- Leading signaling capacity: 22 k trs/s

- Simultaneous 2G/3G/LTE operation
- ATCA based platforms

Leading in all LTE relevant criteria

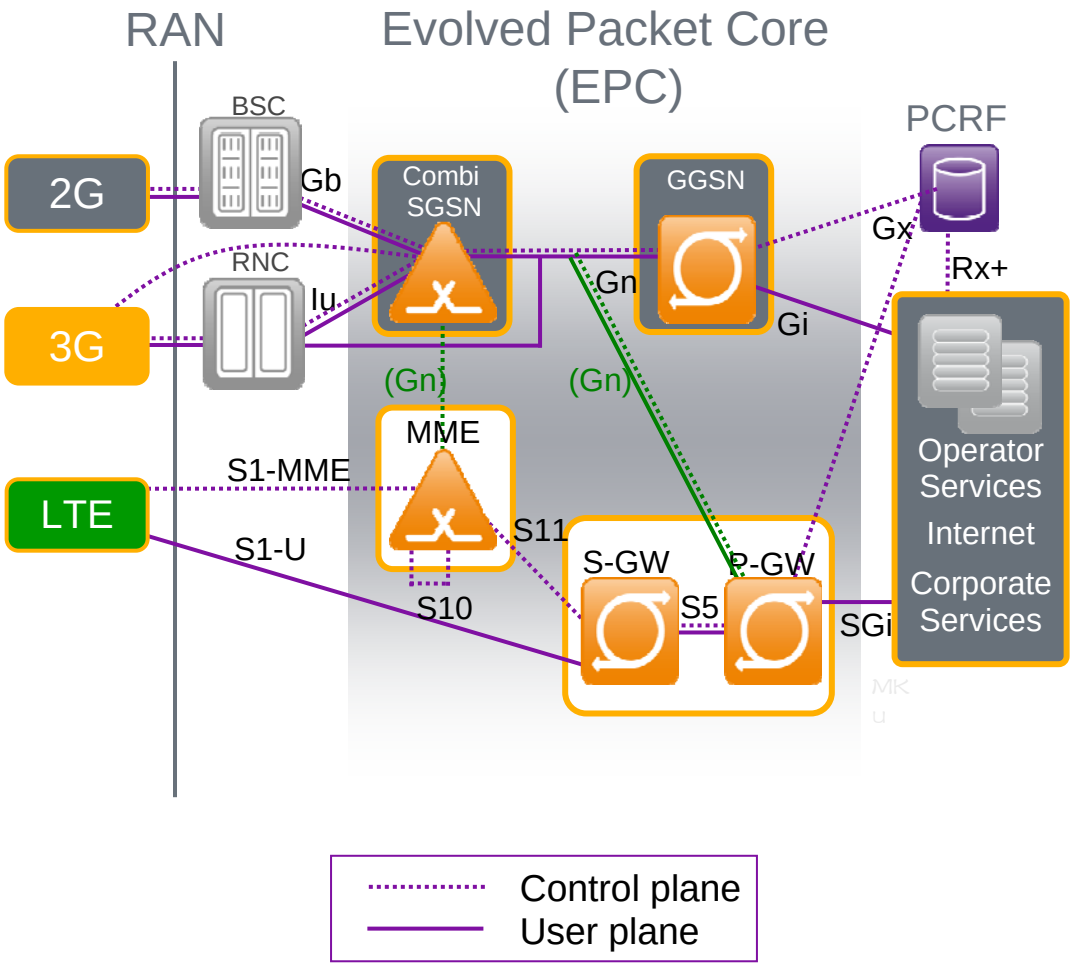
"EPC product platform will need to scale control-plane capacity, and specially that the
transaction rate (i.e. signaling capacity) of the platform will be the key to system performance"

Heavy Reading (11/2009) on Evolved Packet Core

*) per rack = 3 shelves

Early commercial phase:
Inter-working between LTE and 2G/3G – with pre-R8 SGSN

- Service continuity is required when the subscriber moves out from LTE coverage
  - 2G/3G/LTE Multimode UEs allow handovers between LTE and 2G/3G accesses
  - S/P-GW acts as an anchor point also when the subscriber is in 2G/3G radio coverage
  - 2G/3G SGSN has to be connected to EPC
- Pre-R8 SGSN can be connected to P-GW via Gn interface
  - Enables handovers between 2G/3G network and LTE
  - With Rel-7 Direct Tunnel the user plane traffic goes directly from UTRAN to P-GW
  - Existing GGSN can be used for pure 2G/3G terminals and traffic
  - For Inter-System Handover the SGSN selects P-GW to serve the session

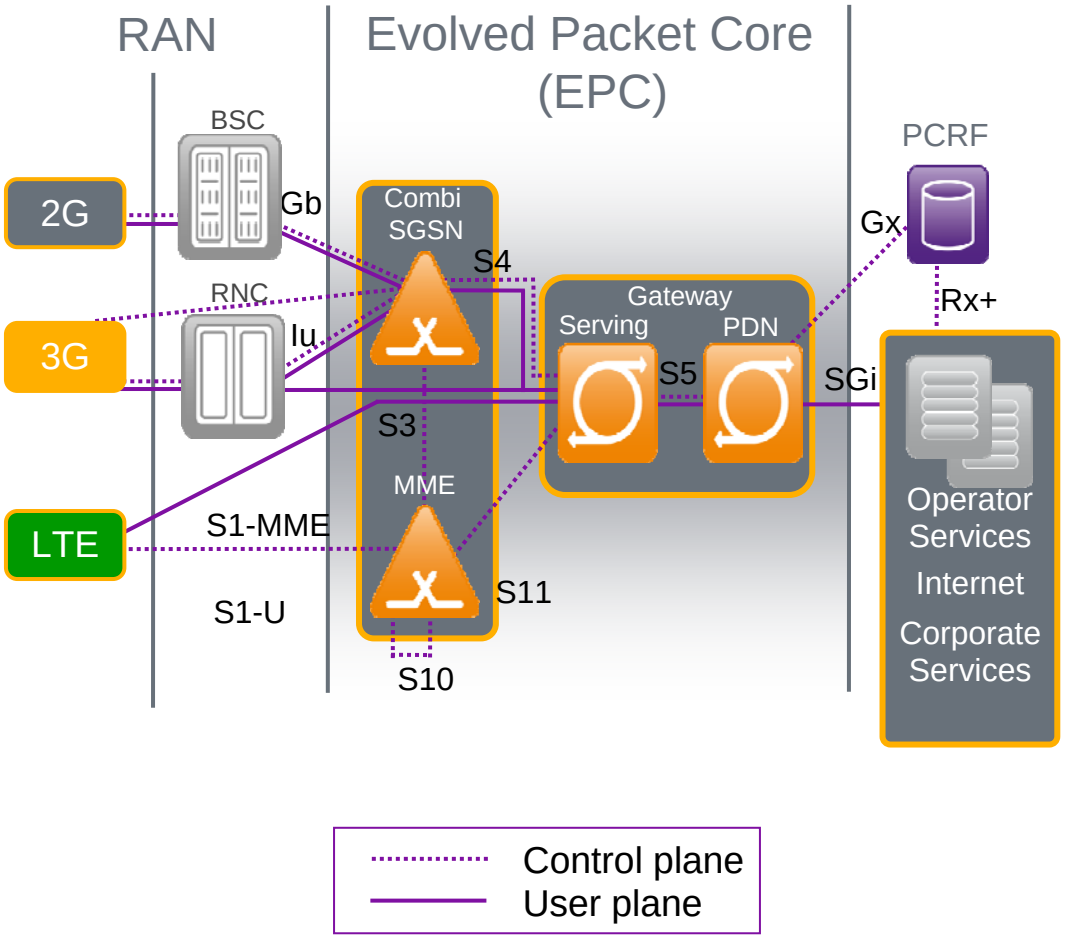


Combined 2G/3G SGSN and MME for all 3GPP accesses

- 2G/3G SGSN and MME can be combined into a single network element
  - Possible solution where operator wants to upgrade existing SGSNs to new hardware or to deploy minimum number of network elements
  - Easier 2G/3G to LTE subscriber migration
  - Reduced inter SGSN-MME signaling
- Common core: S/P-GW serves all 3GPP accesses
  - S-GW and P-GW in a single element to minimize OPEX and CAPEX costs

2 possible implementation options exist:

- MME functionality as overlay solution on a new, flat architecture optimized network element
  - 2G and 3G subscribers are migrated to this element
- MME functionality as SW upgrade to the existing SGSN
  - e.g. when operator has free capacity on existing SGSN's



Enhanced Packet Core: MME and LTE Gateways

Flexi Network Server (Flexi NS) as MME

- Dedicated control plane element for optimized handling of signaling traffic
- High transaction capability and eNB connectivity , up to 2(10) M subscr., 10(50) ktr/s, 40(120) k eNB
  (values in () with 3 shelf configuration)
- High performance ATCA industry platform

Combi SGSN upgraded to SGSN/MME

- DX200 HW designed for complex interface environment, adapts well to different interface variants (FR, ATM, E1/T1, IP)
- Field proven 2G/3G SGSN with large installed base
- MME can be added as SW upgrade to current SGSNs.

