TUTORIAL:
Evolving Architectures for Mobile and Broadband…

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4th November 2008

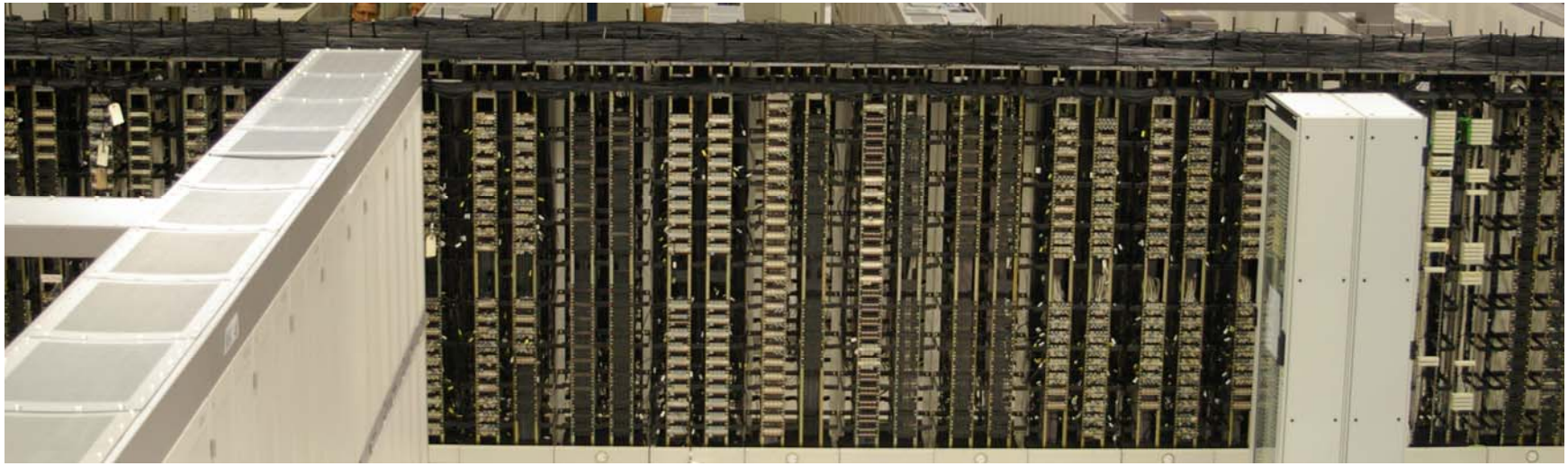
Agenda:

- A question:
  - “We need sync over packet” - Why?
- Surely we only require sync over packet if we have a packet switched network…
- Therefore another question:
  - Why do we need a packet switched network?
- Drivers for PSN - mobile
- Technologies and Migration steps
- What about fixed networks
  - Common core (Infrastructure FMC)
  - Fixed broadband access
- Triple Play and beyond…

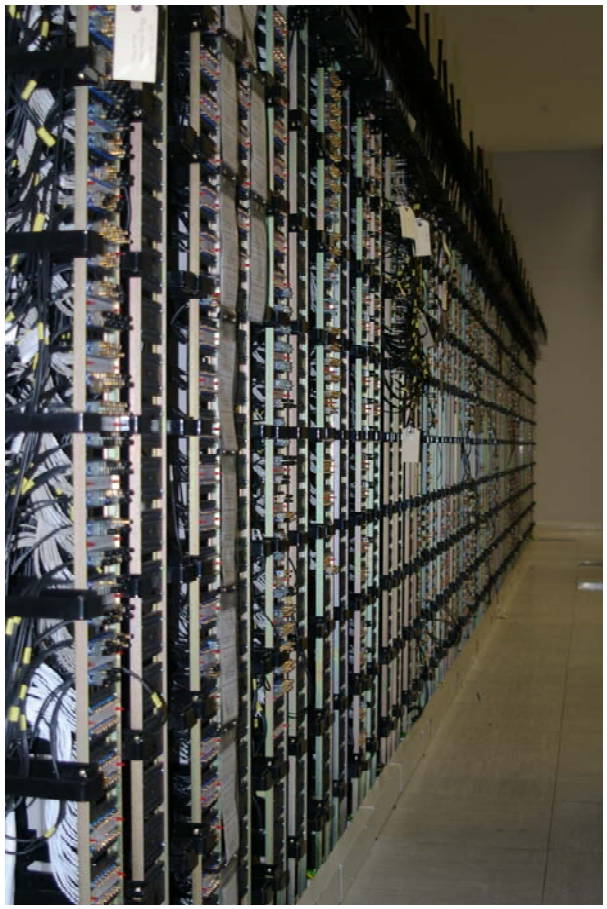
Mobile Backhaul

Question:
E1s have served the industry well to date so why change..?

