Wireless over Pseudowires

Presented by:
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Agenda

- **The challenge of mobile backhaul**
- **"Wireless over Pseudowires"**
- **Reference designs**
- **Synchronisation**
- **Future migration to all-IP**

3G Services are Driving Capacity Growth

Goal: Improve Performance Plus Reduce cost of delivery?

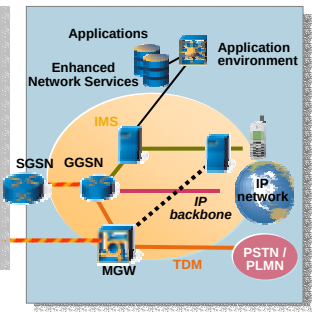
Services	  		?
Data Rates Enablers	2mbps UMTS	14.4mbps HSDPA	14.4mbps HSUPA
Mobile RAN Releases	ATM Rel 99	ATM Rel 4	IP Rel 5

Backhaul is The Missing Link

Terminals

Applications & Core

- Gaming
- TV
- Video on Demand
- Imaging
- Music
- Navigation
- Internet
- Remote working



Radio Technologies

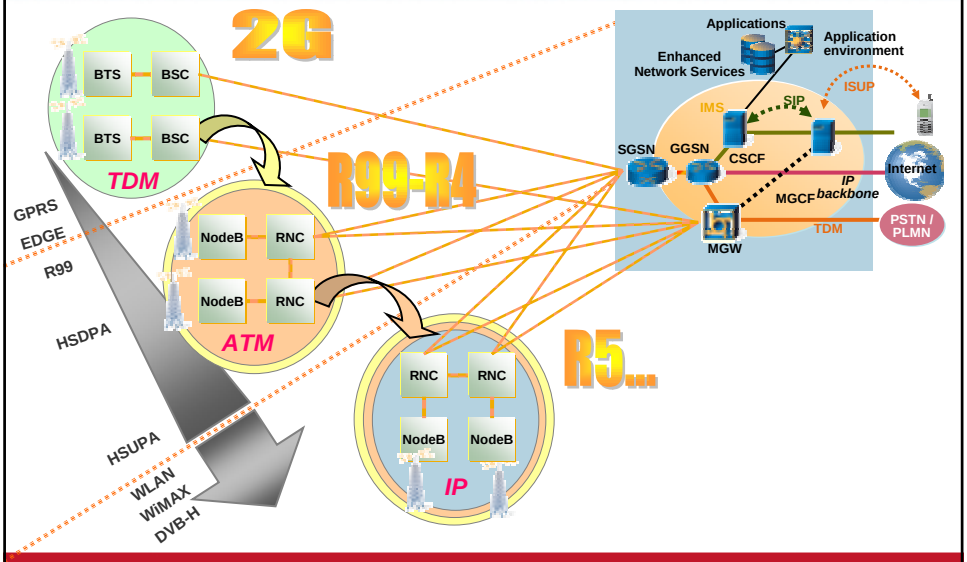
- GPRS
- EDGE
- UMTS
- HSDPA
- WiFi
- WiMAX
- DVB-H (Mobile-TV)

?

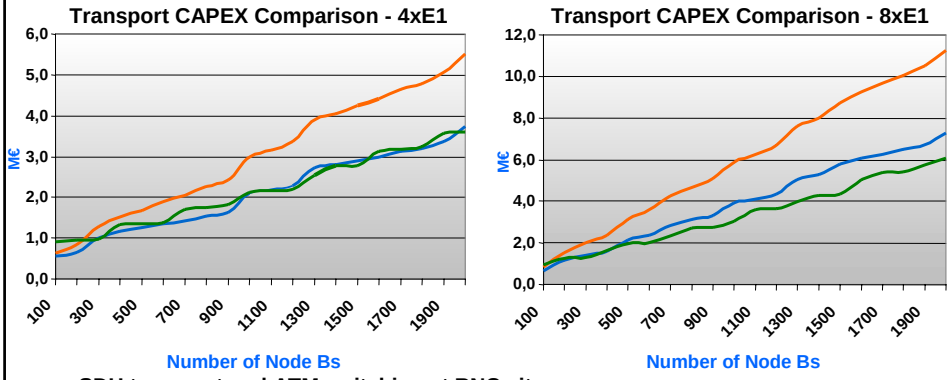
Backhauling

- RAN infrastructure will have heavy commercial impact
- 20-30% of operator OPEX is spent in backhauling today
- Many of the mobile broadband enablers are already Ethernet-based
- Operator spending moves from radio infrastructure to transport