Flexi Network Gateway as Serving GW and PDN GW

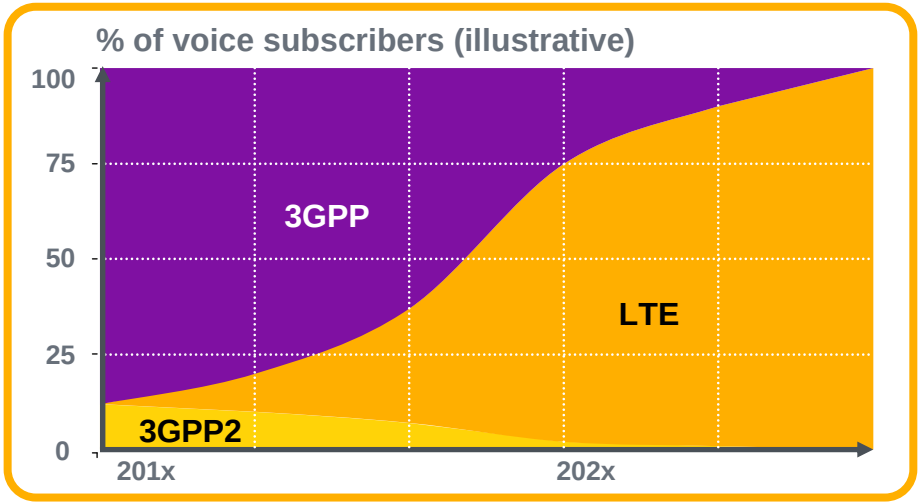
- Highest throughput and packet processing capacity (up to 480 Gbit/s)
- High signaling and connectivity capability
- Flexibility to introduce intelligence in mobile IP edge
- High performance ATCA industry platform

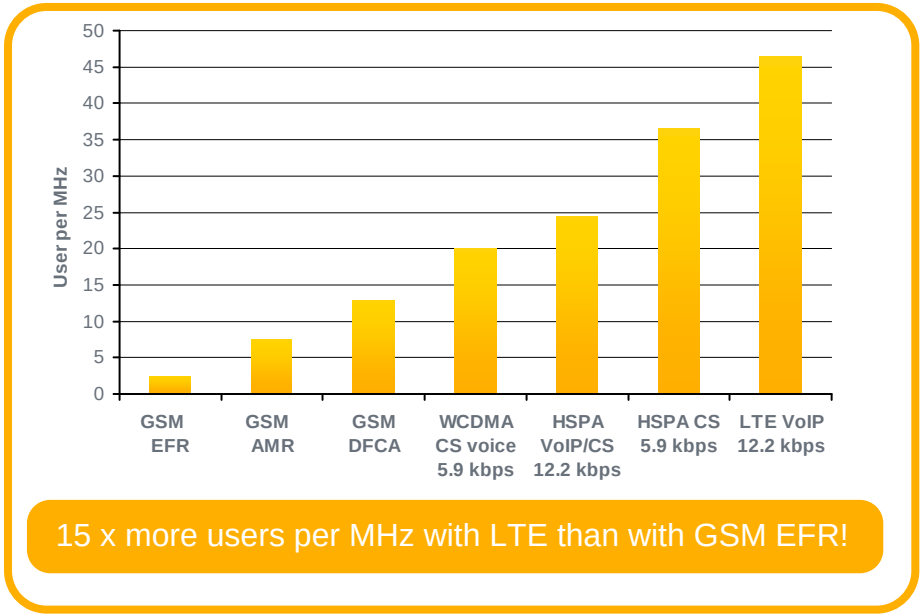
Nokia Siemens Networks

Voice evolution in LTE/SAE

Drivers for Voice over LTE (VoLTE)

- LTE is driven by mobile data growth
- Voice service is mandatory and desirable with increased voice efficiency with LTE
- LTE is full-IP thus voice must be handled over IP
- Although Internet players may enter LTE networks, operators have unique proposition to offer:
  - Same end-user experience and QoS regardless of used access
  - Voice service continuity between different accesses
- Over time Voice over LTE will grow to become the mainstream mobile voice technology





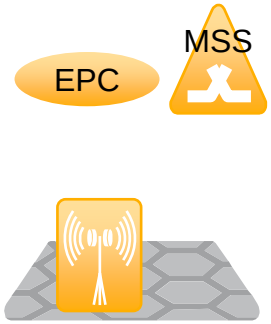
The One Voice initiative

One Voice is an initiative to utilize current open standards to define the mandatory set of functionalities for the UE, the LTE Access Network, the Evolved Packet Core Network, and the IP Multimedia Subsystem in order **to define a technical profile for LTE voice and SMS services.**

The transition to VoLTE technology is smooth with fast-track VoLTE

LTE broadband for high speed data

LTE
HSPA
I-HSPA
2G/3G

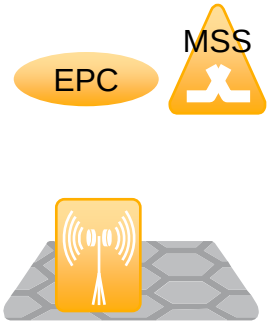


- Main focus on LTE data
- Fallback to 2G/3G CS access for voice
- Re-use existing MSC server system for voice

Introduce NVS VoIP solution

Fast-track VoLTE

LTE
HSPA
I-HSPA
2G/3G

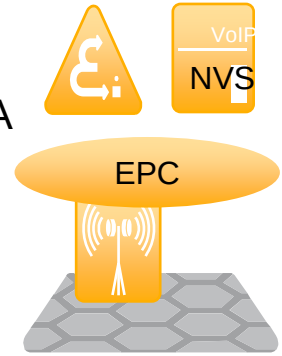


- Simple upgrade of MSS with NVS (VoIP) function
- Fully IMS compatible reuse of CS infra-structure for LTE VoIP capable handsets
- Seamless 3GPP voice service continuity

Evolution to IMS VoIP solution

IMS for enriched IP multimedia services

LTE
HSPA
I-HSPA



- IMS-centric service architecture
- Rich Communication Services with full multimedia telephony
- Support for any access

Voice and SMS implementation options in LTE

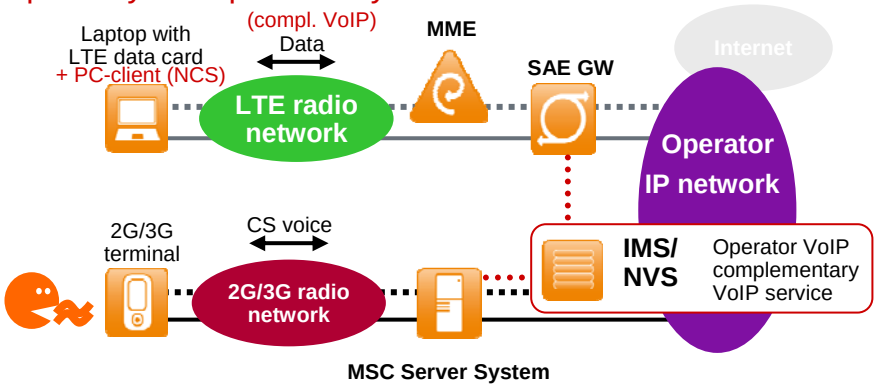
	Fast-track	CS fallback	IMS based VoLTE	VoLGA
VoIP support	Yes	No	Yes	Yes
New hardware requirements	None to minimum	None to minimum	IMS and VoIP server	All new functions implemented with additional hardware
Standardization	According to 3GPP Rel-8	According to 3GPP Rel-8	According to 3GPP Rel-8	Not standardized by 3GPP
Terminals	According to 3GPP Rel-8	According to 3GPP Rel-8	According to 3GPP Rel-8	Not standardized by 3GPP
SMS support	Yes, via LTE or over IP	Yes, via LTE	Yes, over IP	Yes, SMS over IP tunnel. Not standardized by 3GPP
Reutilization in IMS target architecture	Full	Optional	N/A	Cannot be reused in the target architecture

LTE voice evolution

LTE used for high speed packet data access only

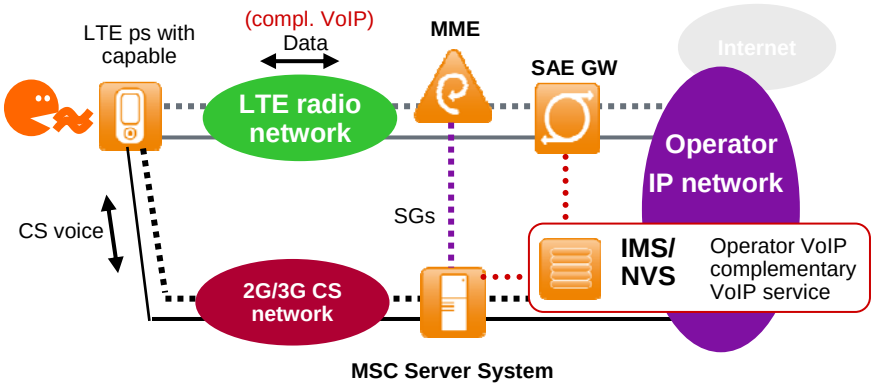
Primary voice service provided over CS network