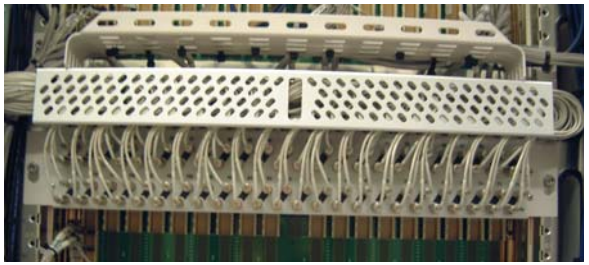
Answer:
Scalability and TCO…



E1 Circuits

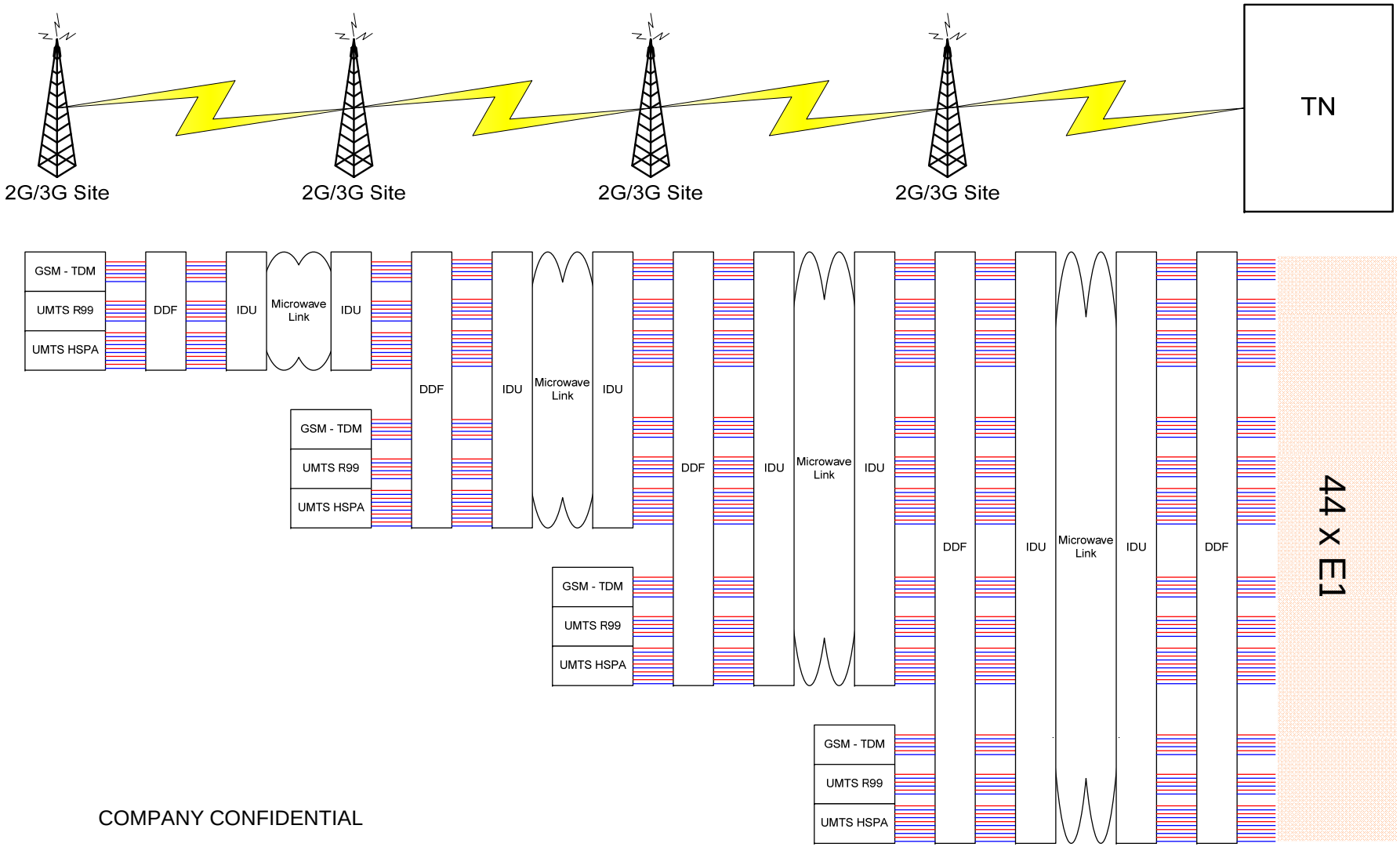


- E1 based DDF
  - BTS/Node B
  - Intermediate sites
  - TN
  - BSC
  - AXC (Metro)
  - RNC
  - AXC (Core)
  - SGSN
  - TRAU
  - Etc…



DDF Cabling for chain of 4 sites

(3 x E1 GSM, 3 x E1 R99 & 5 x E1 HSPA)



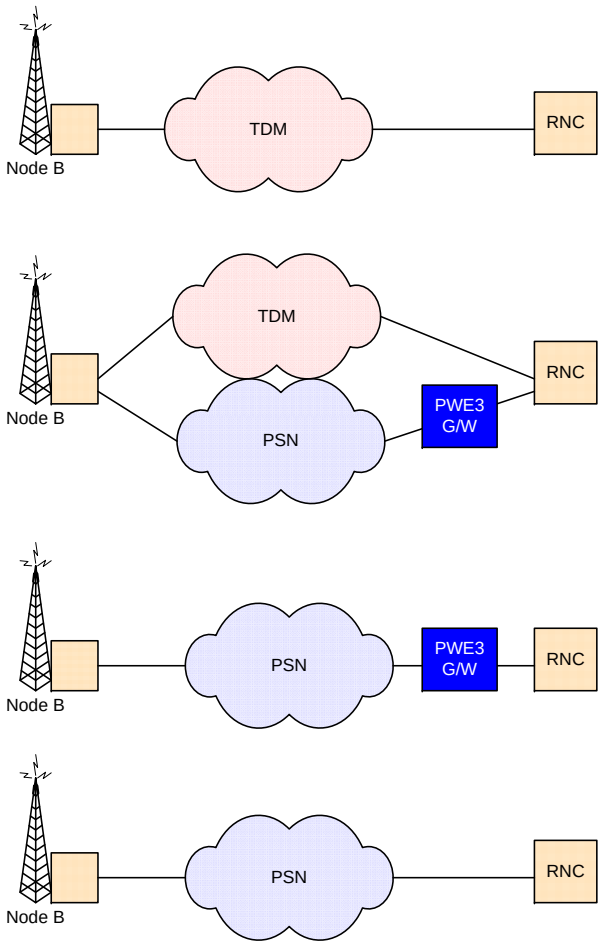
E1 scaling for Mobile Broadband Evolution

(GSM + R99 + HSPA)

- Assuming 11 x E1 per site then total E1 count arriving at TN:
  - TN serving 20 sites = 220 x E1
  - TN serving 30 sites = 330 x E1
  - TN serving 40 sites = 440 x E1
  - TN serving 50 sites = 550 x E1
- Lets now introduce 14.4Mbps (10 x E1s) and then 28.8Mbps (20 x E1s):
  - TN serving 20 sites = 320 x E1 for 14.4 & 520 x E1 for 28.8Mbps
  - TN serving 30 sites = 480 x E1 for 14.4 & 780 x E1 for 28.8Mbps
  - TN serving 40 sites = 640 x E1 for 14.4 & 1040 x E1 for 28.8Mbps
  - TN serving 50 sites = 800 x E1 for 14.4 & 1300 x E1 for 28.8Mbps
- Add some LTE:
  - This requirement is on top of the above due to terminal distribution…

May be driven by pure capacity rather than 28.8…

Iub backhaul evolution



- Traditional TDM
- E1 IMA

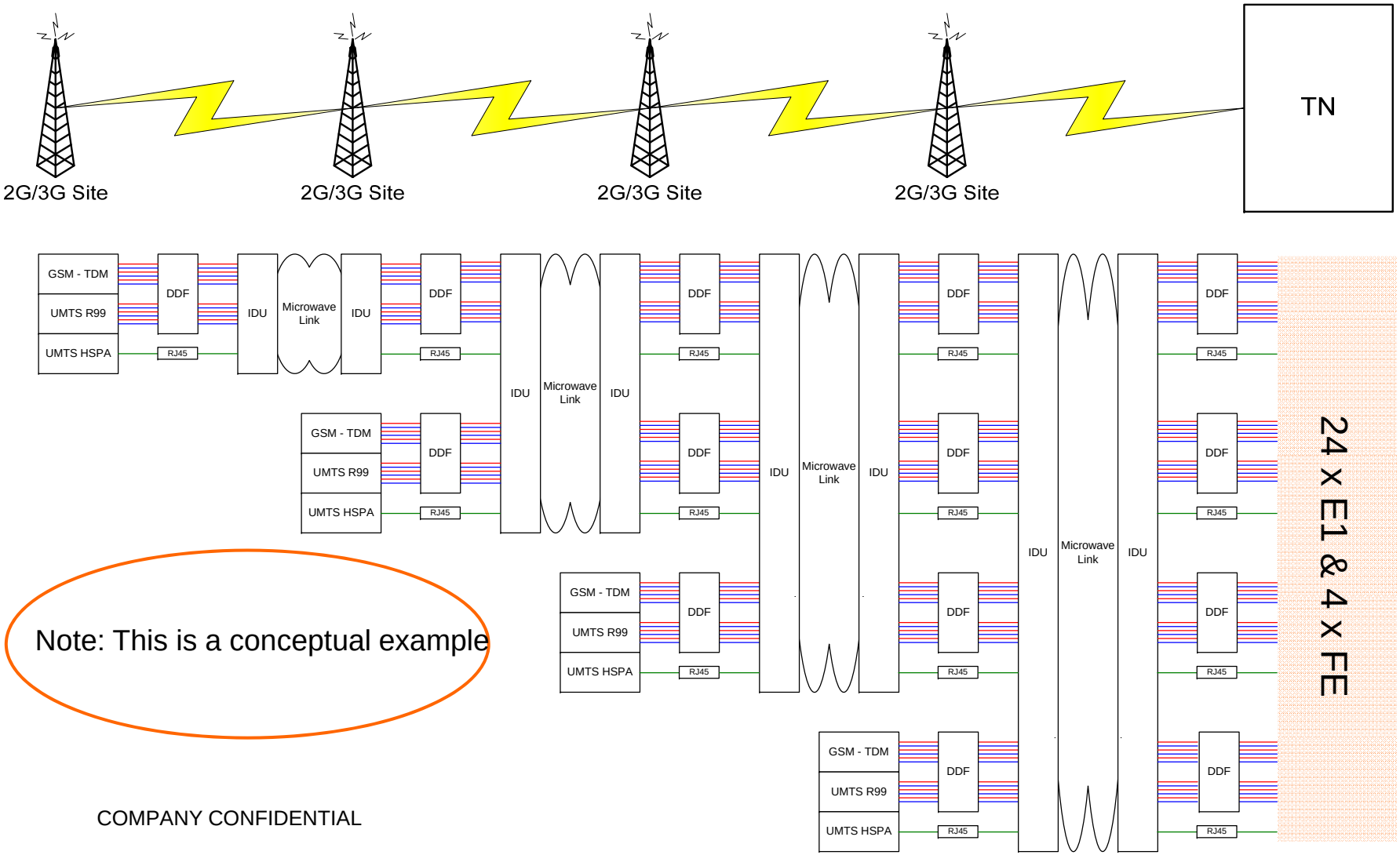
- Hybrid backhaul
- ATM PWE3 for MAC-d flows

