ARCHITECTURE AND TRANSPORT FOR MOBILE BROADBAND BACKHAUL
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OUTLINE

› Technology and market drivers
› Link technologies
› Backhauling of Heterogeneous Networks
› Main remote connection technology
› Sync issues in mobile broadband backhauling
› Summary
INTRODUCTION

ARCHITECTURAL VIEW OF SCOPE

Reference network

Radio

Transport

Radio

Site Infrastr.

2G BTS

3G Node B

LTE eNodeB

RBS Site

Metro Ethernet

Microwave

Copper

Fiber

Mobile Backhaul

Switch/core site

BSC

RNC

CPG

MME

SIU
Radio Drivers for Transport Network Modernization

Broadband goes mobile
From household to individuals and devices

Subscription forecast

Continued HSPA Evolution
Peak rate in Mbps

50 billion mobile connections 2020

A multitude of different devices

Implications
Base stations everywhere
THE BEGINNING OF MOBILE BROADBAND

Mobile Broadband will require packet technologies
Both in Radio and in Backhaul
THE BACKHAUL SITUATION

› Globally
  – 48% micro wave
  – 37 % fiber
  – 15 % Copper

› Large regional variations
  – Fiber common in China, Korea, Japan
  – Microwave dominant in India and strong in Europe
  – Copper dominant in US

› Variations depending on operator type
  – Incumbent has own backhaul and ‘access to L1’ → control of delay
  – Non-incumbent rents backhaul and has ‘access to L2’ → less control

› Microwave Ethernet and Fiber dominate new macro installations

Source: heavy reading
TRANSFORMATION SCENARIOS – TOWARDS PACKET TRANSPORT

- Ethernet introduced to new sites
- ATM phase out
- TDM phase out

**TDM only**
- PDH, SDH, NG-SDH, Ethernet/PDH

**Hybrid**
- Native TDM, Native Ethernet

**Packet only**
- Native Ethernet, CES(TDM)

- Ethernet transport
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HIGH CAPACITY MICROWAVE LINKS

- 1 Gbps, 2,5 Gbps and higher can be reached
- Future-proof microwave solution for LTE and LTE-Advanced
- Optical Ethernet interface
- 70/80 GHz channel (E-band)
- FDD RF interface
- Live Gb test link has been running for 1,5 years

Microwave capacity will not be a bottleneck
BONDED AND VECTORIZED VDSL2

VDSL2 can reach 500 Mbps over 600 m using bonding and vectoring technologies

Existing Cu infrastructure can handle high capacities
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WHEN TO DO WHAT?

Enhanced macro site
› Most straightforward - first step
› Uniform capacity and coverage
› Limited potential

More dense macro layer
› Long term solution for uniform coverage and capacity enhancements
›Limited by site availability

Additional low-power nodes
› Especially for non-uniform traffic demand
› Avoids need for additional macro sites

Higher data rates

Higher area capacity

Very high capacity

Very high data rates
**Heterogeneous Networks – Different Approaches**

**Conventional Pico RBS**
- Main part of processing locally at “pico” site
- Conventional backhaul (copper, fiber, μ-wave, …)

**Relay**
- Main part of processing locally at “pico” site
- Backhaul using cellular radio-access/spectrum
- Backhaul consumes cellular spectrum

**RRU**
- Mainly radio at “pico” site, main part of processing centralized (e.g. at macro site)
- High-speed fiber-based backhaul
Densification of radio networks will happen ~2015 and beyond.

- Many bottlenecks in MBB networks
  - cell edge and uplink capacity
  - indoor coverage

- Heterogenous radio networks
  - Initial deployment of macro for coverage
  - Pico and relay basestations for incremental capacity growth and extended coverage
    - Order of 100 meters inter-site distances
    - Fast roll-out of pico relays, with later roll-out of dedicated transport to the highly loaded relays.
  - Hierarchical radio structures to handle inter-cell interference and resource management
    - Low delay required on X2, and time/phase sync
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USE CASE FOR MAIN-REMOTE CONNECTION OVER GPON INFRASTRUCTURE

Central Office

- MU
- λ converter
- λ converter
- CWDM MUX/DEMUX

GPON Node
- λ_BBA
- λ_{1…4}

Main-remote solution
- λ_1

RRU
- Add/drop traffic to/from RRU:s
- Optical Fiber carrying GPON and M-R traffic

Central Office
- λ_2
- μ
- BBA
- BBA

RRU
- RRU
- Ethernet switch
- MUX/DEMUX
- λ_BBA

Add/drop traffic to/from RRU:s

FTTH
- Central Node
- λ converter
- CWDM MUX/DEMUX
- MU

Electrical connectivity to end-users
High speed fixed & mobile access infrastructure convergence using GPON to support:
- Fixed residential and business FTTH users
- Bonded VDSL2 over GPON connections
- CPRI MU-RRU links for RBSs
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Synchronization (frequency, time-phase or both) is a key aspect in mobile broadband backhaul networks to support:

- the services carried over the packet network (including proper interworking with legacy TDM networks)
- the end-application operations, such as radio base stations.
SyncE to become an established technology also in Mobile backhaul (frequency sync only, but may be used to aid IEEE1588 for time delivery).

Some limitations in multi-operator scenarios

Increased need to deliver accurate phase-time synchronization

PTP (IEEE1588) being specified for Telecom

Frequency Telecom Profile just released; time sync profile being discussed

Access technologies are challenging environments to deliver accurate time due to intrinsic asymmetry (e.g. GPON; xDSL)

Sync solutions for CoMP, CPRI, wireless backhaul in heterogeneous NW requires careful analysis
SUMMARY - CONCLUSIONS

✔ With the rollout of Long Term Evolution the capacity of the radio access network backhaul needs to be upgraded to 100–150 Mb/s. Next generation mobile networks, such as LTE Release 10, will increase the requirement for backhaul capacity to gigabits per second.

✔ The need for increased capacity and decreased cost per transported bit drives packet-based mobile backhaul capacity boosts over microwave, copper and fiber. Backhaul link technologies will not be a bottleneck for Mobile Broadband Traffic.

✔ Variations of backhaul deployment depending on operator type
  Converged versus mobile only operator
  Possibility to use existing infrastructure (Fiber and Copper)

✔ Microwave Ethernet and Fiber will dominate new backhaul installations

✔ Proper sync solutions are one key aspect for a successful deployment of next generation mobile backhaul networks