Optionally: Complementary VoIP via IMS/NVS and PC-client

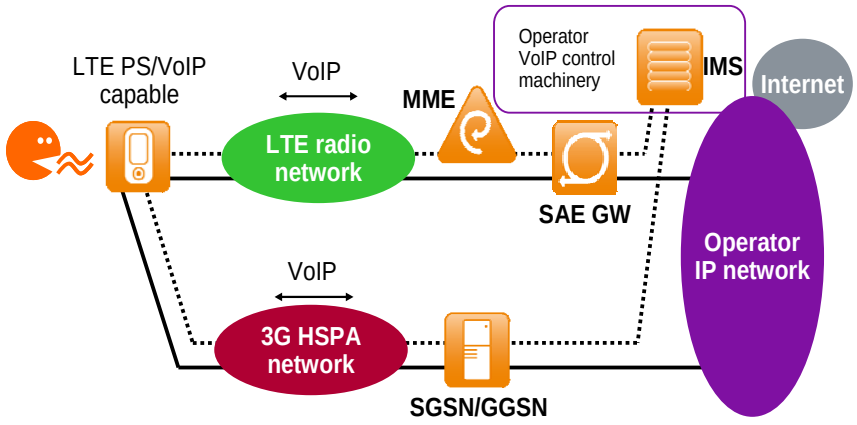


Fallback to CS when primary voice needed

Optionally: Complementary VoIP via IMS/NVS

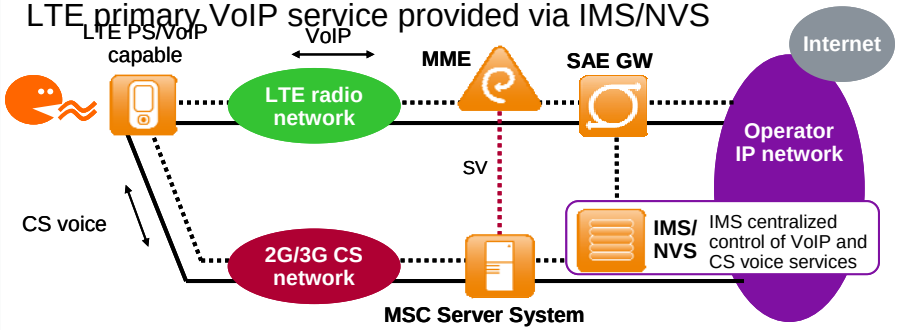


All-IP network

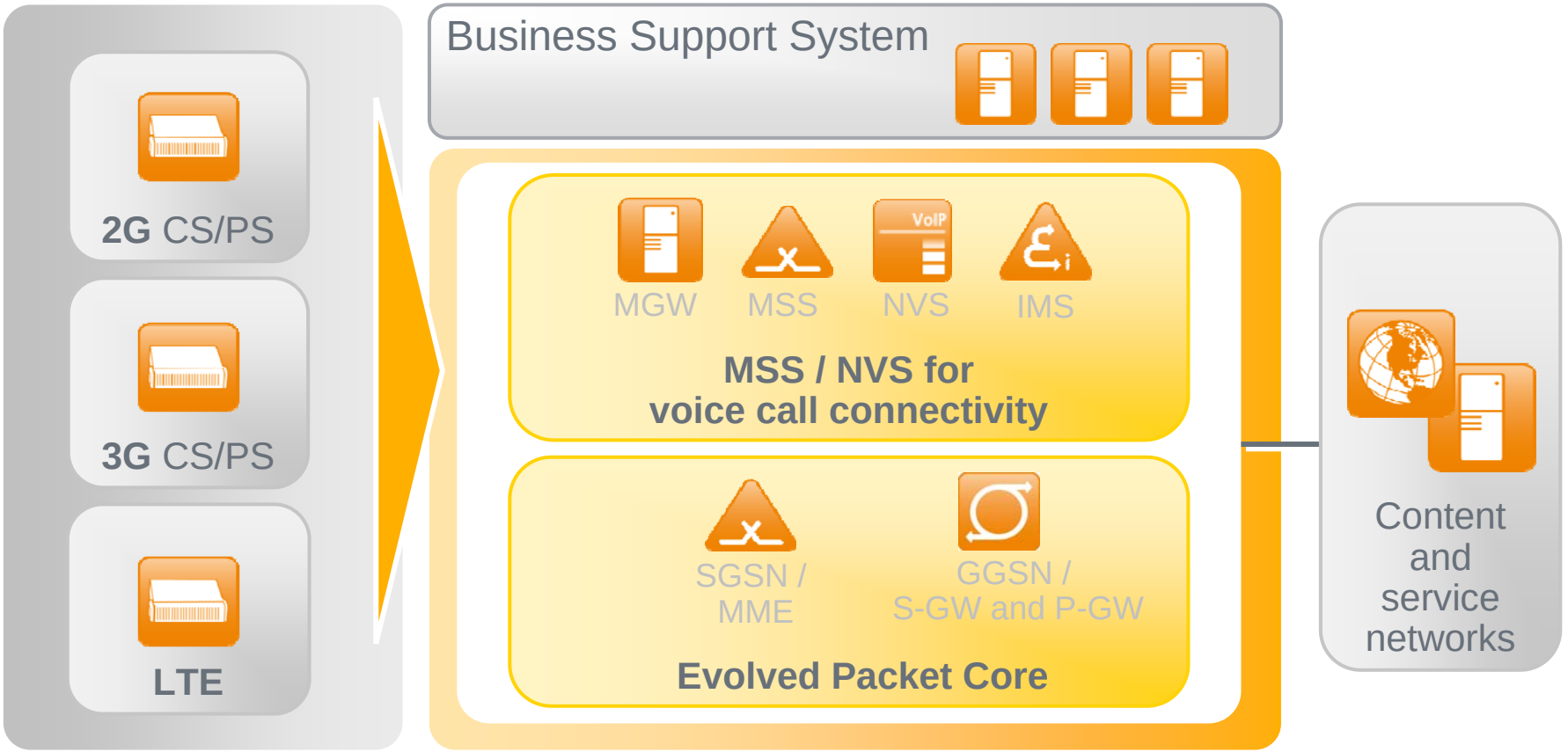


Single Radio Voice Call Continuity (SRVCC)

LTE primary VoIP service provided via IMS/NVS

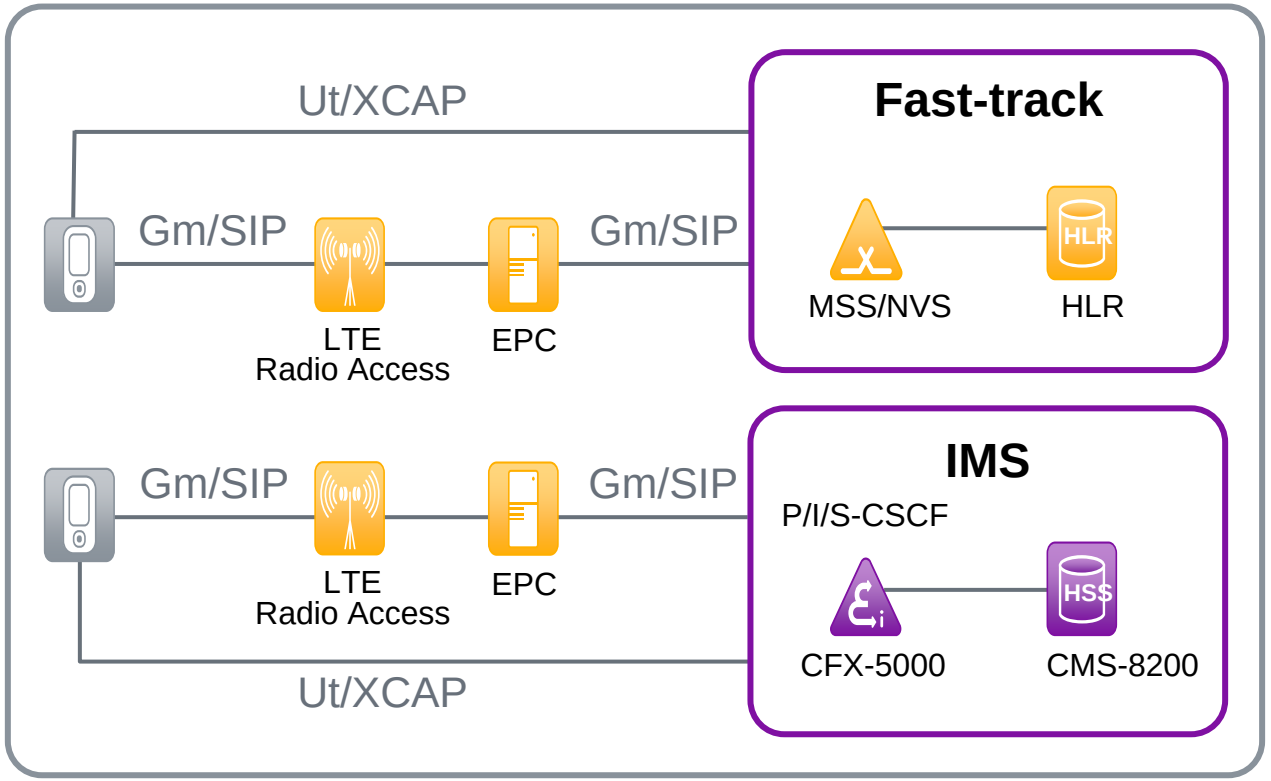


Common voice control solution provides smooth evolution to voice over LTE



Our VoLTE solution supports One Voice

- Nokia Siemens Networks VoLTE solution is One Voice compliant and are already
  based on SIP technology
- Both approaches: IMS and Fast-track are designed to support One Voice targets



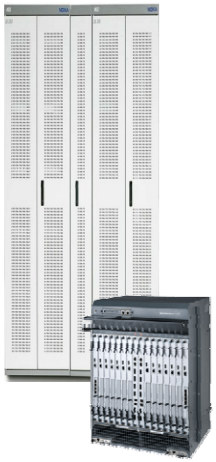
Open multi-application platform strategy