- Full Iub over PSN
- ATM PWE3 for complete Iub

- True IP based Iub
- 3GPP R5 25.933

DDF & Ethernet Cabling for chain of 4 sites

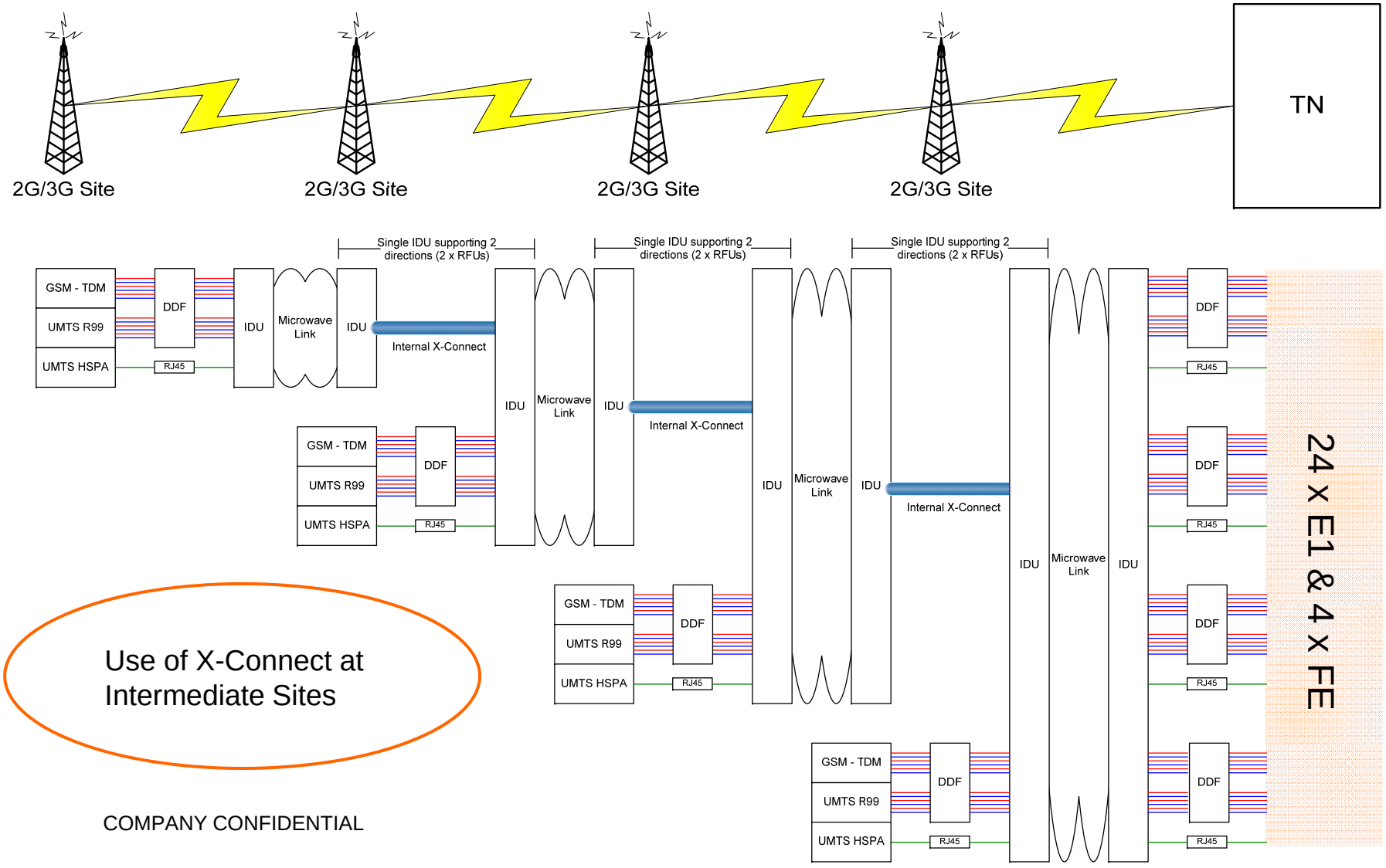
(3 x E1 GSM, 3 x E1 R99 & 1 x FE HSPA)



Note: This is a conceptual example

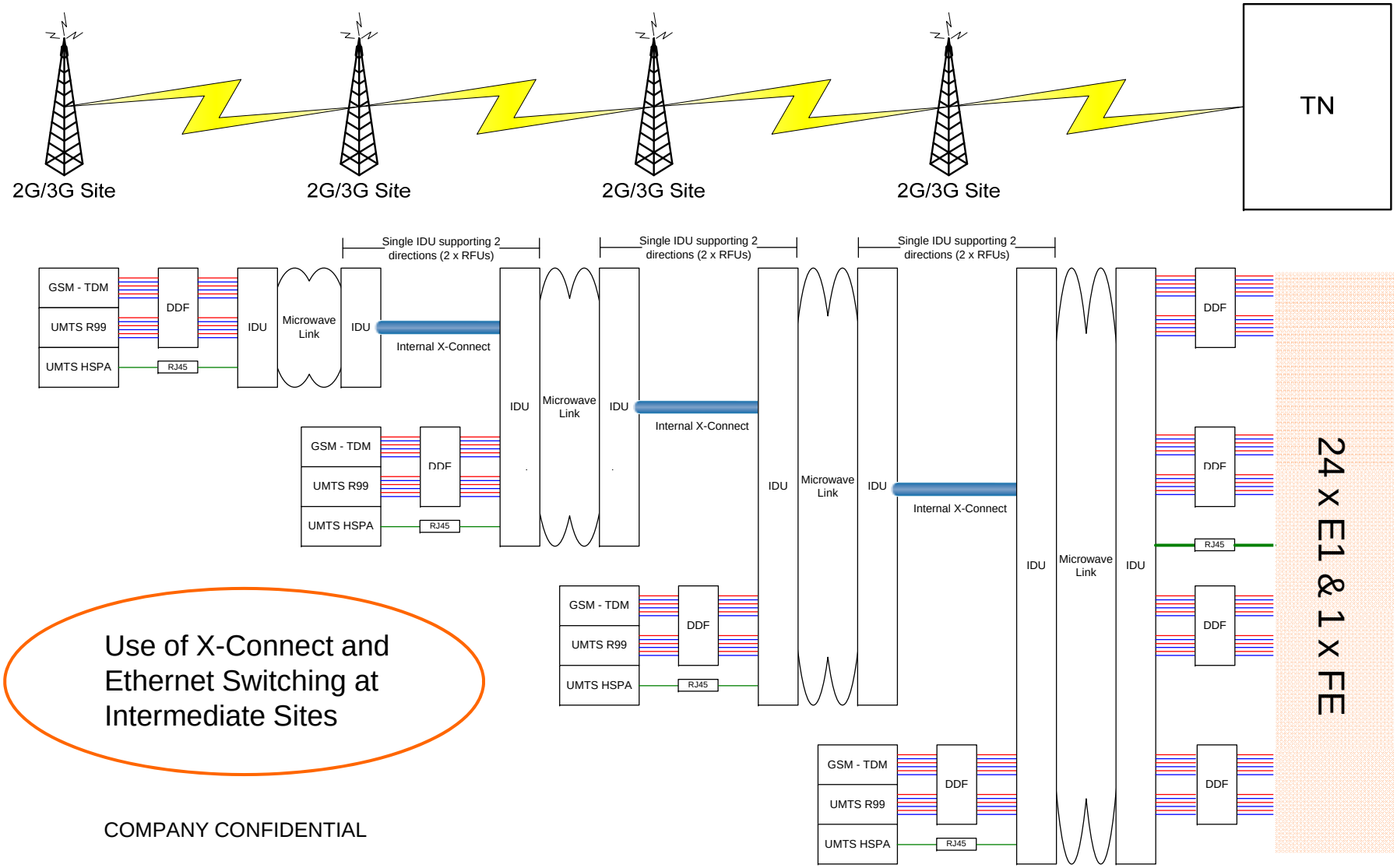
DDF & Ethernet Cabling for chain of 4 sites