The Challenge of Future Proof Backhaul

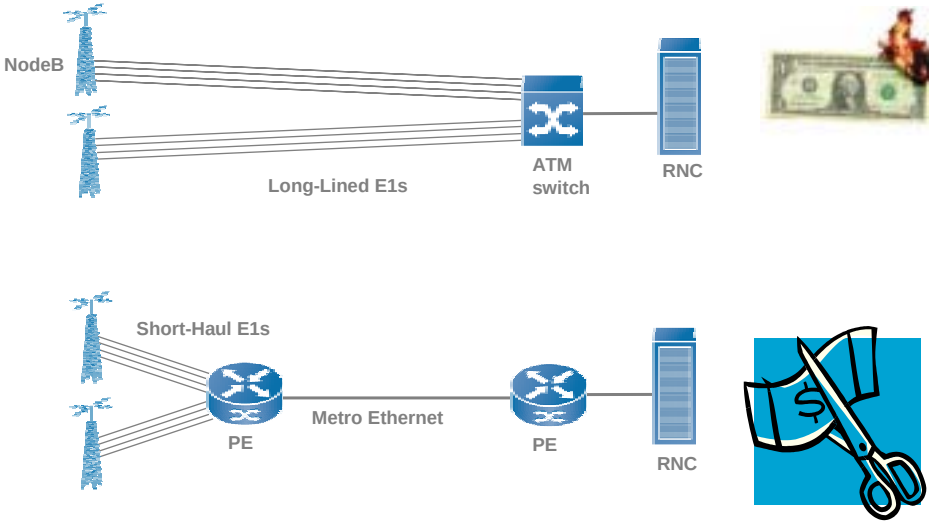


3G Backhaul Using MPLS
CAPEX Savings vs. TDM Backhaul



- SDH transport and ATM switching at RNC site
- RNC Application ("MPLS" aggregation box directly in front of RNC)
- Hub Application (MPLS aggregation boxes distributed to hub sites)

3G Backhaul Using MPLS
NETEX Savings vs. TDM Backhaul



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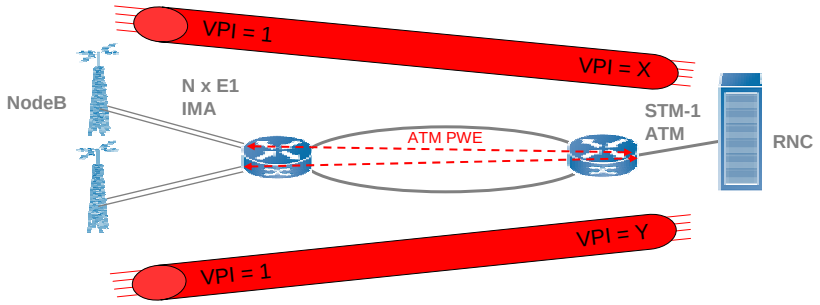
UMTS Backhaul Using MPLS
ATM VP Transport

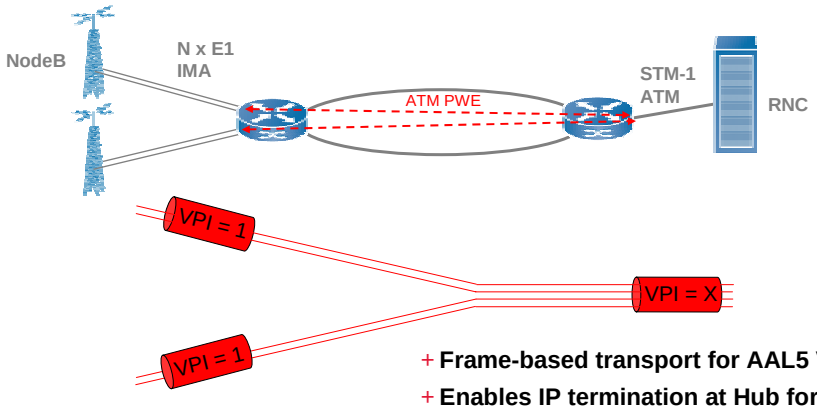


ATM Cell
VC Label
Tunnel Label
L2 Header

PW Encapsulation

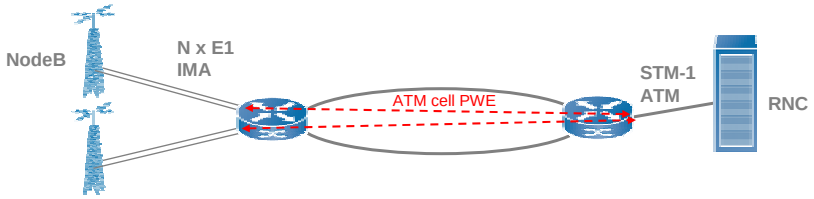
+ **Simple to provision**
- **Inefficient transport**
- **Requires CBR QoS for VP**