Multimedia gateway

MSC server family
MSS/NVS, DX HLR

GW / GGSN

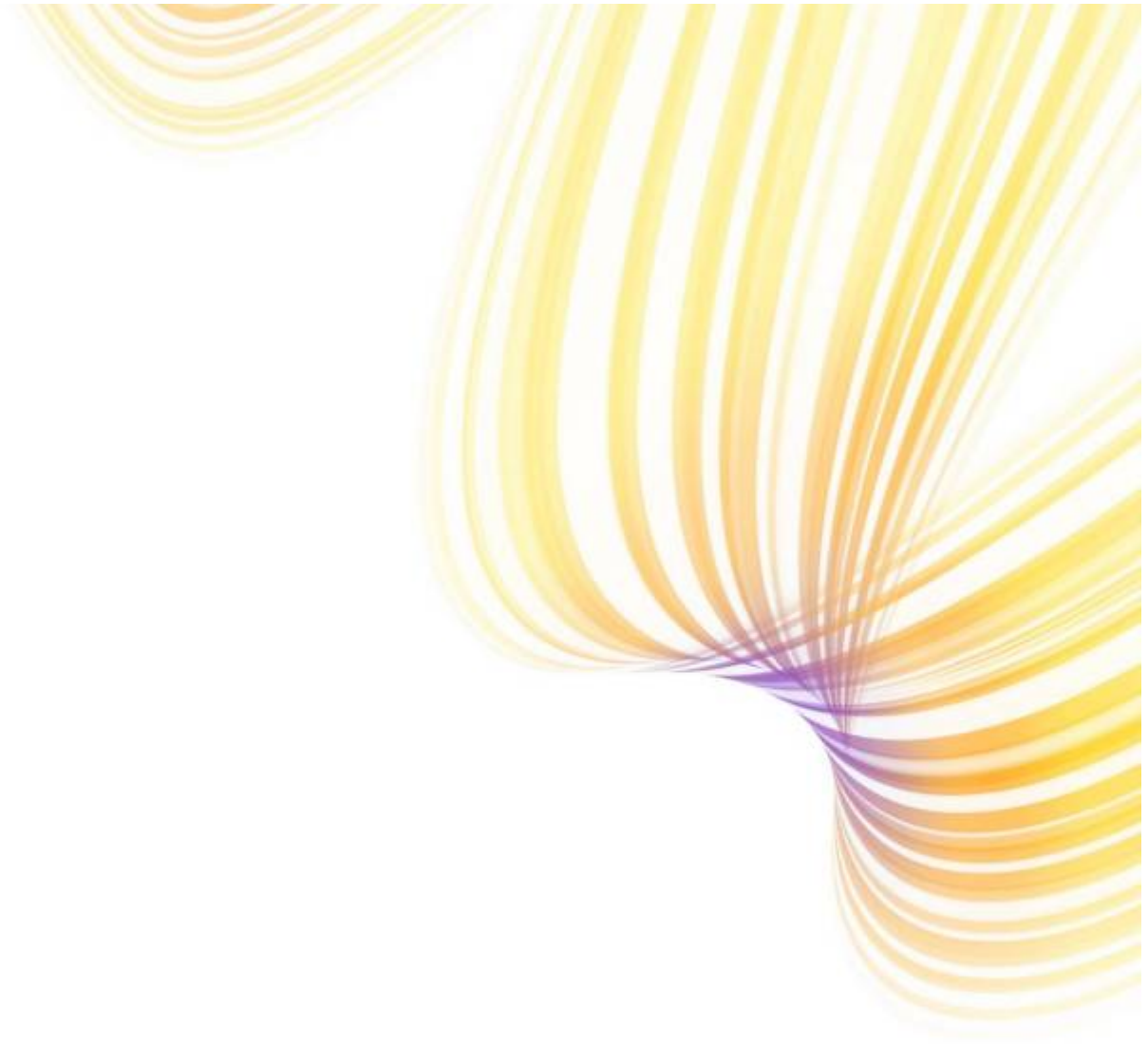
MME / SGSN



Common COTS ATCA HW platform

Different core network elements can be equipped into the same cabinet.

Transport



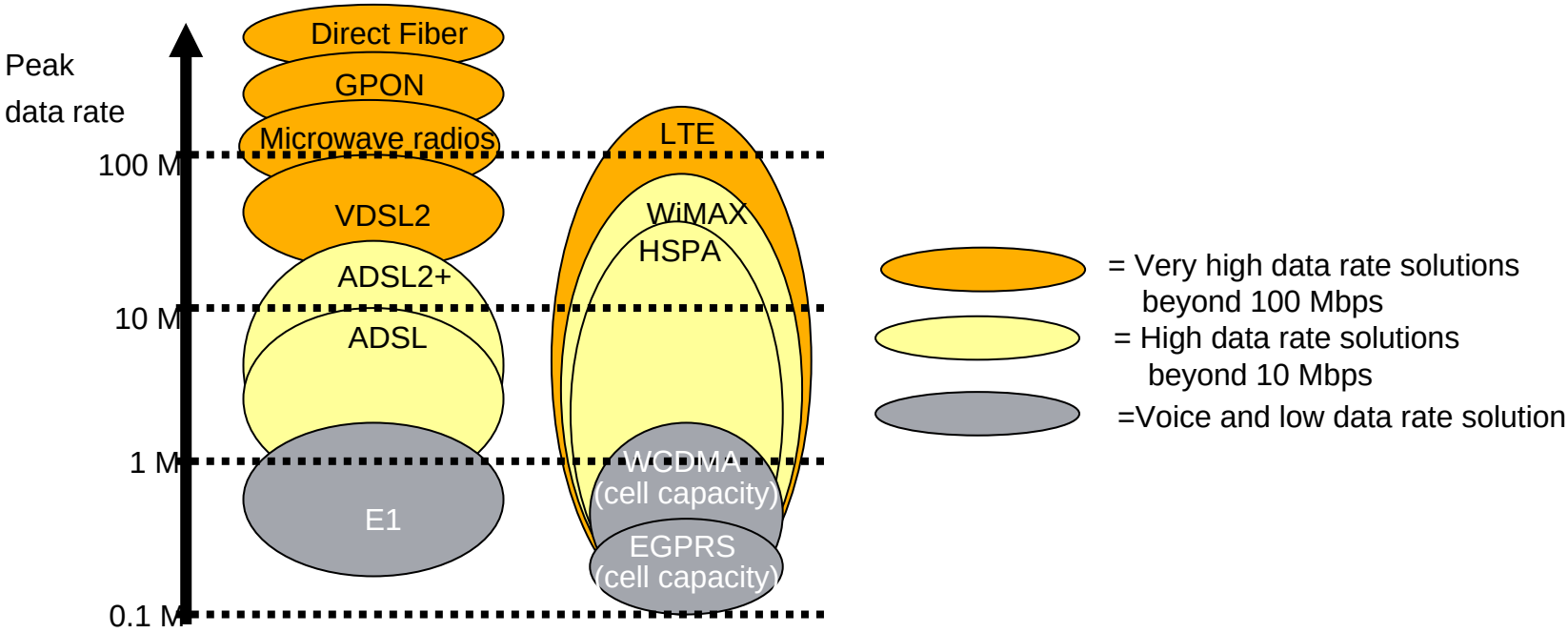
Transport

Assumptions:

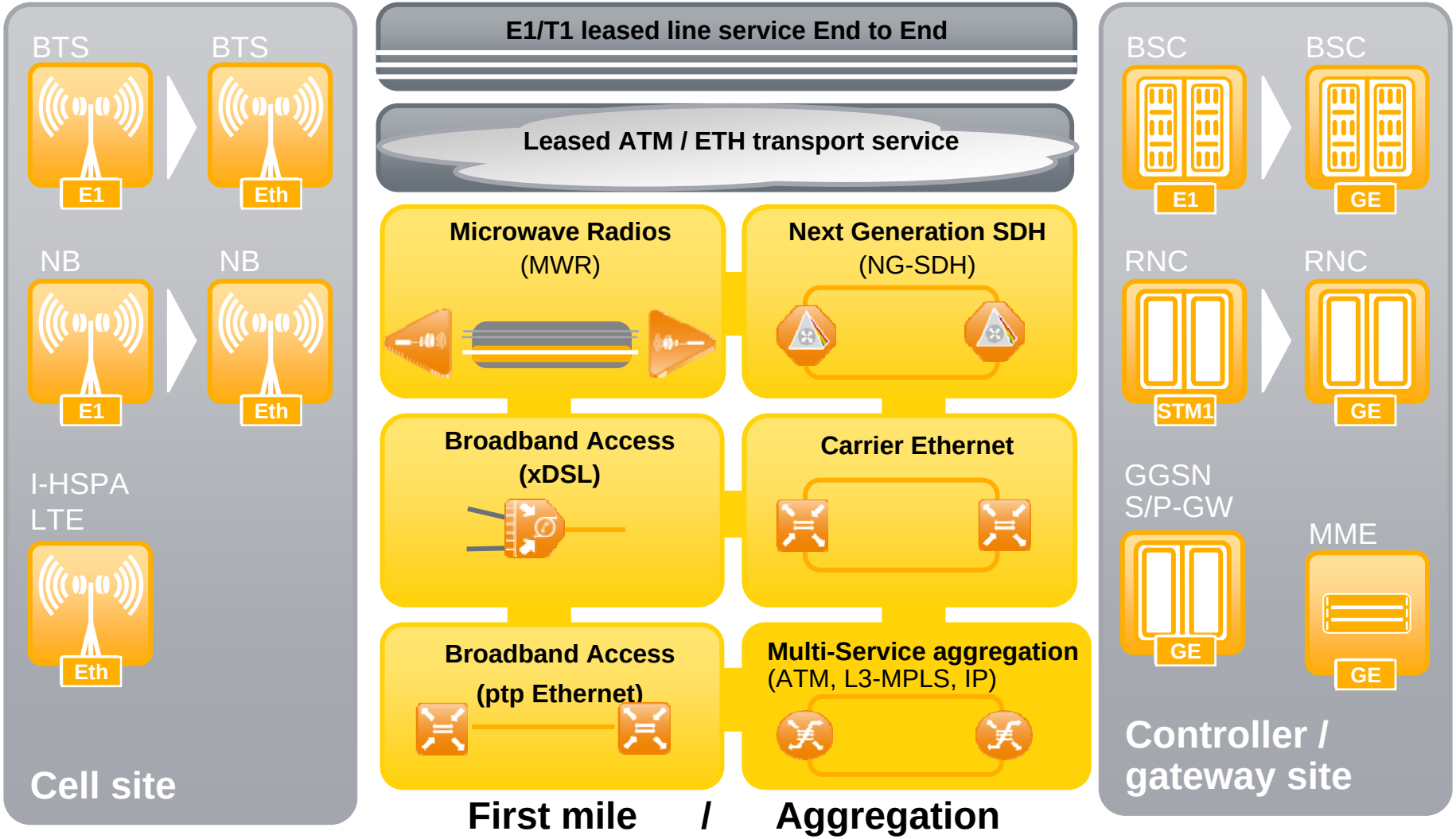
Ethernet interfaces at eNB (data rates >= 100 Mbps)

