
ERICSSON
THE EVOLUTION OF MOBILE NETWORK AND THE ROLE OF NETWORK TRANSPORT
Rodolfo Di Muro, PhD, MBA
Programs marketing

AGENDA

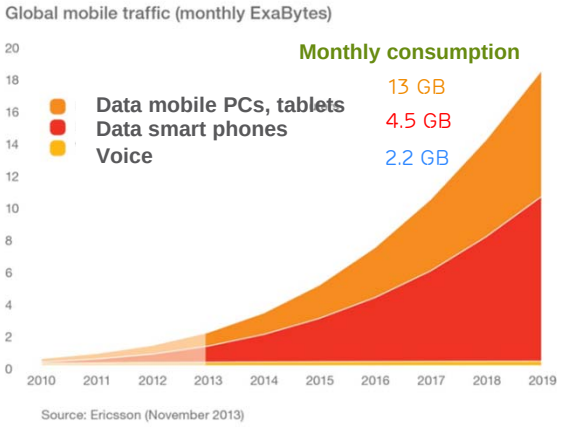
1. Mobile network evolution – business opportunities
2. The role of the transport network
3. Time and phase synchronization
4. How to gain control on transport performance
5. Summary

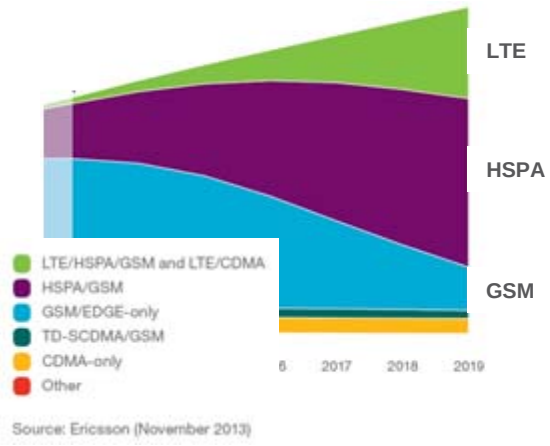
MOBILE EVOLUTION

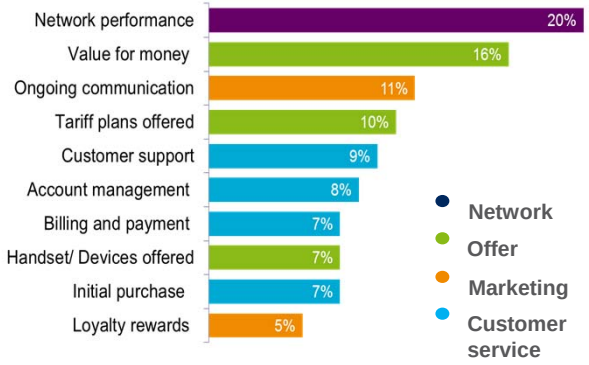
10 x

4x

Performance







Mobility Report, 2014

TRAFFIC GROWTH
>50% mobile data from VIDEO

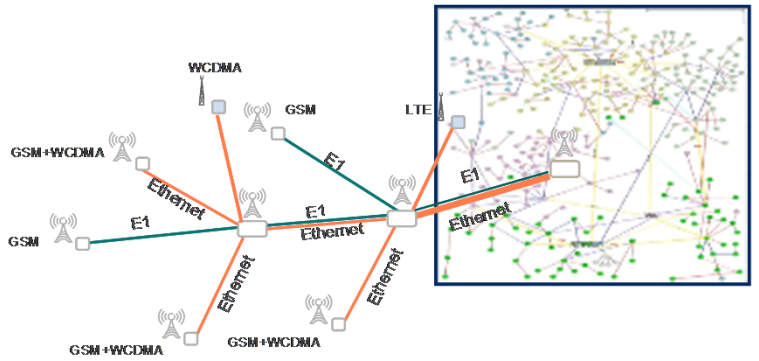
MOBILE SUBSCRIBERS
$9,3 billion
$2,6 billion on LTE