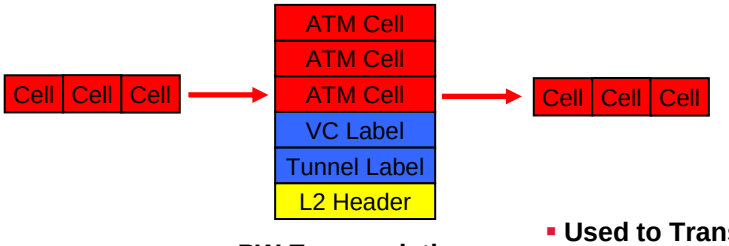
UMTS Backhaul Using MPLS
ATM VC Transport



+ **Frame-based transport for AAL5 VCs**
+ **Enables IP termination at Hub for management and signalling traffic**
+ **Enables per-VC QoS (CBR, VBR, UBR)**
- **Complex to provision**

UMTS Backhaul Using MPLS
ATM VC cell Transport

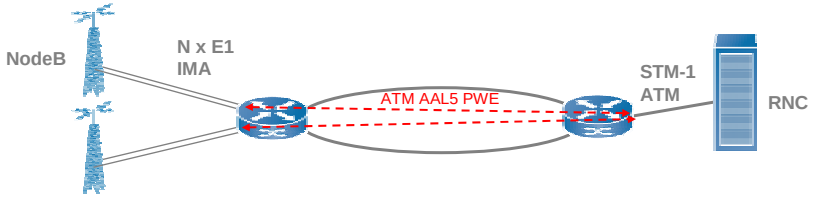


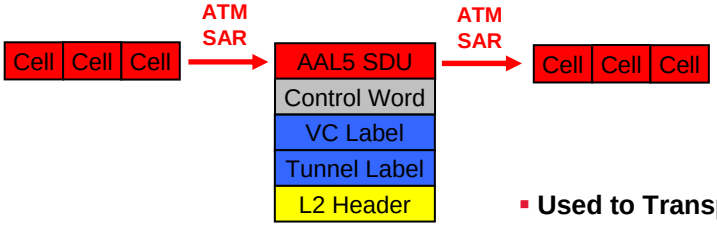


PW Encapsulation

- **Used to Transport**
  - **Sync (AAL0)**
  - **Bearer (AAL2)**

UMTS Backhaul Using MPLS
ATM AAL5 SDU Transport

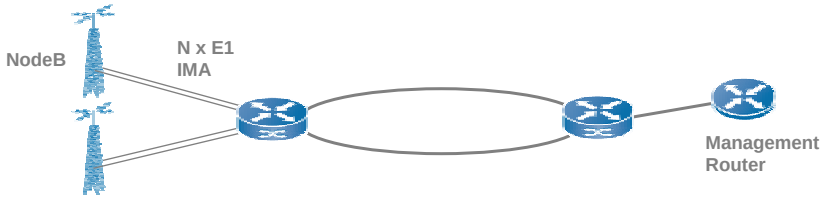


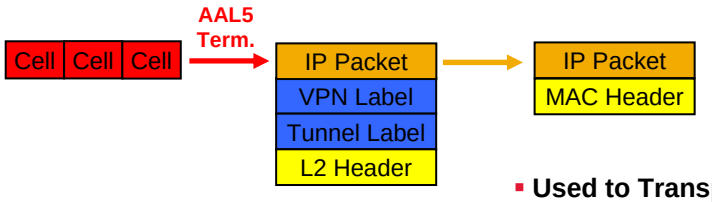


PW Encapsulation

- **Used to Transport**
  - **Signalling (QSAAL)**
  - **Other data**

UMTS Backhaul Using MPLS
IP/ATM Termination into RFC2547

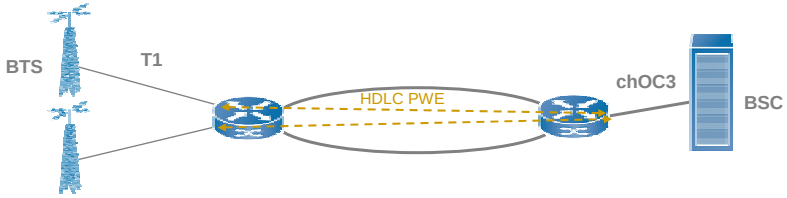


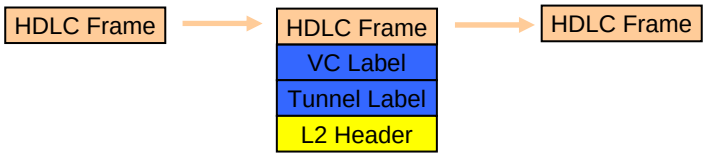


VPN Encapsulation

- Used to Transport
  - Management (Mub)