Symmetrical links at the moment (only DL is considered)

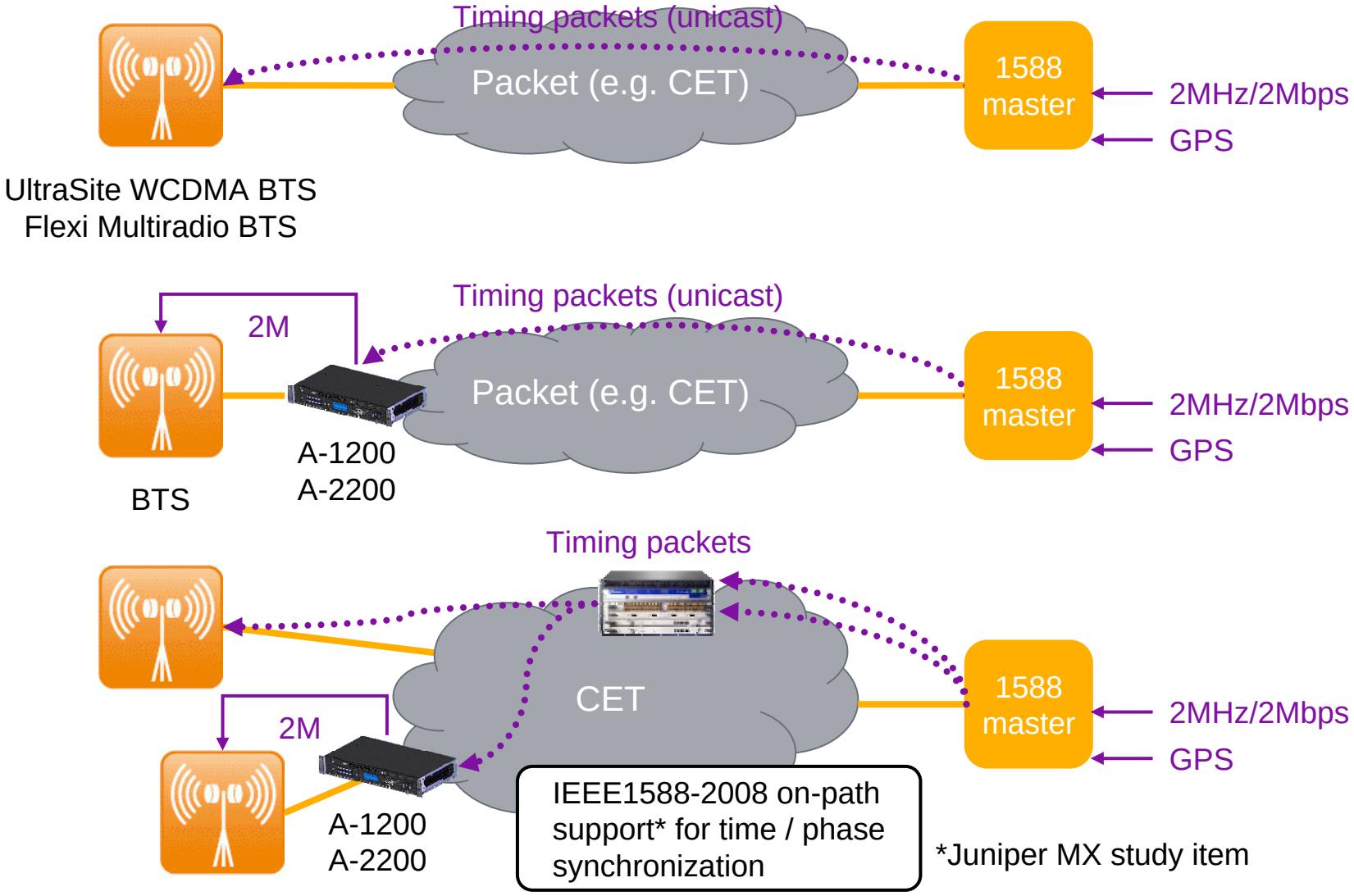
IPsec assumed to protect U-plane data



NSN Mobile Backhaul End-2-End Solutions



IEEE1588-2008 deployment options
CET ensures hard QoS for timing packets



Best-of-breed platforms for building complete backhaul networks

Flexi BTS

2G, 3G, LTE

Feature rich

“Zero footprint”

FlexiPacket Radio

High capacity packet Microwave Radio

Complete system contained in outdoor unit

“Zero footprint”

A-1200, A-2200, FlexiPacket Hub

Compact, modular access switches optimized for fiber & microwave radio access

Juniper MX

High capacity metro aggregation

Fully redundant

hiT 7300

Multi reach DWDM

Industry-leading optical mesh and DWDM automation

Symmetricom TimeProvider 5000

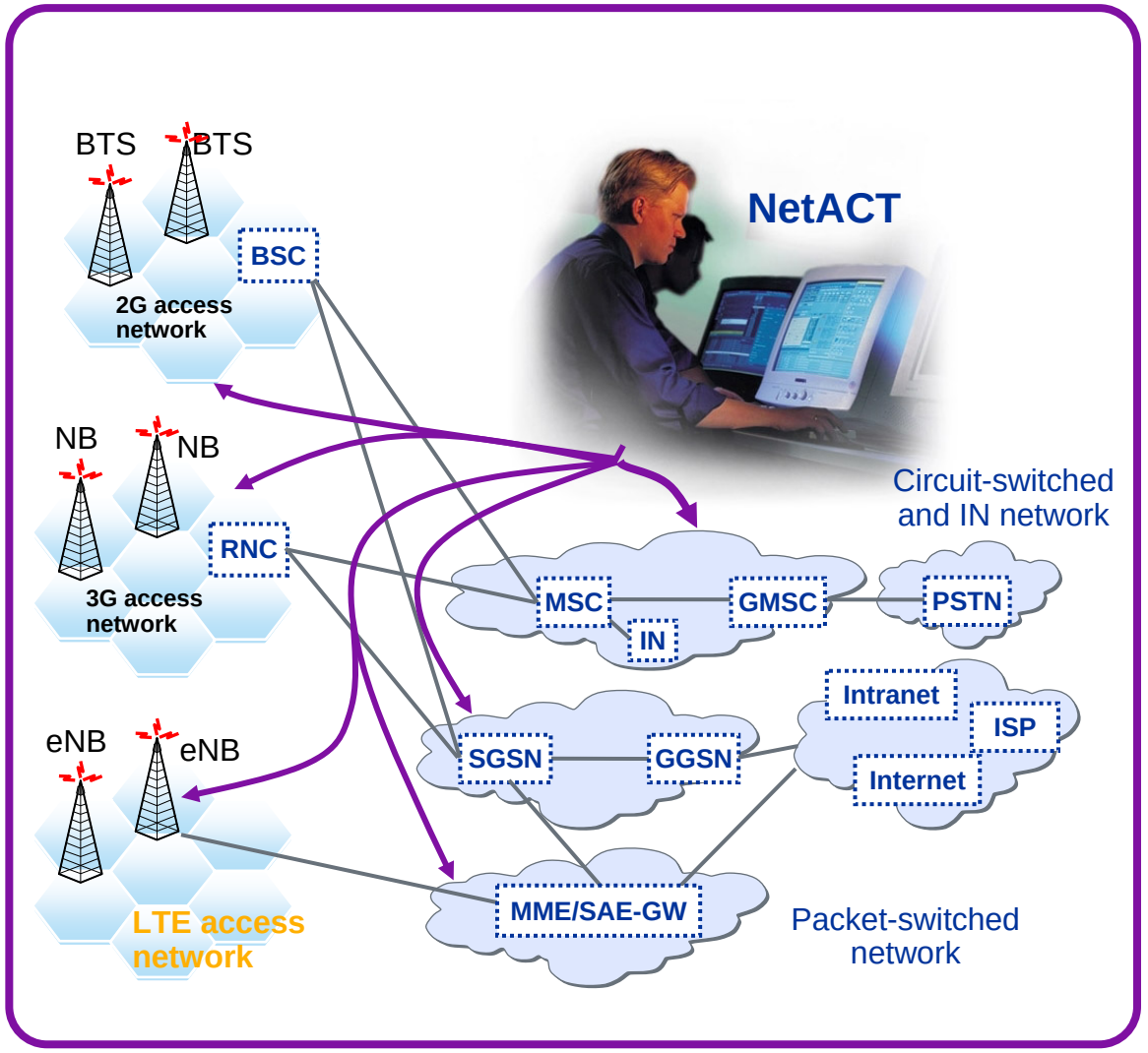
Compact, high capacity IEEE1588-2008 Grand Master