(3 x E1 GSM, 3 x E1 R99 & 1 x FE HSPA)



DDF & Ethernet Cabling for chain of 4 sites

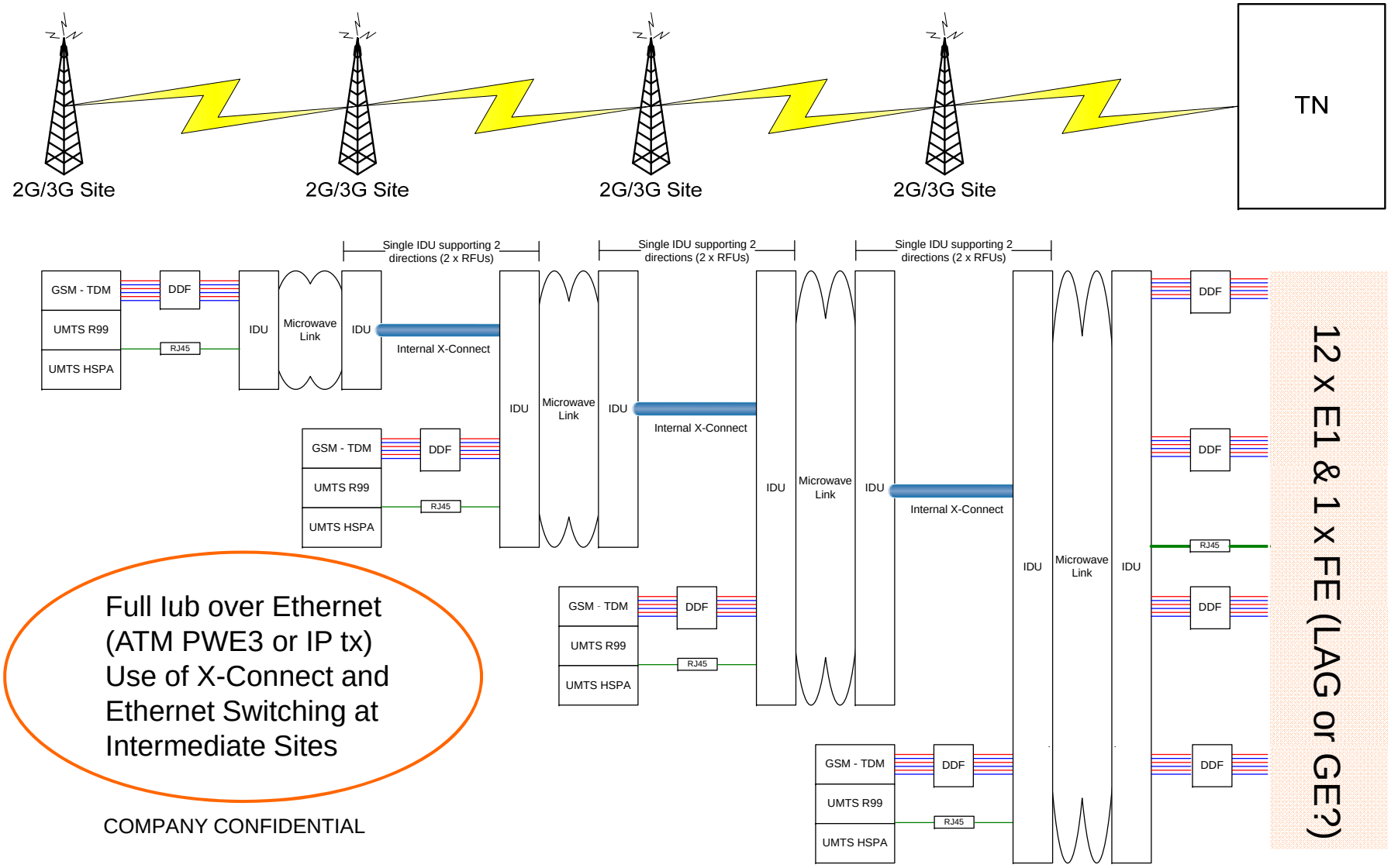
(3 x E1 GSM, 3 x E1 R99 & 1 x FE HSPA)



Use of X-Connect and Ethernet Switching at Intermediate Sites

DDF & Ethernet Cabling for chain of 4 sites

(3 x E1 GSM & 1 x FE R99 & HSPA)



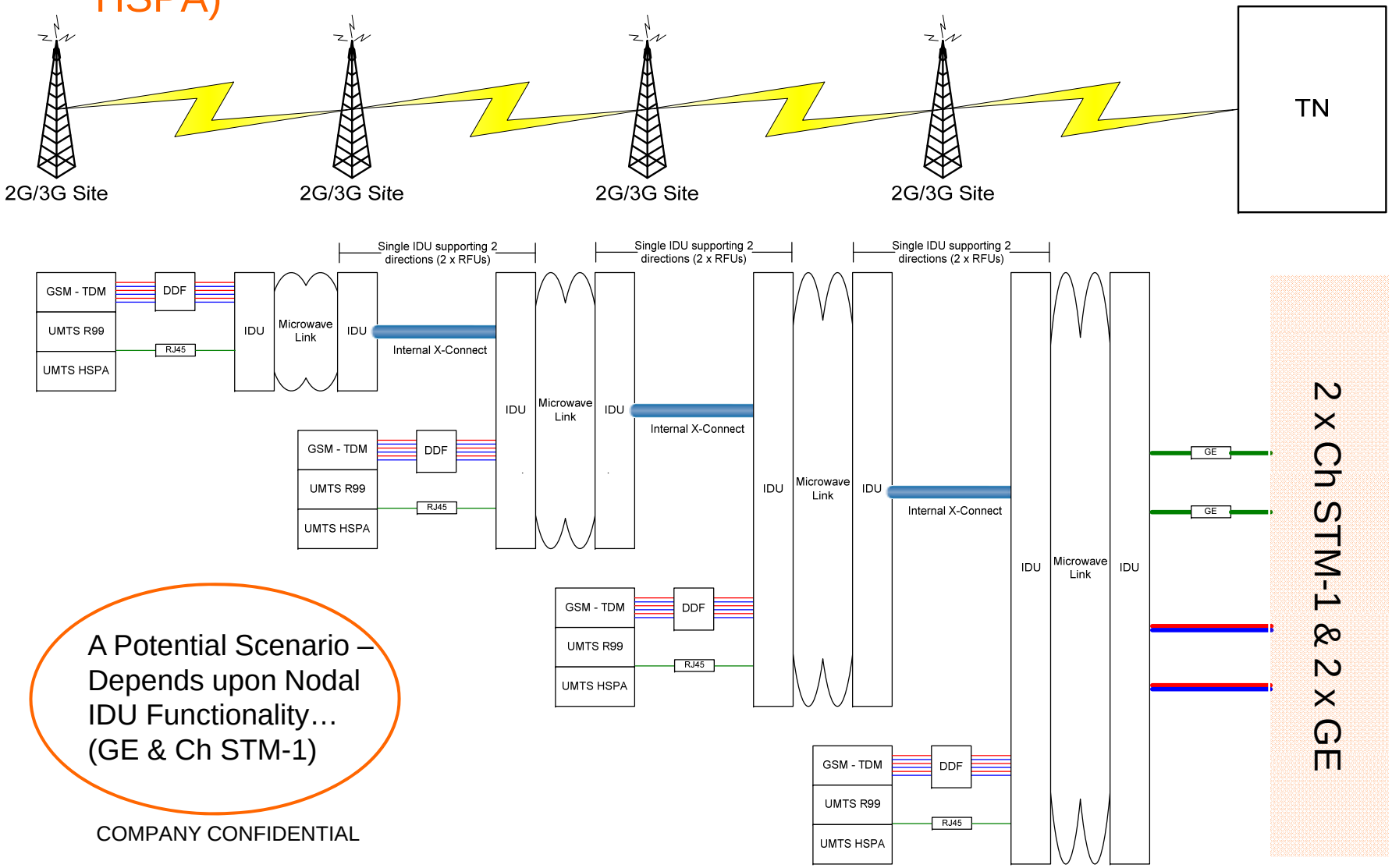
Full Iub over Ethernet (ATM PWE3 or IP tx)
Use of X-Connect and Ethernet Switching at Intermediate Sites