  - Signalling (SIGTRAN)

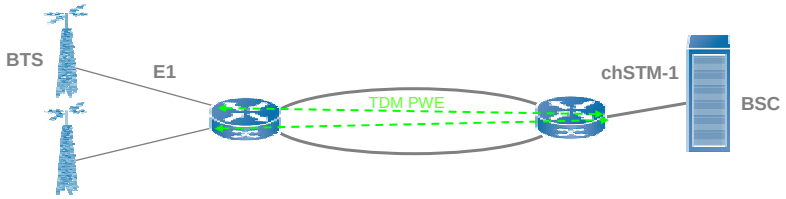
CDMA 1xRTT Backhaul Using MPLS
HDLC Transport

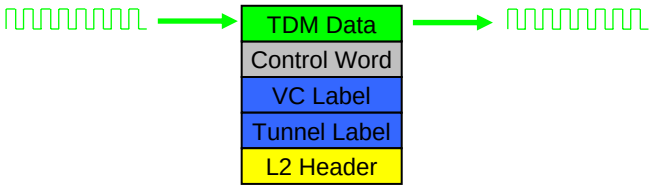




PW Encapsulation

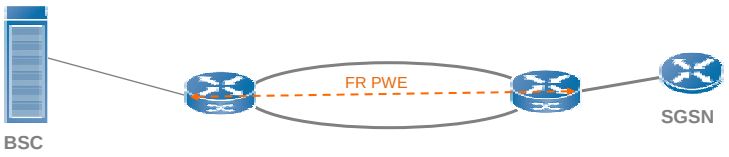
GSM Backhaul Using MPLS
TDM Transport using SAToP or CESoPSN

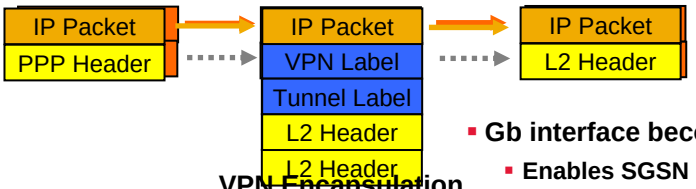




PW Encapsulation

GSM - GPRS Backhaul Using MPLS
FR PWs Migrating to IP VPN





VPN Encapsulation
PW Encapsulation

- **Gb interface becoming IP**
  - **Enables SGSN pooling**
  - **Requires IP-VPN for GPRS backhaul**

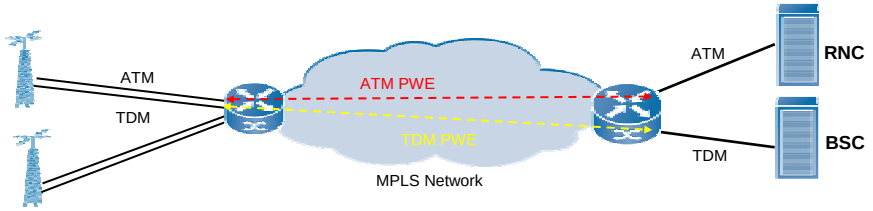
Agenda

- The challenge of mobile backhaul
- "Wireless over Pseudowires"
- **Reference designs**
- Synchronisation
- Future migration to all-IP

Reference Design
Rural Deployment – Optimising Capacity

- **Capacity Today**
  - > Leased T1/E1 or PDH microwave from cell site to hub site
  - > Leased SONET/SDH (or SONET/SDH microwave) from hub to RNC site