Nokia Siemens Networks

LTE / SAE Operability

NetACT : Overall Network Management Solution

- One management system for all technologies
  - LTE
  - GSM / EDGE BSS
  - WCDMA RAN
  - circuit-switched & packet core
- Multivendor network integration
- Network and Service Assurance,
  Network Planning and Configuration,
  Administration, etc



Management Solution for LTE

Nokia Siemens Networks NetAct

Automation

- Sophisticated and field tested applications for LTE management
- Self-optimisation, Self-configuration and Self-healing solutions
- Even better visibility to network quality and end user behavior

Costs under control

- OPEX drops:
- ✓ Efficient and automated network operations
- ✓ Less people needed for network planning and operations
- Optimizing network capacity utilization
- Revenue increases: Higher service availability/quality

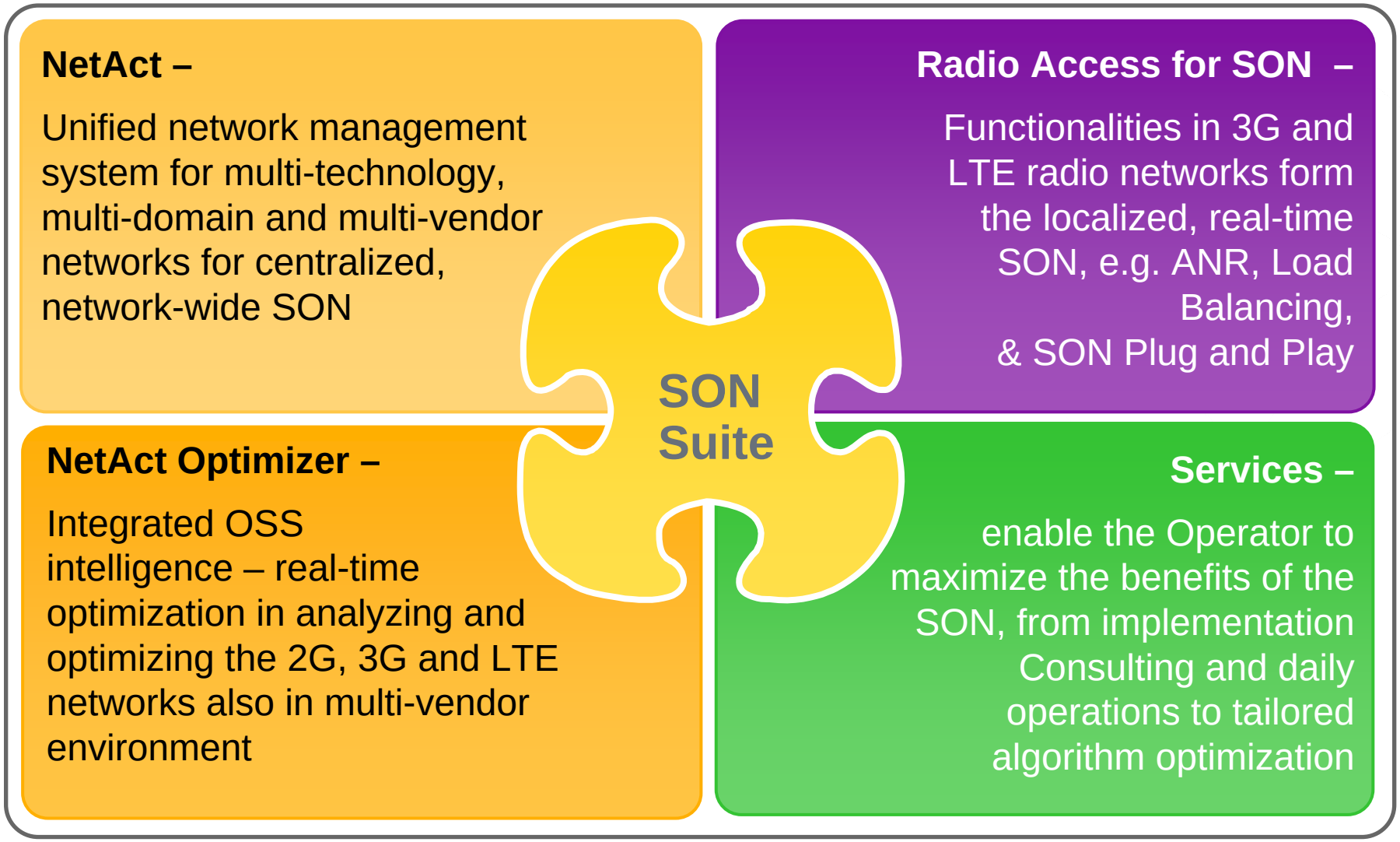
Natural evolution

- LTE is natural technology step for NetAct customers
- Today, over 200 NetAct customers
- 10 000 NetAct users online all the time
- Over 600 million subscribers are served by NetAct

One management system

- Multi-technology and multi-vendor support by integrated OSS system
- Complete set of O&M applications for element, network and service management
- Flat O&M architecture

SON Suite elements for 2G, 3G and LTE



Self Organizing Networks simplify through automation

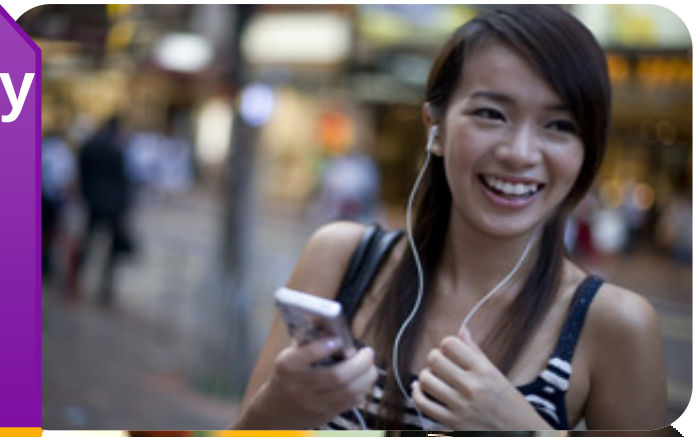
Self-Healing
- Automated preventive correctio
- Minimized revenue loss

Self-Optimization
- Optimal use of capacity
- Maximized revenue flow

Self-Configuration
- Automated BTS/eNB deployme
- Faster roll-out

Quality

OPEX



Key operational benefits in Configuration, Optimization and Healing

Self-Configuration

- Flexibility in logistics (eNB not site specific)
- Reduced site / parameter planning
- Simplified installation - less prone to errors
- No / min. drive-tests
- Faster roll-out

Self-Optimization

- Increased network quality and perform.
- Parameter optimization
- Reduced maintenance, site visits

Self-Healing

- Error Self-detection and mitigation
- Speed up maintenance
- Reduce outage time