END USERS
satisfaction
Performance for be loyal to operators

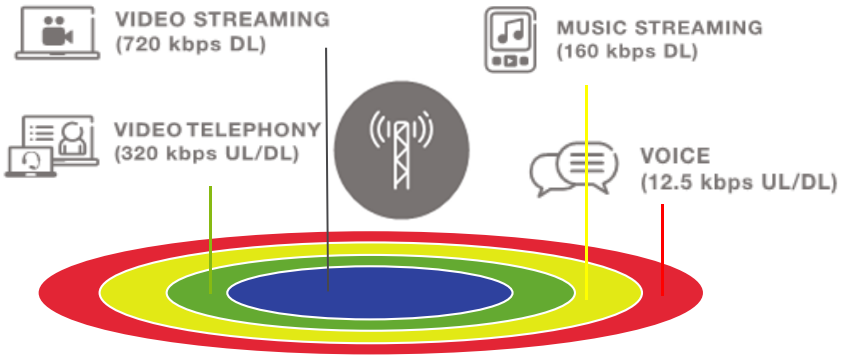
BUSINESS OPPORTUNITIES

Heterogeneous network and App-coverage addresses new services opportunities

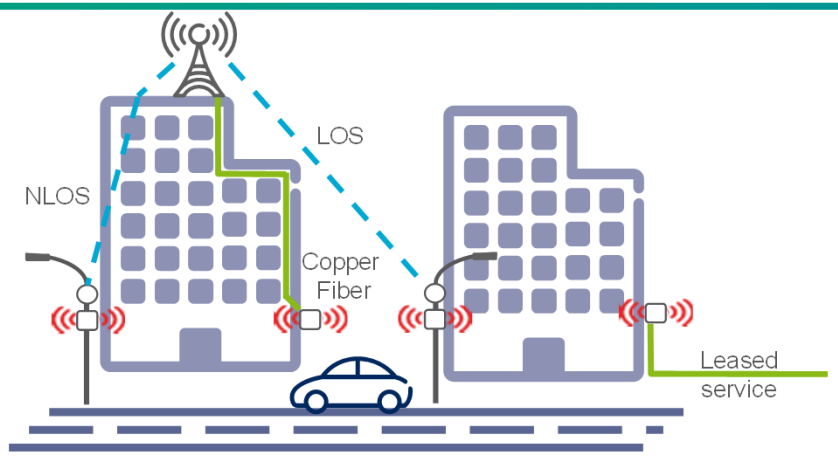
Heterogeneous Network



Network Modernization



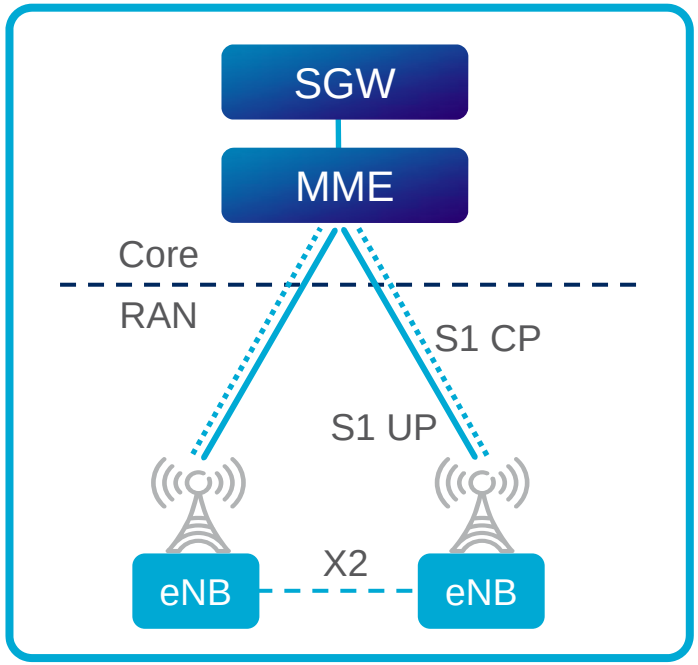
Every app has its own coverage map



Indoor and Outdoor

LONG TERM EVOLUTION

The all-IP Network Architecture for LTE



450Mbps in commercial LTE-A

RAN evolves on IP on cell site
Packet based on Transport

IP for routing X2 handover X2 is 2% of S1 – switched at central level

Security IPsec protect traffic, in untrusted environments

Synch as phase, Time and frequency is needed with packet topology with right PDV

Cell site gateway create tunnel on backhaul with any layer technology without impacting performances (L2,L3)