Optimised Hybrid for Mobile Broadband Evolution

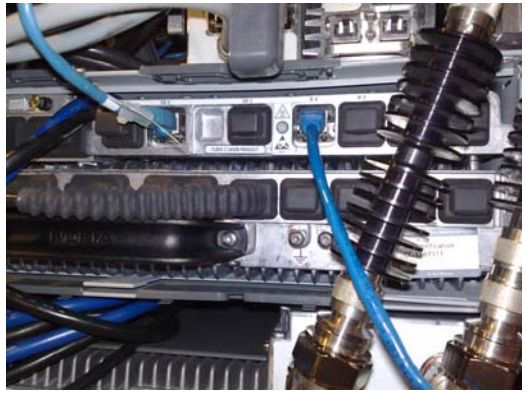
- Assuming 3 x E1 per site and 1 x FE then total E1/FE count arriving at TN:
  - TN serving 20 sites = 60 x E1 & 10 x FE
  - TN serving 30 sites = 90 x E1 & 15 x FE
  - TN serving 40 sites = 120 x E1 & 20 x FE
  - TN serving 50 sites = 150 x E1 & 25 x FE
- Lets now introduce 14.4Mbps and then 28.8Mbps:
  - TN serving 20 sites = 60 x E1 & 10 x FE for 14.4 & 60 x E1 & 10 x FE for 28.8Mbps
  - TN serving 30 sites = 90 x E1 & 15 x FE for 14.4 & 90 x E1 & 15 x FE for 28.8Mbps
  - TN serving 40 sites = 120 x E1 & 20 x FE for 14.4 & 120 x E1 & 20 x FE for 28.8Mbps
  - TN serving 50 sites = 150 x E1 & 25 x FE for 14.4 & 150 x E1 & 25 x FE for 28.8Mbps
- Add some LTE:
  - This requirement is on top of the above due to terminal distribution…
- Note: Actual number of Ethernet connections depends upon aggregation/switching capability and use of Nodal radio systems, maybe just 2 x GE per TN…
- Note: GSM E1s may be presented as channelised (structured) STM-1 interface, again depends upon use and capabilities of Nodal radio and BSC equipment

DDF & Ethernet Cabling for chain of 4 sites

(3 x E1 GSM (Ch-STM-1 aggregation at TN) & 1 x FE R99 & HSPA)



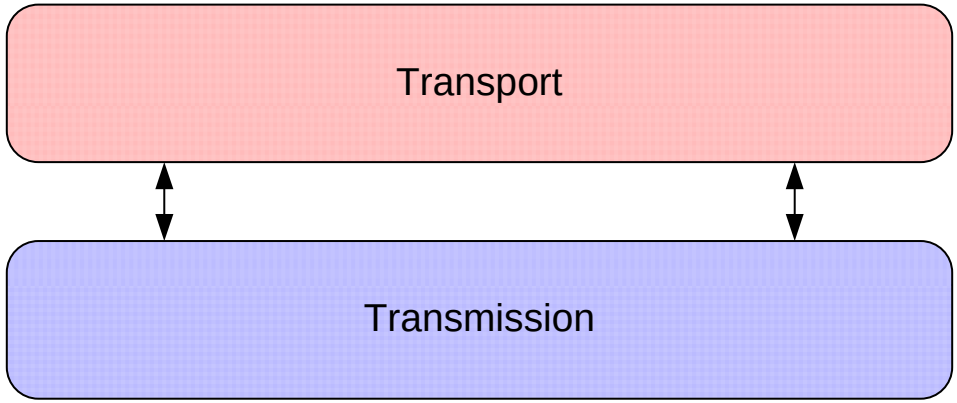
IP Transport Network Layer



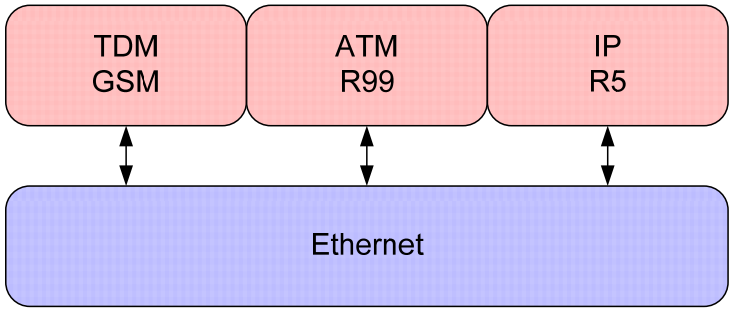
- 3GPP Release 5 introduces the concept of IP Transport in UTRAN
- However, IP does not equal Ethernet
- IP can be carried over ATM - PDH - SDH
- R99 ATM based UTRAN can be carried over Ethernet
  - ATM PWE3
- GSM can be carried over Ethernet
  - TDM PWE3
  - CESoPSN or SAToP
- Therefore careful consideration is required…

Transport, abstraction and transmission

- We know the end game is IP however even that's not simple
  - IP over what and how?
  - This impacts the functionality we require on the backhaul network

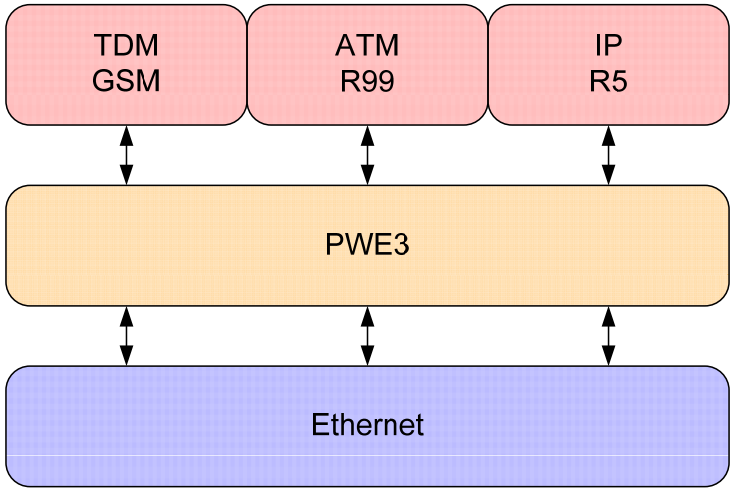


Network functionality



- Next-generation backhaul must support legacy services
- What is the mechanism for this?

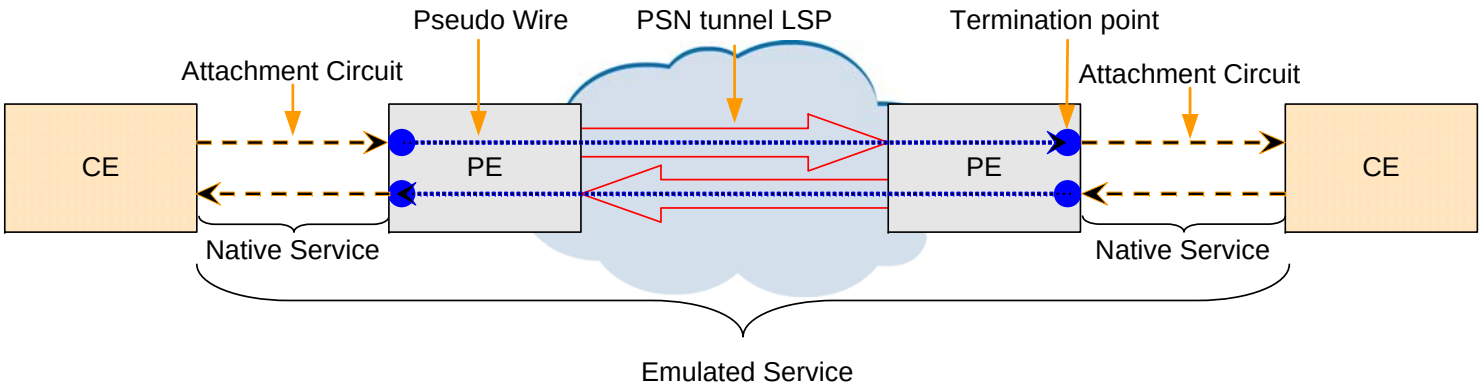
- Pseudo-wires enable the transport of legacy protocols over Ethernet
- Are pseudo-wires a short term requirement?