Wide Experience and Engagement in SON

history and experience

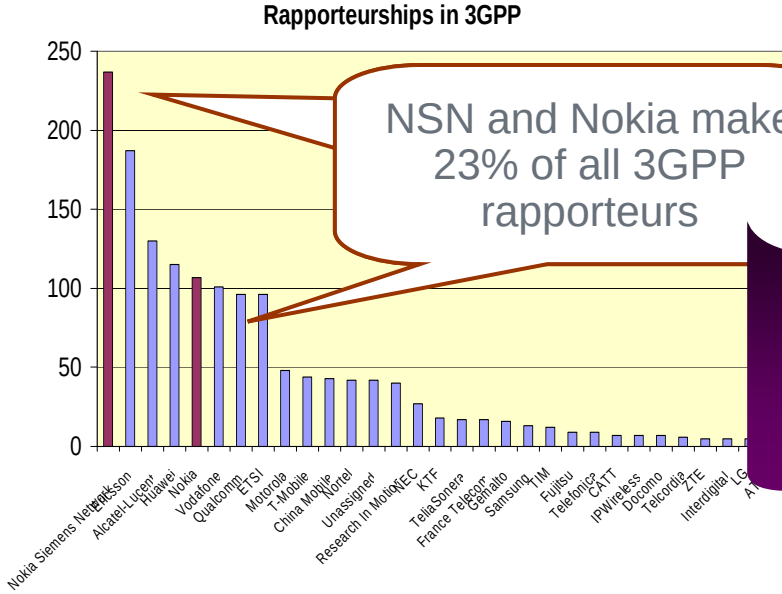
SOCRATES

Self-Optimization and Self-ConfiguRATion in wirelESs networks

4WARD

Future O&M, Monitoring & Optimization as embedded capabilities

Key roles in current international SON research



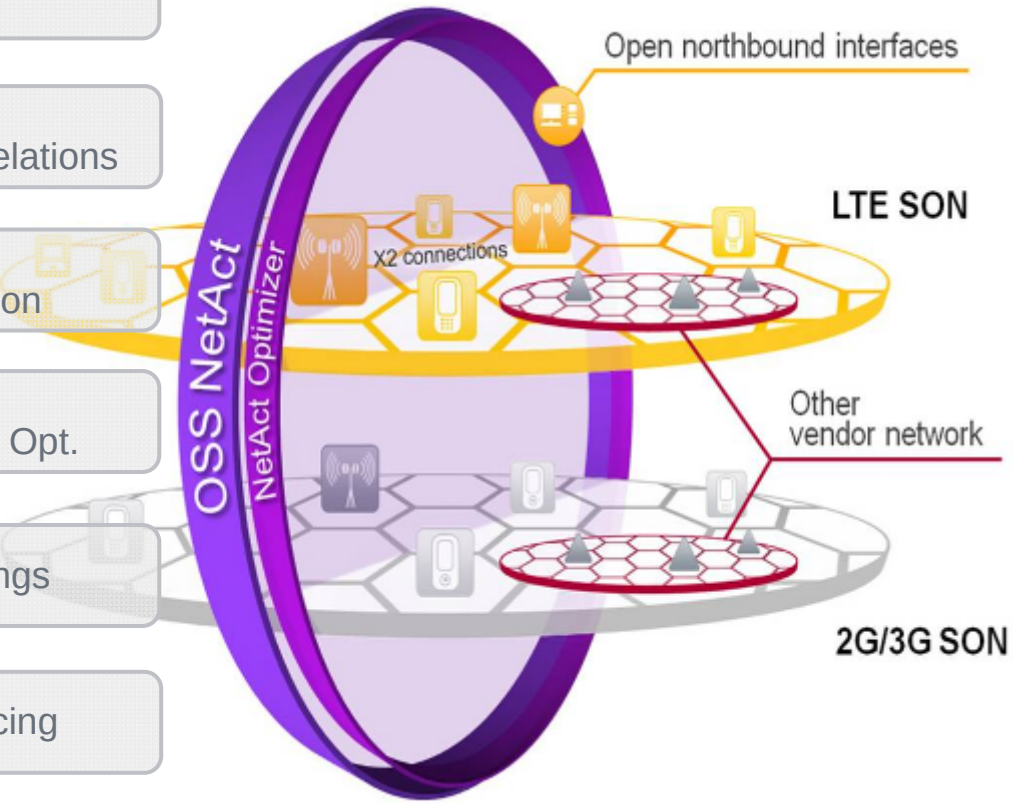
NSN and Nokia make 23% of all 3GPP rapporteurs

Driving 3GPP; Rapporteurships for

- SON WI (RAN3)
- Minimization of Drive Tests WI (RAN2)

Multi-level Architecture: SON Suite

- Plug & Play
- Automated Neighbor Relations
- Cell Outage Compansation
- Mobility Robustness Opt.
- Power Savings
- Load Balancing
- Coverage and Capacitiy Opt.

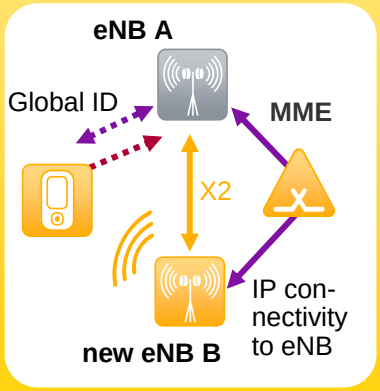


- **Performance and Robustness**
- **Adaptive to Operational Processes**
- **MultiTasking SON** multiple SON use case handling
- **Multi RAT**
- **Multi vendor**

Most comprehensive offering in Automatic Neighbor Relation (ANR)

Industry

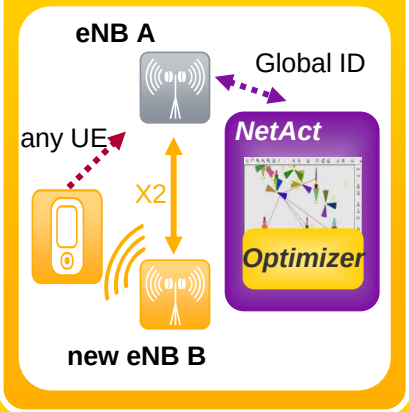
3GPP (R8)



- UE to support ANR required (3GPP R8)

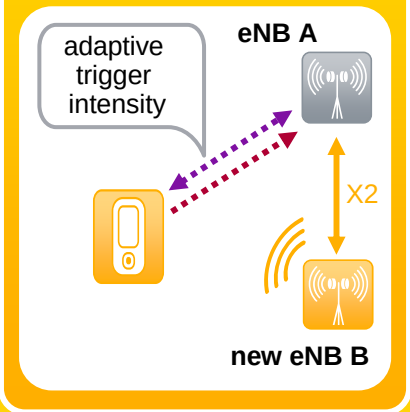
Nokia Siemens Networks extended offering

Any UE / (2G,3G,LTE)



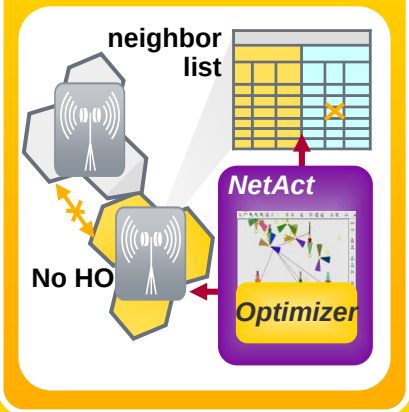
- Also triggered by UE measurements, but works with any existing mobile
- Physical ID <-> Global ID mapping done by NetAct; faster than 3GPP
- OPEX savings same as 3GPP

Adaptive ANR



- "Fast / exploring" mode
- → Fast relation setup during roll-out
- "Eco / monitoring" mode
- → Reduce energy, signalling and interference while still self-updating changes

Neighbor relation self-optimization



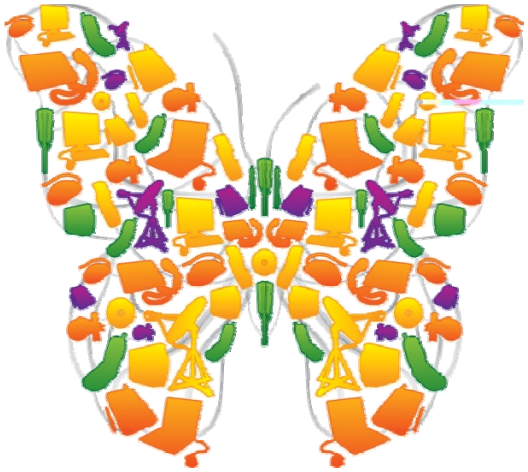
- NetAct Optimizer supervises all registered cell relations
- Statistically reliable data derived from measurements
- Blacklisting of inefficient neighbor relations

SON Suite facts and figures

- Over 50% reduction of mobile networks optimization OPEX
- On average 14% reduction of drop call rate
- BTS integration to network in few minutes
- Network optimization cycle time reduced from 3 months to 7 days
- Over 50% manual work reduction in improving Key Performance Indicators
- Up to 50% cut of handover failures by parameter value correction and maintenance
- Over 50% of cell overload eliminated with SON load balancing

NSN SON does not require any new hardware.

Environmental Considerations
Power consumption & efficiency

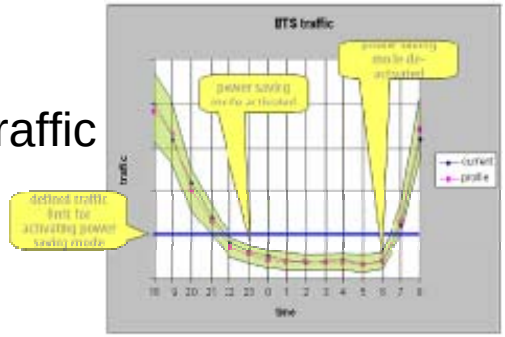


Save energy. Save money.
Good green business sense.

How to decrease Radio Network energy consumption and CO2 emissions?

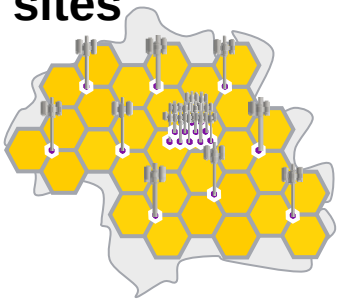
Reduce energy consumption per site

- Use more energy efficient BTS
- Reduce site power consumption
  - Increase site temperature
  - Use Outdoor BTS
- Optimize energy consumption versus traffic



Reduce the number of BTS sites

- Increase cell coverage
- Share networks



Use renewable energy sources

- Solar cells, wind and hybrid solutions on site
- Green energy: hydro, wind and bio generated grid electricity

Nokia Siemens Networks

Why Nokia Siemens Networks?
Industrial leader in WCDMA BTS Site power consumption

From operator point of view only the *Complete BTS Site* power consumption is relevant

= <u>the REAL resulting OPEX cost</u>

Flexi BTS power consumption includes all required BTS site elements:

- ✓RF and baseband
- ✓Outdoor capability as such
- ✓Integrated transmission

Flexi BTS enables the lowest BTS site power consumption

Complete BTS Site

Not a complete BTS Site

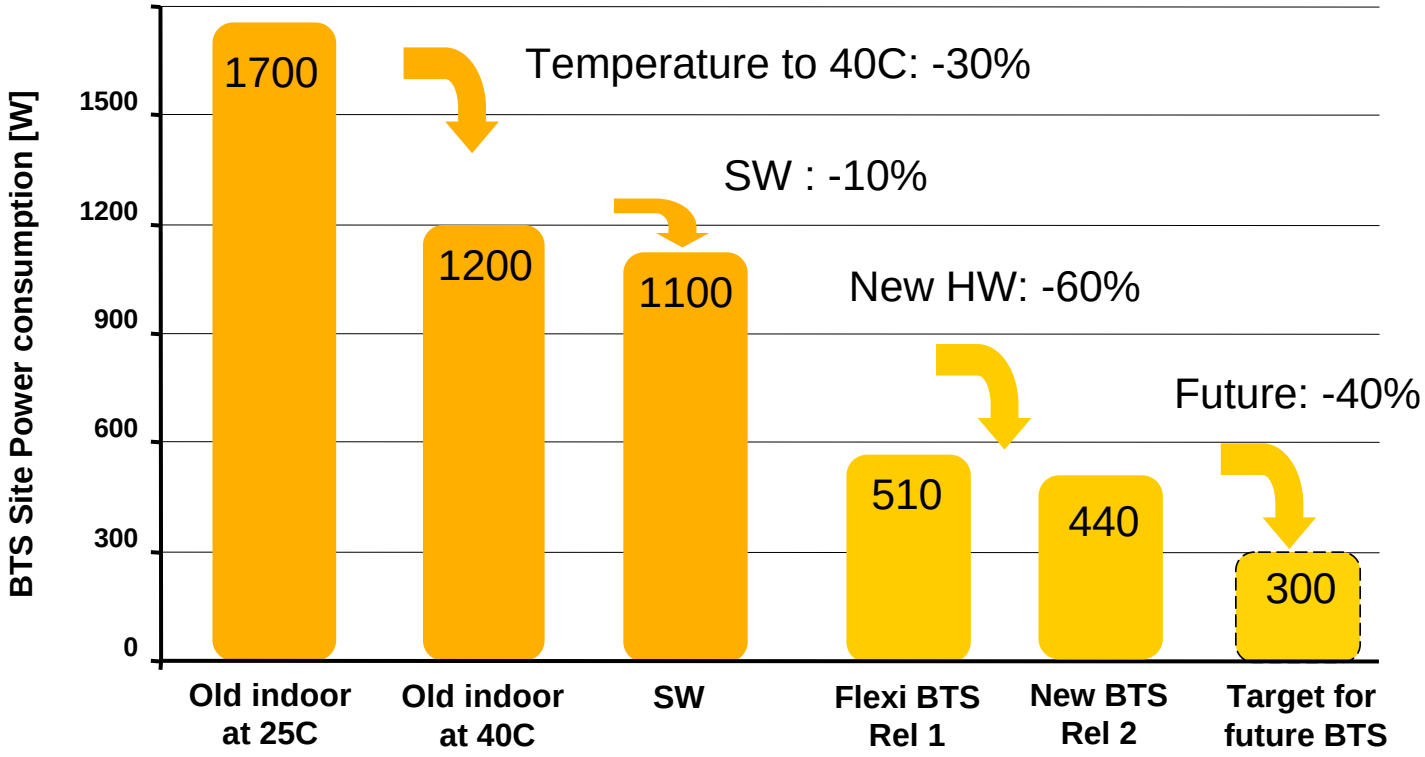
Where to put this indoor unit?

*Depending on SW level

Nokia Siemens Networks

WCDMA/HSPA BTS site power reduction

Example of average power consumption of 1+1+1 WCDMA/HSPA BTS Site @ 20W



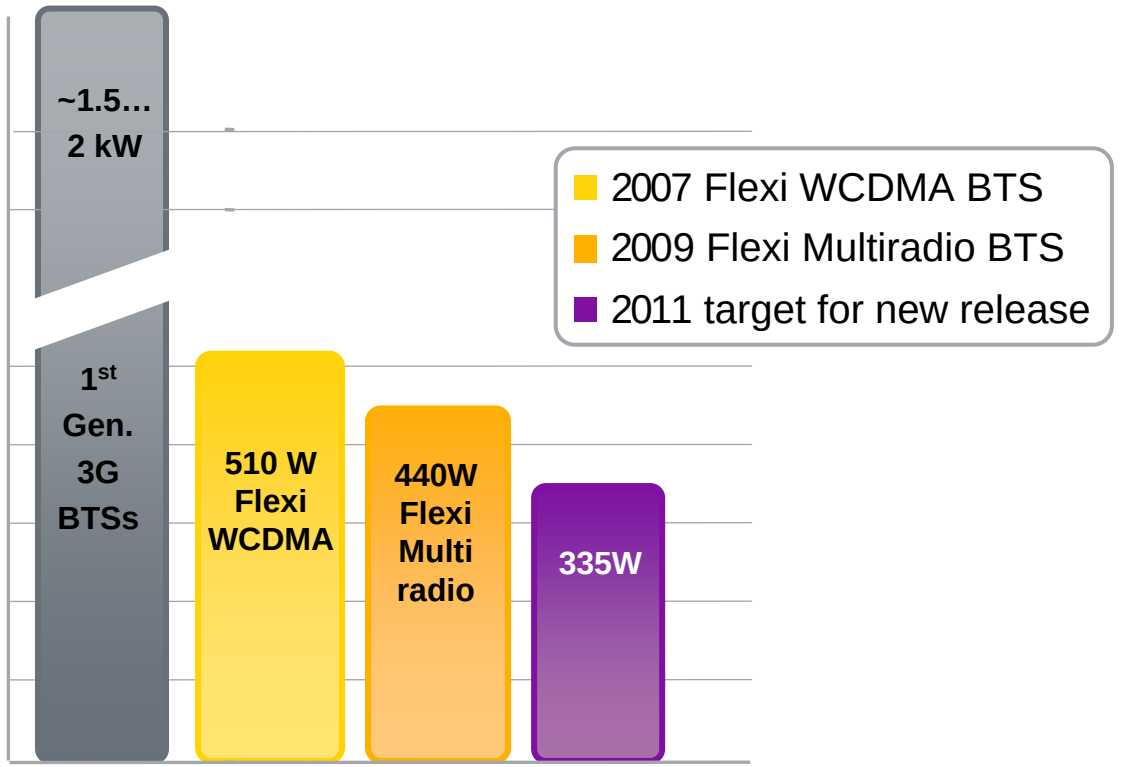
Using installed BTS HW

With new BTS HW

Based on typical base station site configuration & typical traffic load

Nokia Siemens Networks Flexi BTS world leading energy efficiency

- **A new level of BTS energy efficiency is set with new 3 Sector RF Module**
- **3-sector Flexi Multiradio BTS in typical WCDMA or LTE operation will now consume only 440W**



Based on typical base station site configuration & typical traffic load
1+1+1 @ 20W, 50% load

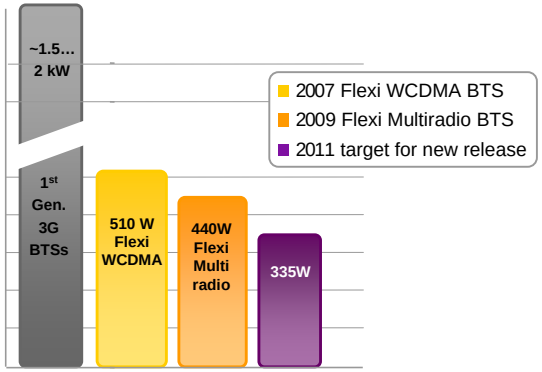
Summary Products & Solutions

Nokia Siemens Networks' LTE solution (1)

Flexi Multimode BTS

Mobility Manage-ment Entity (MME)

- **smallest macro BTS in this class** (50 liter, <50 kg for 3 sectors BTS)
- **Lowest energy consumption** (440W for 3 sector BTS)
- **High output power and high performance** (3x60 Watt, 3x120 W with 2x2 MIMO, 20 MHz)
- **Flexible in deployment** (fits for every site solution)
- **No additional footprint, low installation costs** (no lifting equipment)
- **HW commercially available since Q3/2008**
- **Upgradable to LTE by SW only** (no additional HW boards required



Based on typical base station site configuration & typical traffic load
1+1+1 @ 20W, 50% load

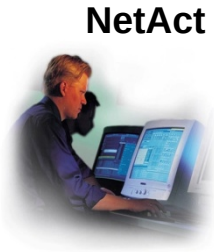
- **High performance ATCA industry HW platform**
- **Based on field proven and highly reliable SGSN SW (99.999 % availability)**
- **Combined MME /SGSN**

Nokia Siemens Networks

Nokia Siemens Networks' LTE solution (2)

SAE Gateway

NetAct as Management system

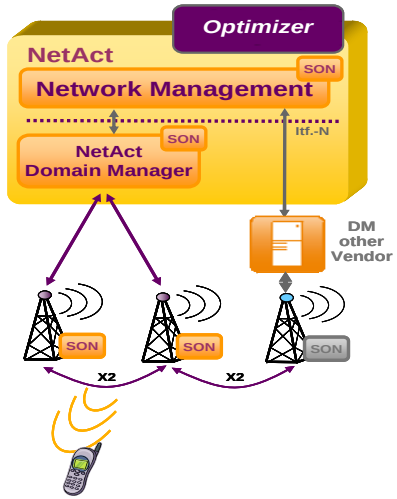


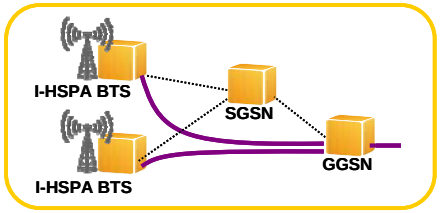
Nokia Siemens Networks flat network architecture experience

- High performance ATCA HW platform
- High throughput (up 360 Gbps)
- Including GGSN functionality
- Sophisticated traffic management
- Policy control functions

- One management system for all technologies and NE (Radio, Core, GSM, WCDMA, LTE,…)
- Support of Multivendor Integration
- All O&M applications for element, network, service management
- Self Organizing Network (SON)

- Our SGSN is the first one to support direct tunnel
- I-HSPA supports similar flat network architecture as LTE





Nokia Siemens Networks' unique LTE solution guarantees

- Investment Protection
- Lowest OPEX and CAPEX
- Lowest cost per Megabyte