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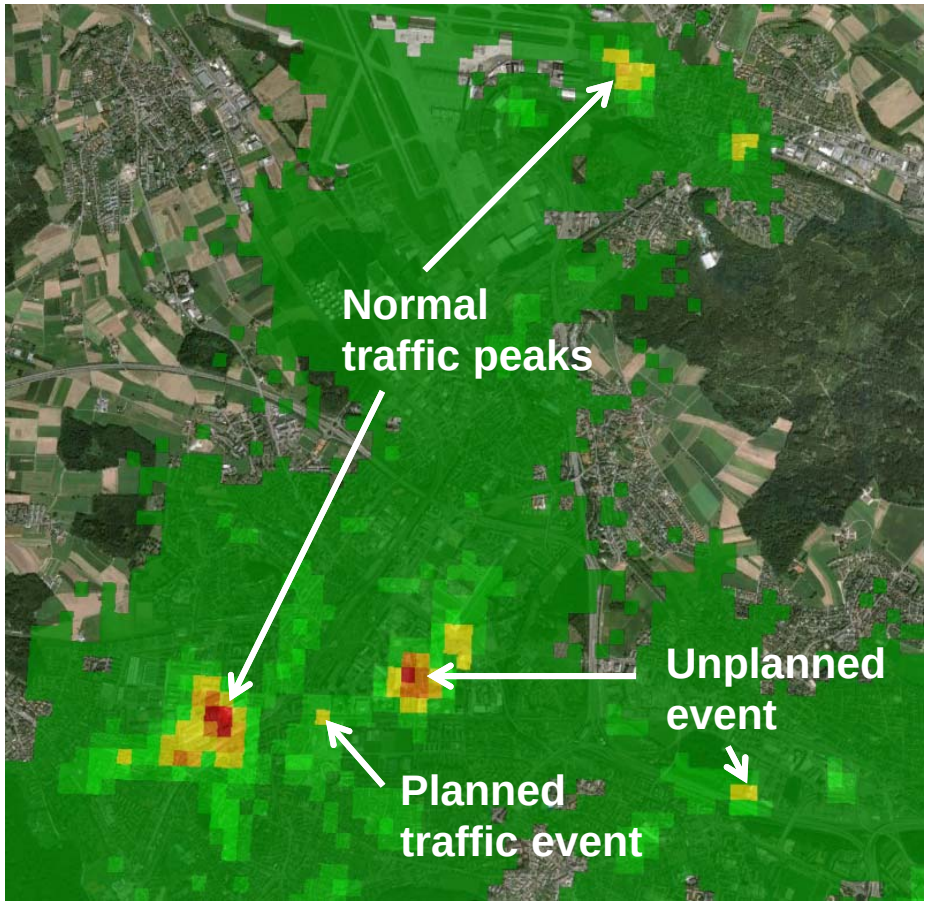
1 Mobile network evolution – business opportunities

2 The role of the transport network

PERFORMANCE?



High capacity situations are network wide

- High capacity situations occurs daily
- Network must be configured to support all these events at the same time
- Common that networks are configured for low load and single user performance