What exactly is a pseudo-wire..?

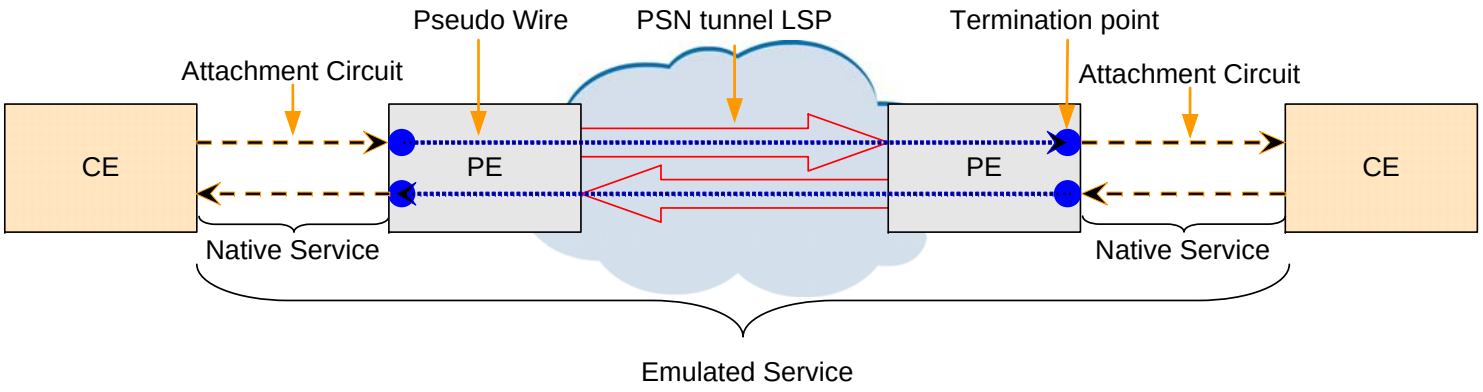
IETF RFC 3985 (One of many RFCs relating to pseudo-wires)

- Pseudo Wire Emulation Edge-to-Edge (PWE3) Architecture
- PWE3 is a mechanism that emulates the essential attributes of a telecommunications service (such as an E1 or ATM circuit) over a PSN
- PWE3 is intended to provide only the minimum necessary functionality to emulate the wire with the required degree of faithfulness for the given service definition

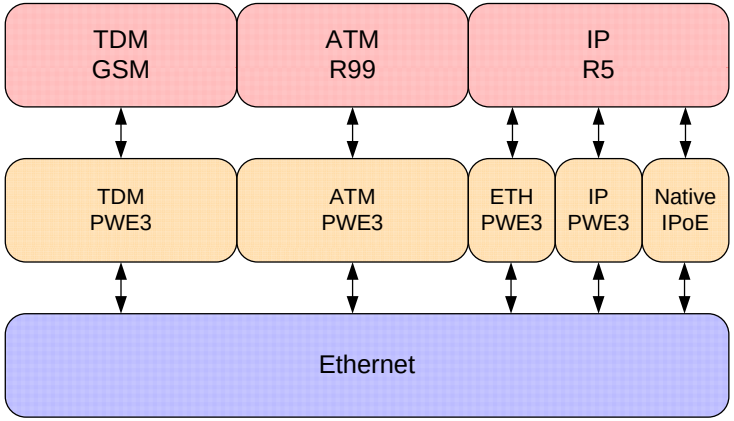


Creating pseudo-wire services

- What's needed to create a pseudo wire?
  - Client signal termination points at the endpoints
  - An IP routing protocol to establish reach-ability between endpoints
  - A tunnelling protocol to establish a connection between the endpoints
  - A signalling protocol to establish the pseudo-wire connecting the termination points through the tunnel

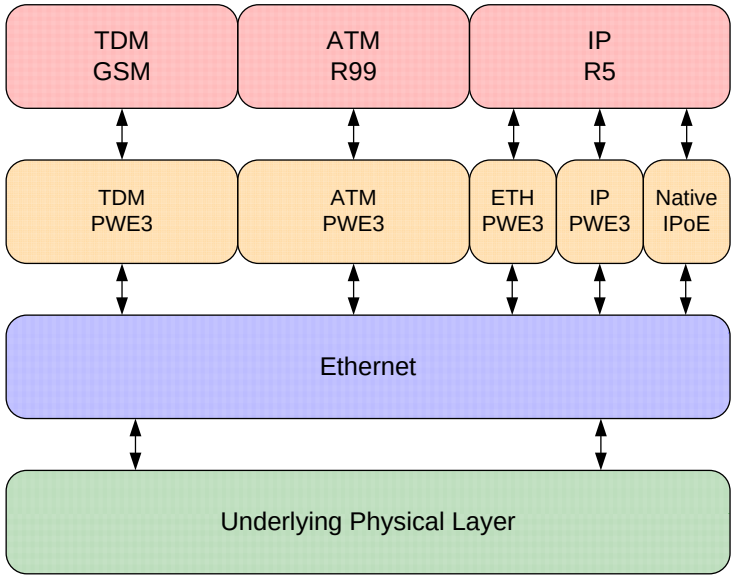


Transport support



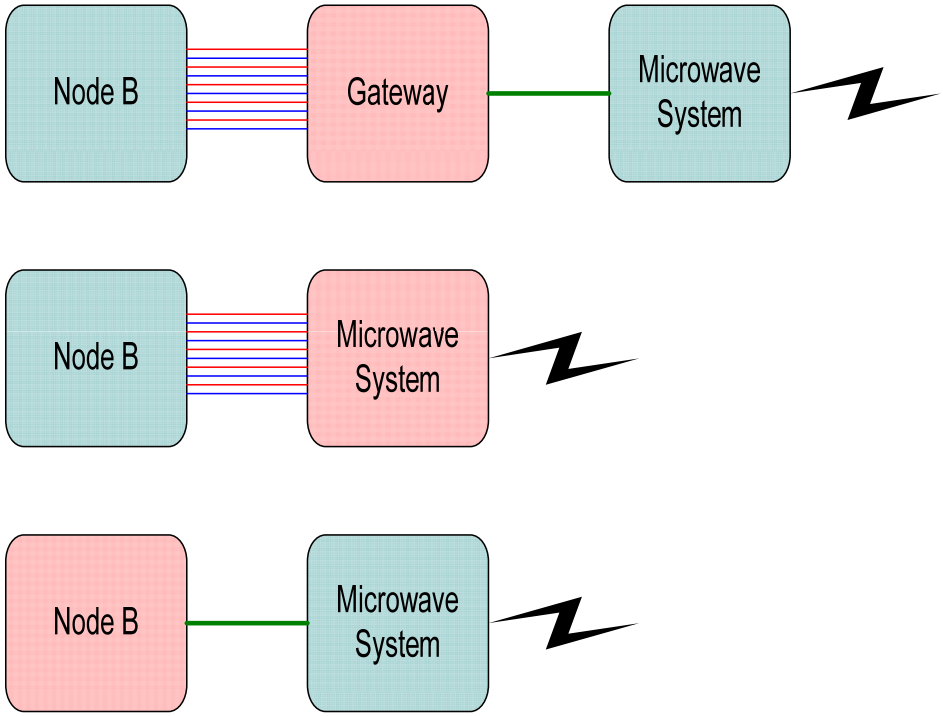
- Do R5 Node B's require pseudo-wires?
- Possibly…

- Ethernet requires an underlying physical layer
  - Microwave radio
  - Optical fibre
  - Copper



Ethernet makes sense however…

Where do we place the support for pseudo-wires?