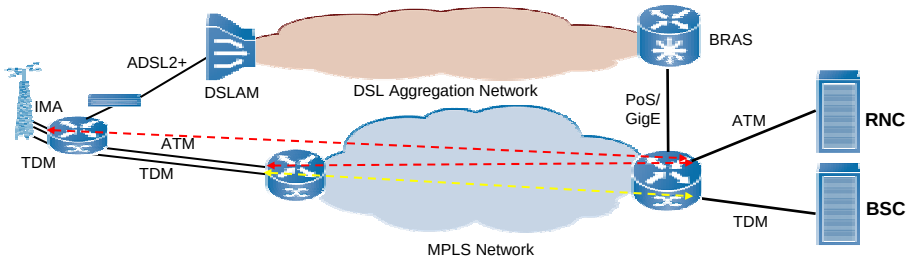
- **Solution: MPLS at Hub Site**
  - > Maintain ATM or TDM T1/E1 circuits to hub site
  - > Use MPLS PWE from hub site to RNC site
    - – Enables clear-channel transport (plus option to use Ethernet if available)
    - – Enables statistical gain between cell-sites



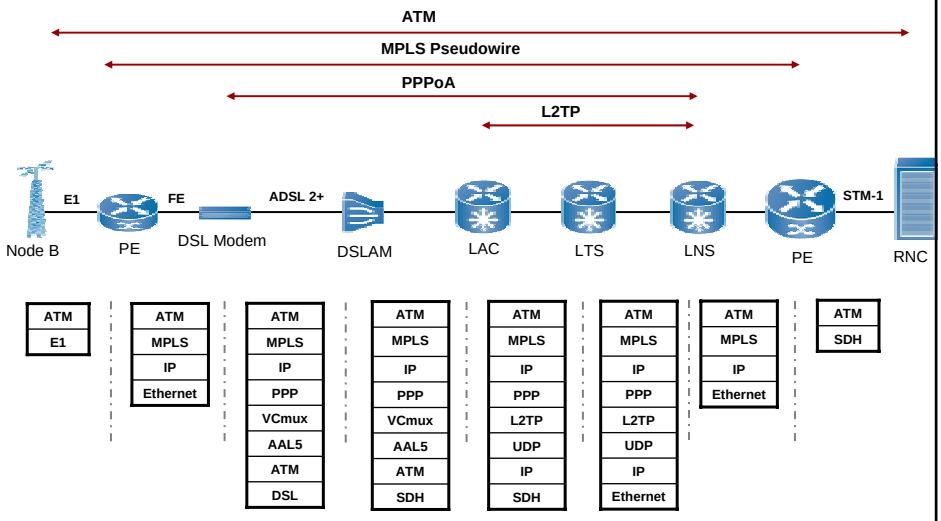
Reference Design
Suburban Deployment – Adding HSDPA

- **Capacity Today**
  - > Leased T1/E1 or PDH microwave from cell site to hub site
  - > SDH/SONET from hub site to RNC site

- **Solution: MPLS at Cell Site with DSL offload**
  - > Maintain ATM or TDM T1/E1 circuits to hub site
  - > Add wholesale ADSL capacity for 3G data using PWE over IP

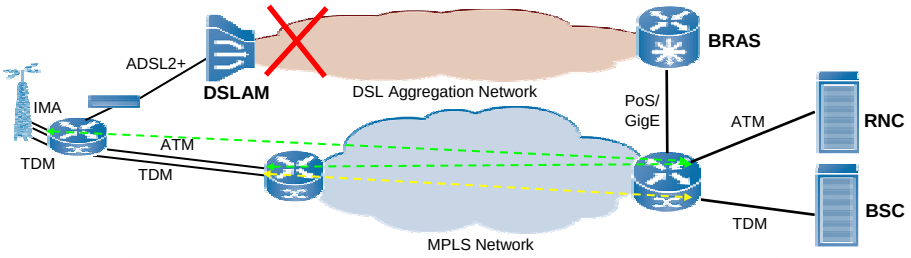


PWE over DSL Backhaul
Using MPLS over IP (RFC4023)



PWE over DSL Backhaul
Using MPLS over IP (RFC4023)

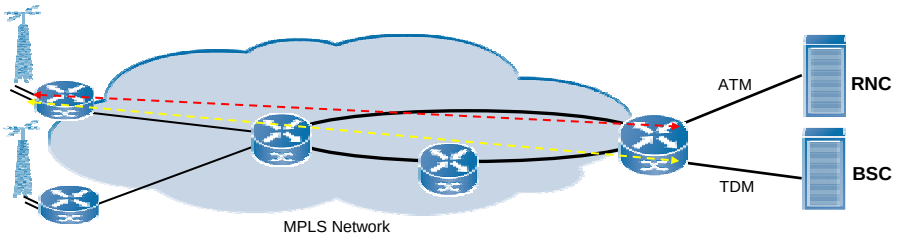
- **"Overlay Network" causes control plane challenges**
  - > tLDP session as per RFC4447 can be used to provision PWs, but failure detection will be slow
  - > VCCV-BFD from PE to PE provides faster detection
  - > Need mechanism to notify DSL network failures to the RNC