LTE + TRANSPORT

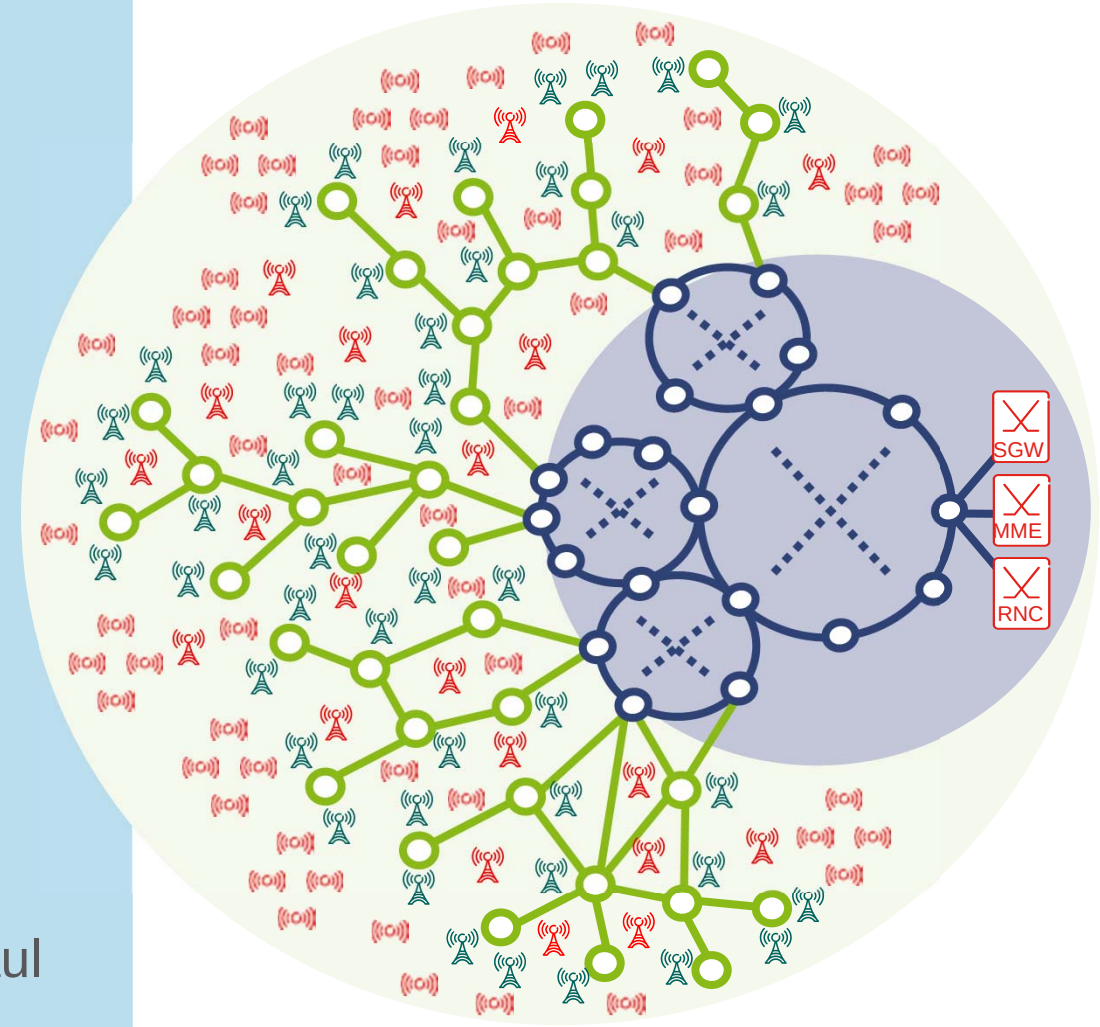
RAN evolution

LTE- TDD
LTE – FDD
Carrier Aggregation
LTE broadcast
Spectrum efficiency

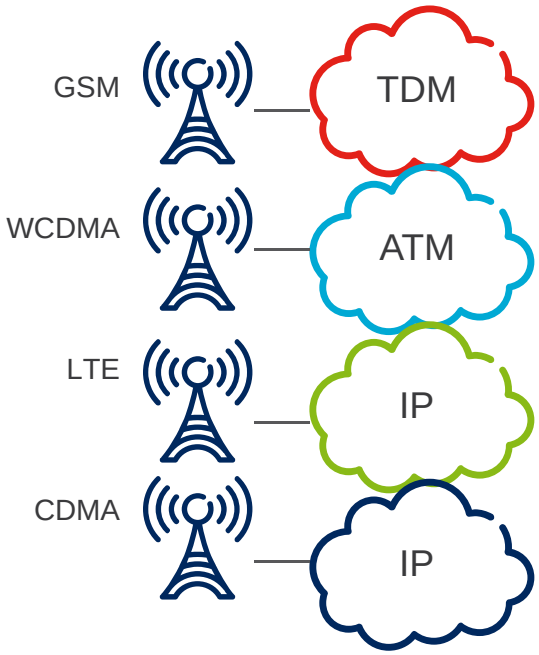
Transport

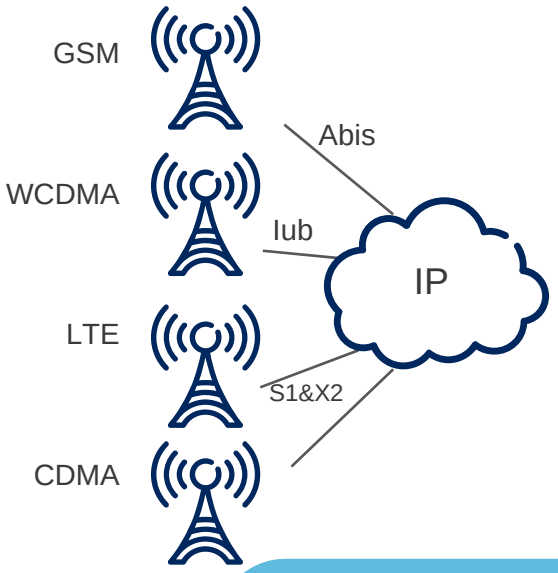
Traffic & capacity dimensioning
Buffering mix mode
More bandwidth
Bandwidth optimization
SW+HW solution with optimum functionality

Coordination backhaul, midhaul and franthaul to meet latency
SON simplifying operation



EVOLUTION OF RAN MIGRATION TO ALL-IP





- QoS Mgmt
- Different topologies
- Synchronization - frequency, time/phase
- Peak rates 5..150Mbps*
- IPv4, IPv6
- IPSec

TN Characteristics Recommendations

- Delay: <20ms, eNB..SGW
- PDV: <10ms (packet-based freq sync)
- Packet Loss: $<10^{-4}$
- Peak Rate: Max 180..190Mbps

KEY CHALLENGES: RAN AND TRANSPORT

NETWORK EVOLUTION

- Dimension for high capacity
- Introduce new spectrum
- Small cells deployments

SMALL SITES INTRODUCTION

- Optimizing IP connectivity and type of backhaul used
- Synchronization & management
- Adding appropriate security, not just Ipsec.

SUPPORTING RAN EVOLUTION

- LTE drives requirement for new phase/time synchronization
- Increased capacity requirements, new topology

NETWORK PERFORMANCE

- Performance management to correlate RAN and transport KPIs
- Optimize network QoS to enforce policy decisions

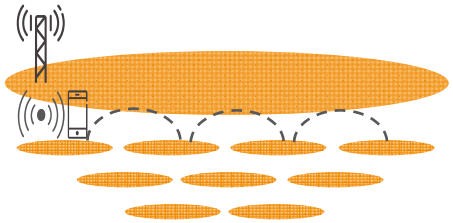
SECURING NEW REVENUE

- Provides multi-access transport capable of delivering large range of Enterprise or Utility services, for example
- VPNs, leased lines, etc..