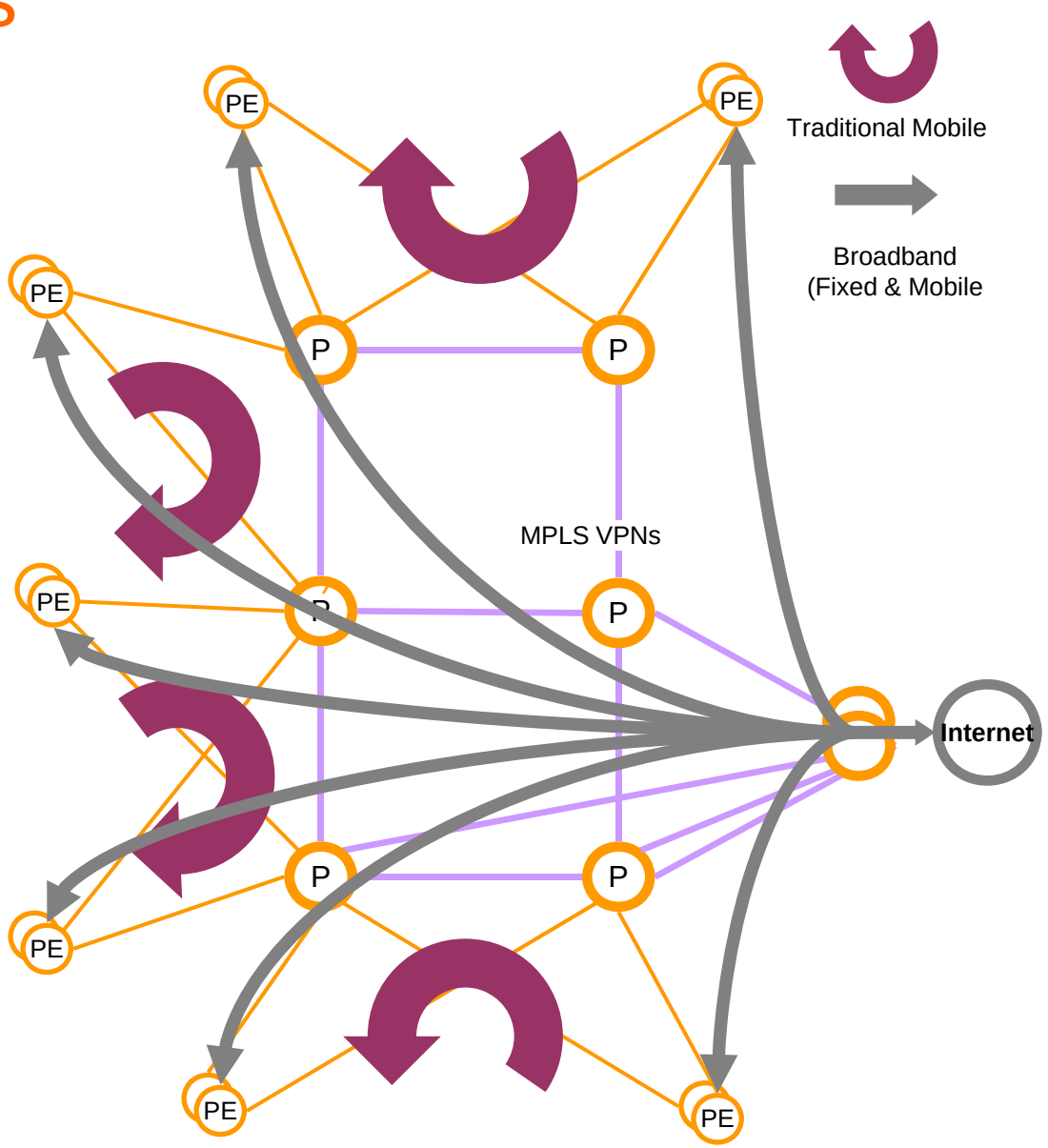
- Cell Site Gateway?
- Microwave System?
- Node B?

Common Core transmission/transport (Infrastructure FMC)

GRN traffic flows

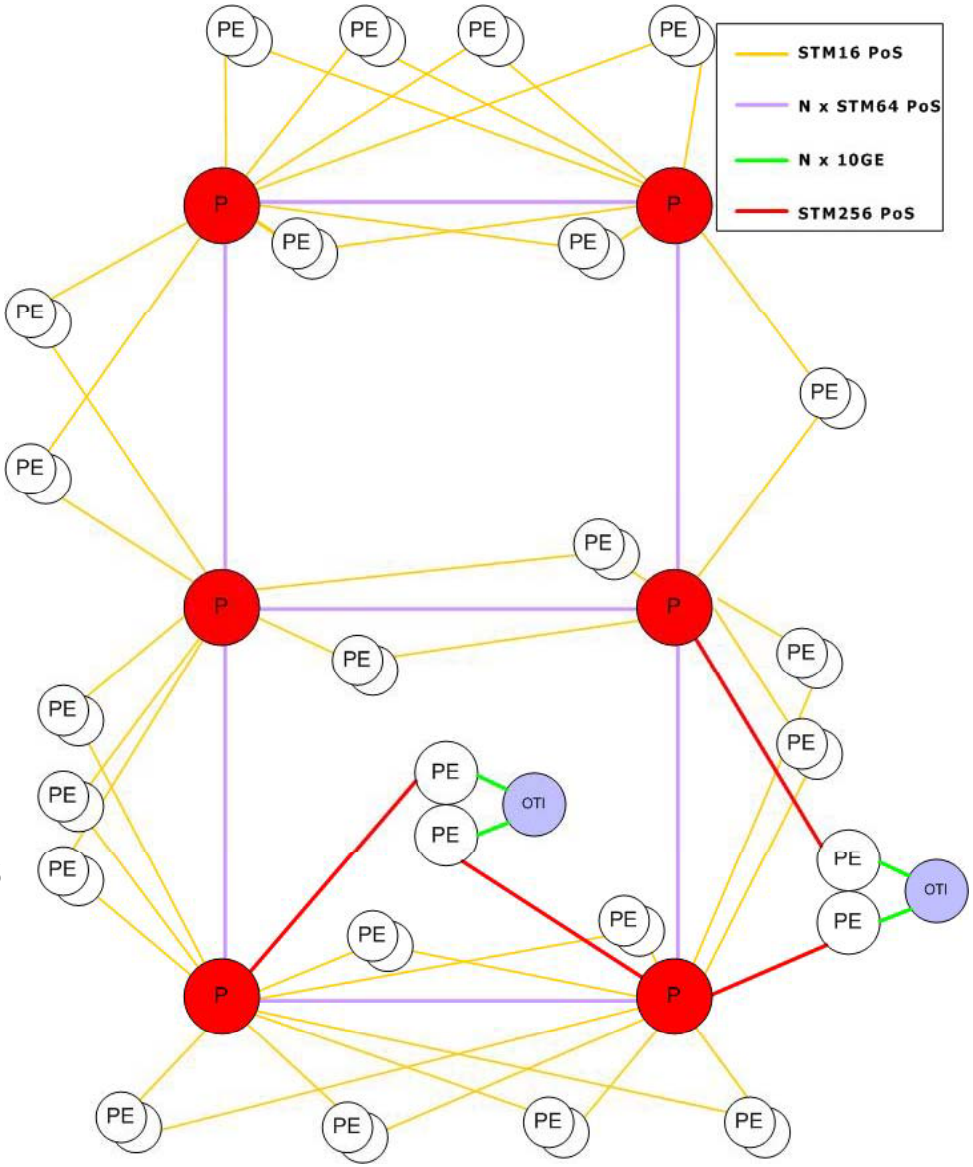
Gigabit Router Network

- Core IP/MPLS network
- Connects all OUK switch sites, data centres, corporate offices and call centres
- Provide access to Internet transit
- Being re-engineered to provide
  - Classic P core
  - Optical by-pass



OUK Core Network Overview (GRN)

- ‘High Availability’ Architecture and Features
- ‘Converged’ MPLS Network: Mobile & Residential Broadband Internet, Mobile and Residential Voice, Gn & Gi backhaul, Video, Billing, Corporate, etc.
- Based on RSVP LSPs with FRR protection (no optical protection)
- Five QoS classes
- Redundant Internet Peering Points
- *Optical by-pass not illustrated*