RADIO COORDINATION SMALL CELLS

Uncoordinated Cells

Basic Mobility

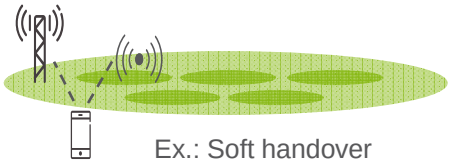


Ex.: Femto cells

Add **9** Cells for 2X Capacity

Tight Coordination

Full Mobility, distributed baseband

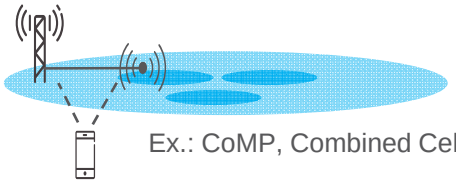


Ex.: Soft handover

Add **5** Cells for 2X Capacity

Tightest Coordination

Full Mobility, common baseband



Ex.: CoMP, Combined Cells

Add **3** Cells for 2X Capacity

Deployment with femtos in macro cells

With pico RBS
- Phase sync +/- 1.5 µs.
- latency 1-10 ms,

RRU joint scheduling (air interface) using CPRI (fronthaul)

LTE REQUIREMENTS SMALL CELLS & MACRO

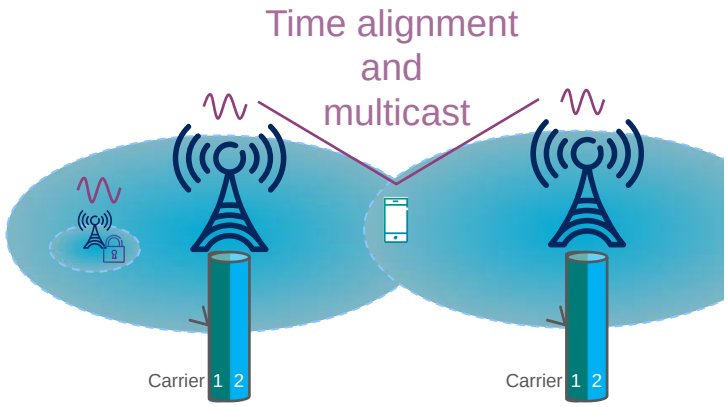
Carrier aggregation will increase the demand for backhaul capacity last mile

Coordinated Multi Point puts no additional transport requirements if using common baseband

LTE Broadcast requires time alignment between RBSs in the eMBMS cluster".
Support for multicast in transport is required

Cell Interference (FeICIC) requires time alignment between macro cells and small cells

IPSec – security- recommended for small cells



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LTE: TIME/PHASE SYNC NEEDS ACCURACY AT AIR

LTE Broadcast (eMBMS)