Fixed Broadband

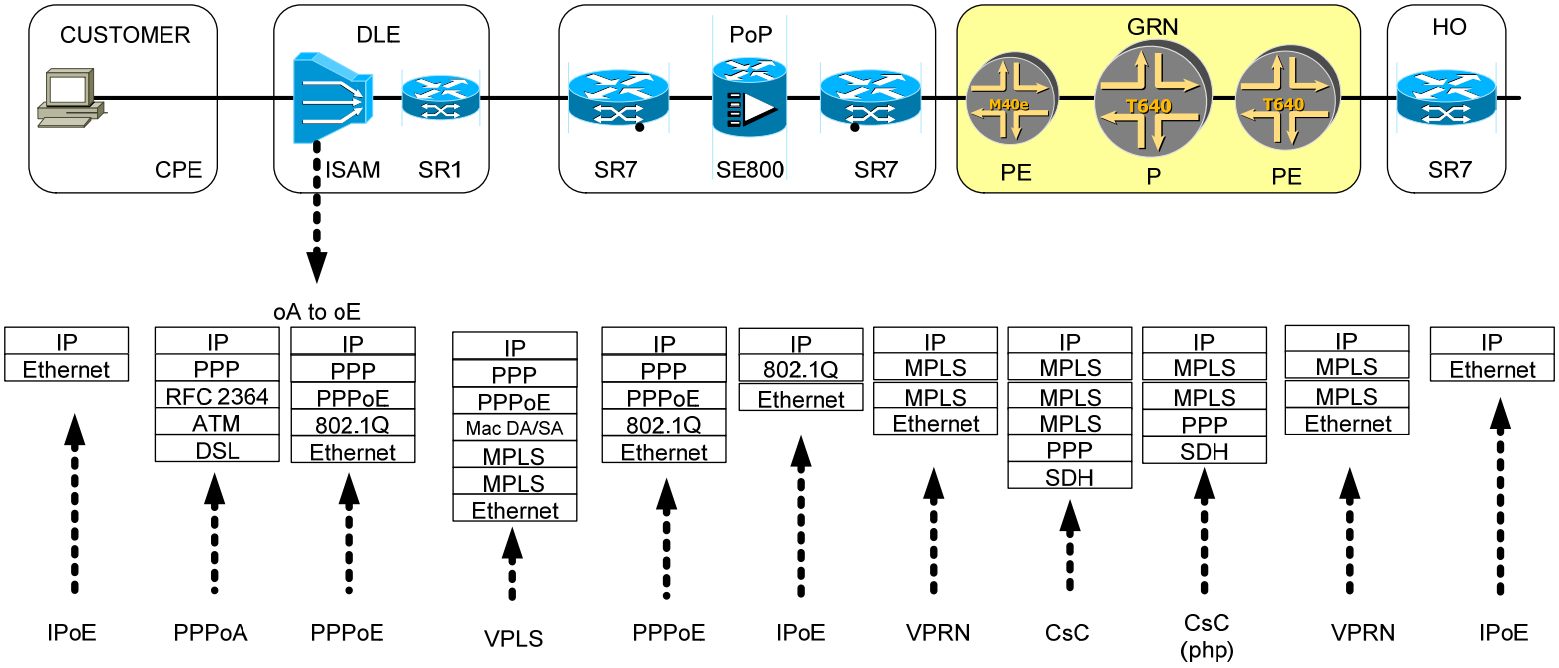
Fixed broadband

(ADSL - ADSL2 - ADSL2+ - G.SHDSL)

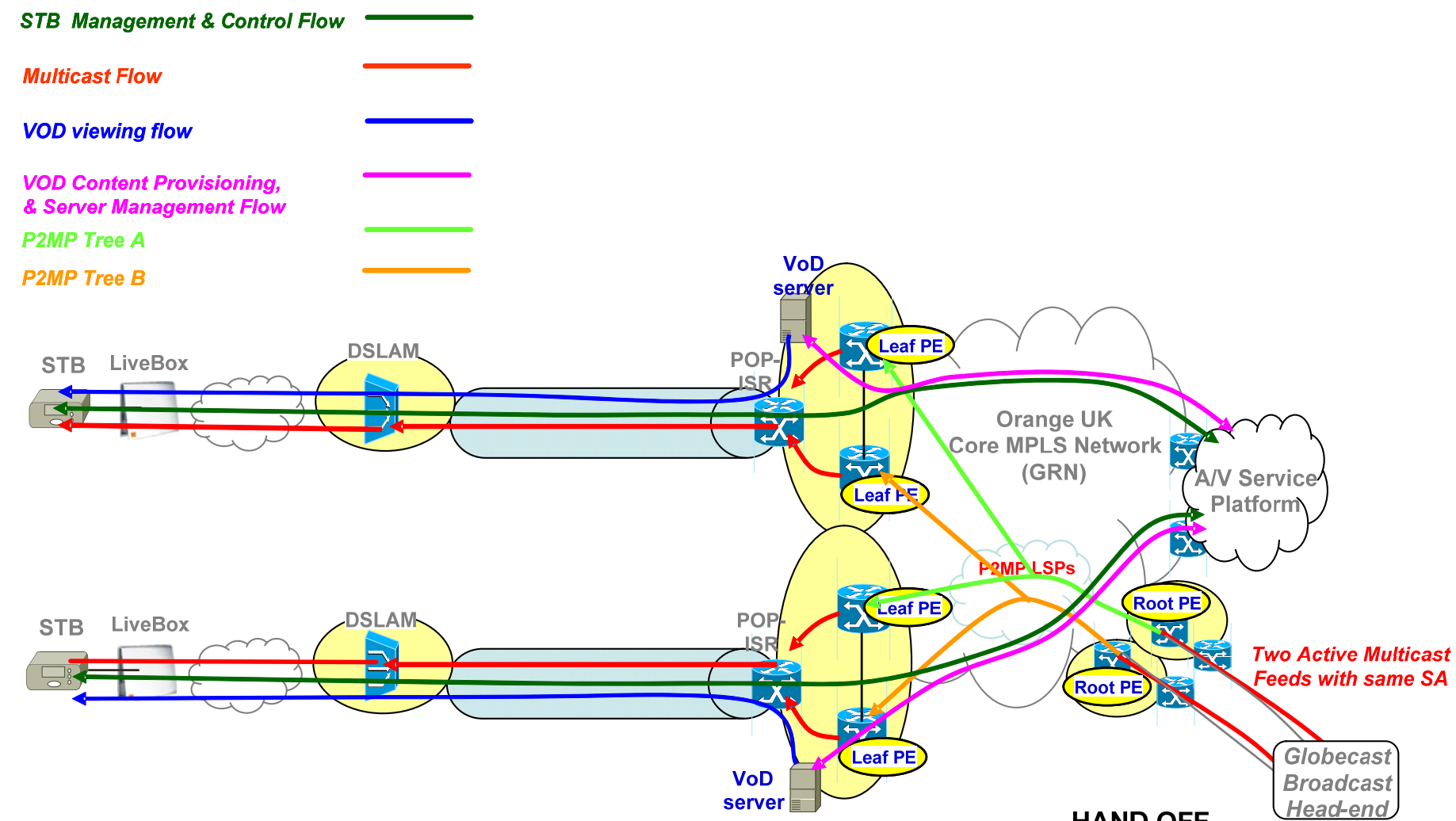
- Different starting point
  - Internet v's Telco…
- Ethernet backhaul started to replace ATM due to TR-101
  - DSL Forum (Broadband Forum) Technical Report 101
  - Migration to Ethernet-Based DSL Aggregation
- Introduction of the Ethernet DSLAM (sometimes called IP DSLAM)
  - ADSL is still ATM though…
- ATM - Ethernet Inter-Working Function (IWF)
  - Ethernet based backhaul
  - Increasing use of IP/MPLS towards the unbundled DLE/LEX

End to End Encapsulation

Protocol Encapsulation



OUK IPTV End-to-End Architecture



Summary

- The evolution of mobile networks and the implications of mobile broadband demand a fundamental re-think of backhaul architecture
- A move to packet based backhaul is inevitable
  - 3GPP R5 - LTE - EPC/SAE - IMS
  - Already happening in fixed
    - DSL Forum (now Broadband Forum) TR-101
- The correct solution and level of FMC will be a balance between cost, technology, scalability and operational impact
  - Therefore overall TCO…
- **Sync over Packet will be critical to cost-optimised network evolution!**

Thanks!

Any Question?

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