- +/-1.5..10us absolute time accuracy

LTE TDD

- +/-1.5us , cell radius < 3km
- +/- 5us, cell radius > 3km

Co-ordination Features for Small Cells

- +/-1..5us absolute time accuracy for FeICIC, future CoMP over X2

Positioning

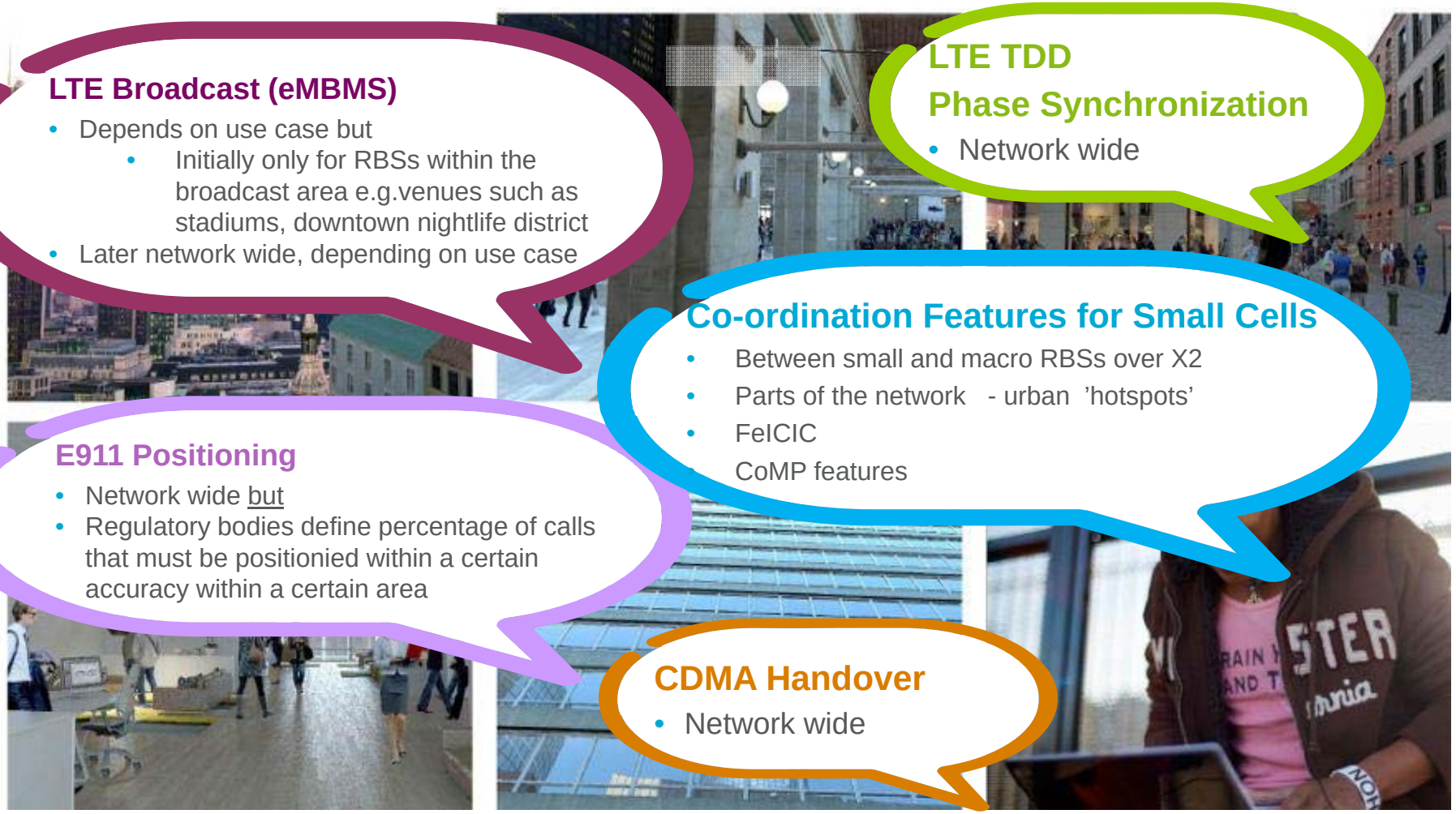
- Absolute time acuracy of ~+/-200ns * for positioning of E911 calls (most accurate positioning within 50m)

CDMA Fallback

- +/-1.5..+/-5 us frame alignment

** Regulatory demands in some countries. Assumes GNSS solution. Applicable to only % of calls*

SYNC ACCURACY NEEDS - WHERE IS THIS NEEDED?



LTE Broadcast (eMBMS)

- Depends on use case but
  - Initially only for RBSs within the broadcast area e.g.venues such as stadiums, downtown nightlife district
- Later network wide, depending on use case

LTE TDD
Phase Synchronization

- Network wide

Co-ordination Features for Small Cells

- Between small and macro RBSs over X2
- Parts of the network - urban 'hotspots'
- FeICIC
- CoMP features

E911 Positioning

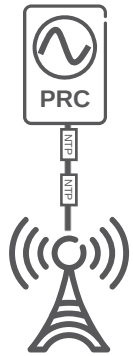
- Network wide <u>but</u>
- Regulatory bodies define percentage of calls that must be positioned within a certain accuracy within a certain area

CDMA Handover

- Network wide

SYNCHRONIZATION ALTERNATIVES

NTP



Frequency sync

Effective NTP solutions deployed

Proven solution for many years

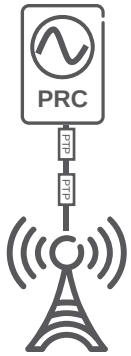
SyncE

Frequency sync

Physical layer sync

Needs support in all intermediary nodes

PTP (1588v2)

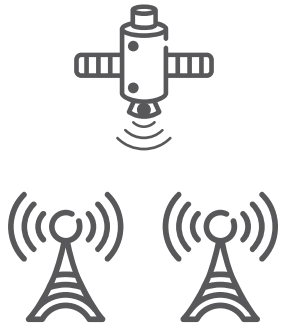


Frequency, time and phase sync

External master

Needs transport network support for time sync

GNSS

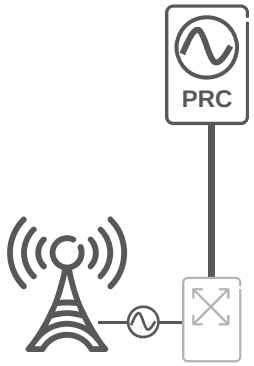


Frequency, time and phase sync

Best performance

Indoor installation may be an issue

TDM



Frequency sync

Migration case

Intra RBS solution

Packet based Sync — **Packet based Sync**

Physical nw sync — **Physical nw sync**

Satellite

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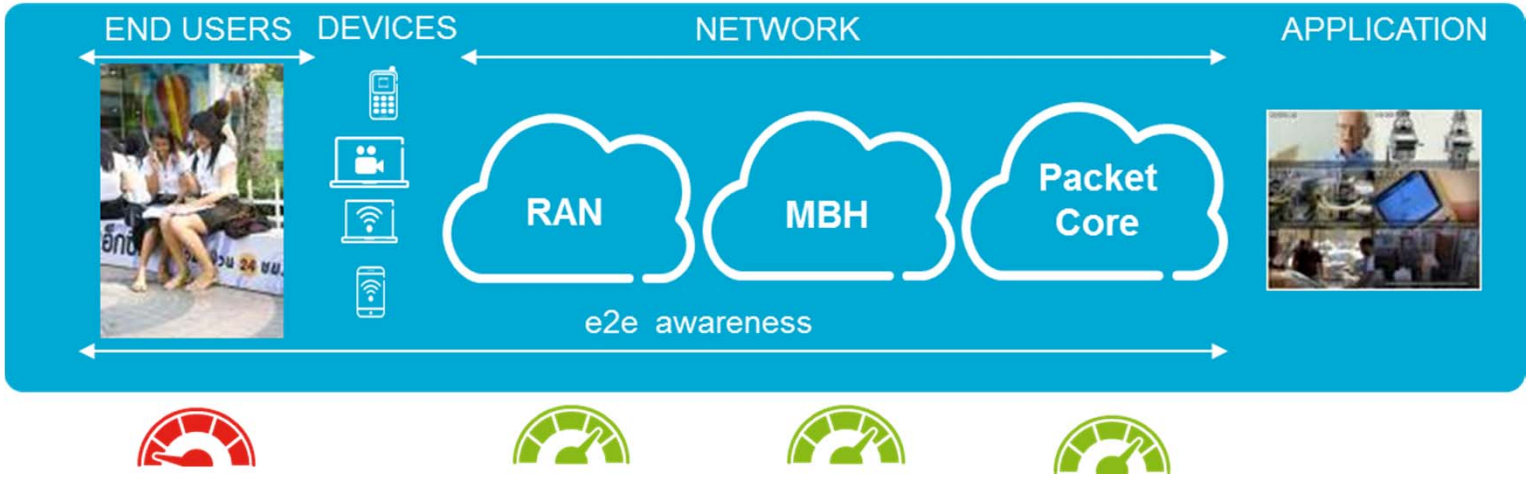
NETWORK PERFORMANCE

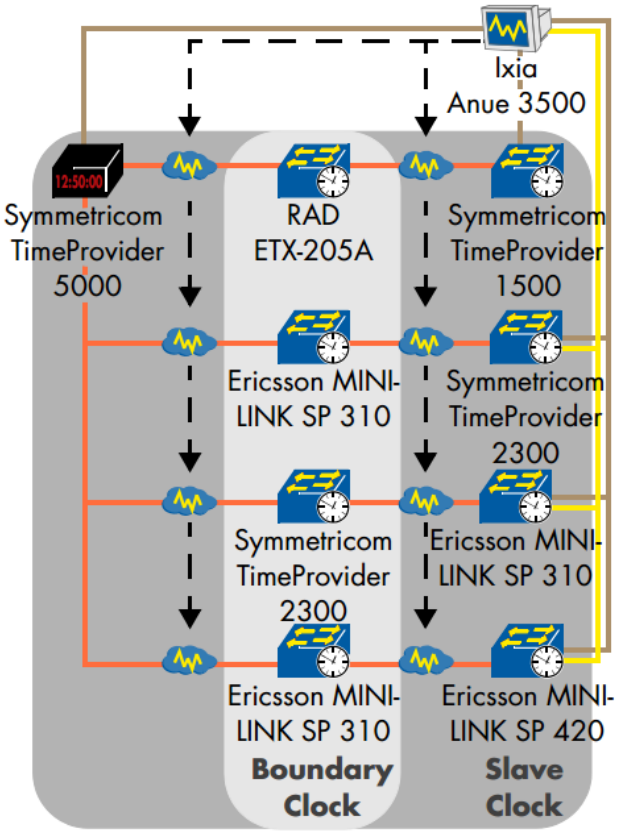
- Performance enables service differentiation, optimises the network investments, improves network performance that impacts the end users



End user impact	End to end network impact
Drop calls	E2e QoS, Sync, Performance monitoring
Low throughputs	Traffic shaping, scheduling, buffer setting
Lack of service due to disable cells (sync)	

Superior network performance requires transport investment

PROOF POINTS: BOUNDARY & TRANSPARENT CLOCKS)

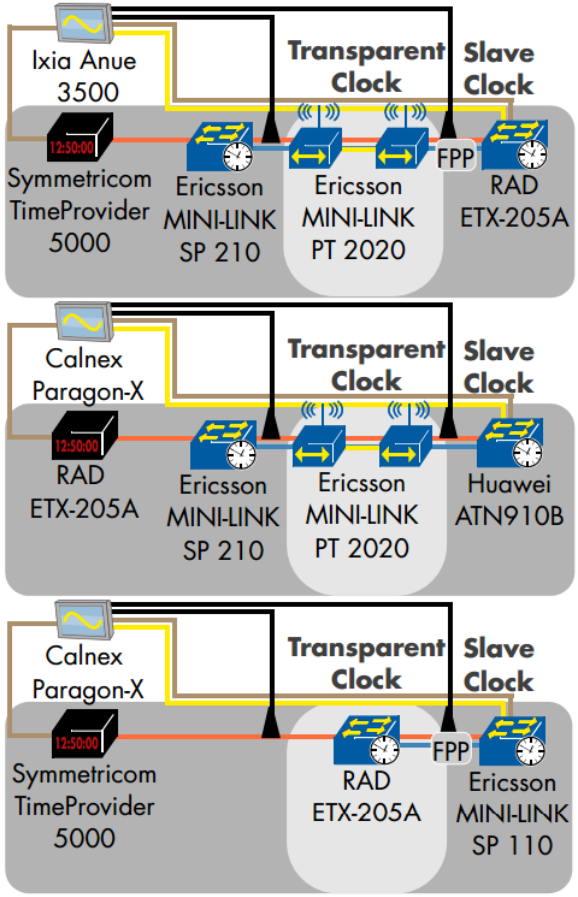


Transparent Clock:

PT 2020 compensating IP/unicast
SP 210 as Boundary Clock for test case

Boundary Clock:

SP 310 for IP/unicast & Ethernet/multicast
SP 420 for Ethernet/multicast

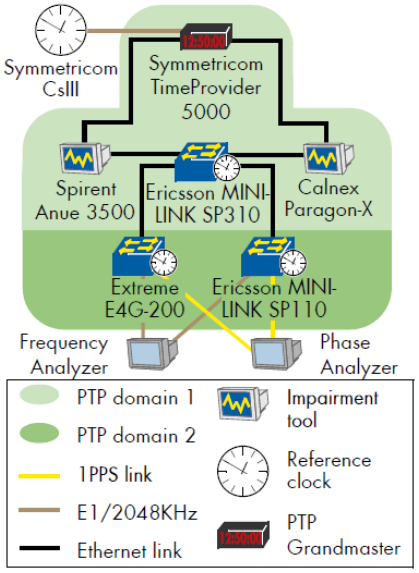


White paper available at http://www.eantc.de/fileadmin/eantc/downloads/events/2011-2015/EWC2013/EANTC-EWC2013-WhitePaper-Final_online.pdf

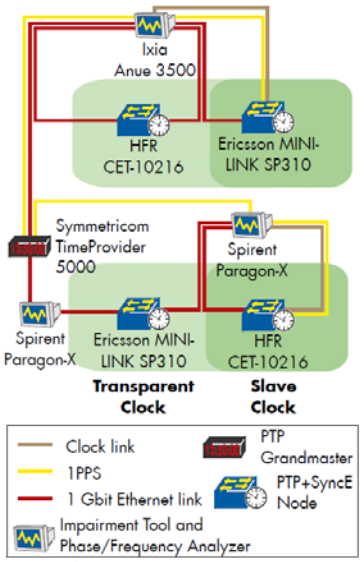
EANTC public vendor inter-operability from **August 2013**

INTER-OPERABILITY (MULTI-VENDOR RAN & BACKHAUL)

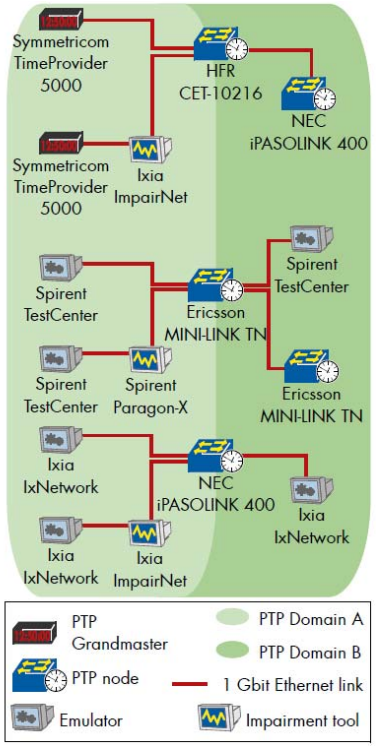
- Vendor inter-operability of IEEE 1588 is **not** a trivial task…
  - Ericsson participates in public inter-operability testing with EANTC
  - Reduce the cost of network integration testing



Boundary Clock (CEWC 2011)



Hybrid Clock (CEWC 2012)



Best Master Clock Algorithm (CEWC 2012)

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SUMMARY

LTE put more stringent sync accuracy requirements on backhaul, eg LTE TDD, Coordination features in heterogeneous networks, LTE broadcast

Packet based solutions for frequency synch is fully proved (NTP or PTP solution)

Packet based solution for time and phase synch, PTP

PTP requires BC to improve Performance

Experience from early deployments tell us that securing performance of phase and time sync is not trivial.

IOT is crucial to guarantee Performance

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