Reference Design
Urban Deployment – Fibre to the Cell Site

- **Capacity Today**
  - > Leased T1/E1 or PDH microwave from cell site to hub location
  - > SDH/SONET from hub location to RNC site

- **Solution: MPLS at Cell Site**
  - > Use FE or GigE over fibre from cell site to hub location
  - > Use GigE or 10GigE over fibre from hub site to RNC site



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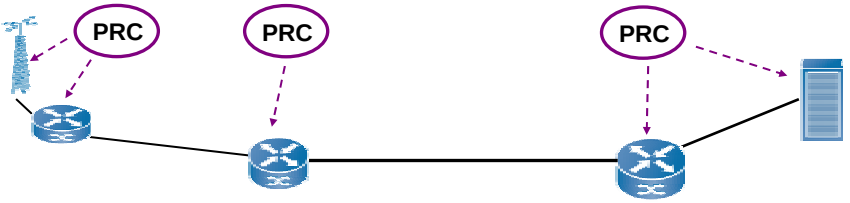
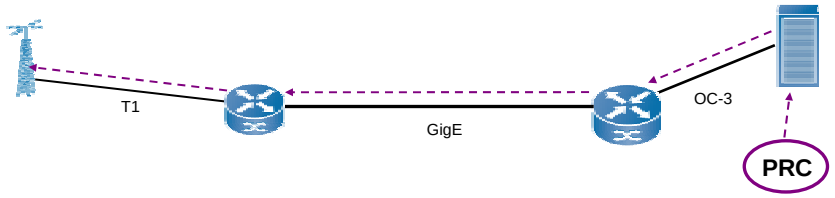
Synchronisation Distributed

- **Use external clock at each site**
  - > Expensive proposition to provide a clock at every cell-site!



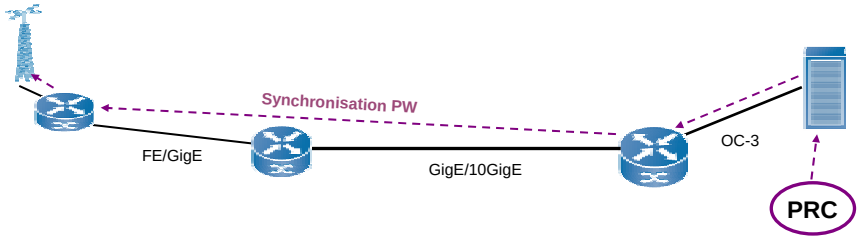
Synchronisation
Synchronous Physical Layer

- **Synchronise all elements from the physical layer**
- **Distribute timing from one element to the next**
- **Well known and understood using SDH/SONET or E1/T1 circuits**
- **Ethernet Based**
  - > G.8261
- **Good fit for rural and suburban scenarios above**
- **Good fit for urban scenario if deploying a dedicated network**



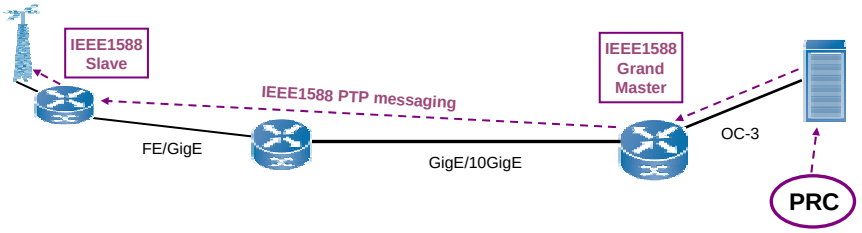
Synchronisation
Adaptive Timing

- **Monitor jitter buffer levels**
- **Perform averaging and low pass filter to detect jitter**
  - > Tolerant to packet loss and reordering
  - > Vulnerable to low frequency jitter components
- **Two methods:**
  - > Synchronise each pseudowire
  - > Synchronise node using “synchronisation pseudowire”



Synchronisation
IEEE1588 Precision Time Protocol

- **Hierarchical tree with master/slave clocks**
- **Designed for testing/automation applications**
  - > Being enhanced for telecom applications



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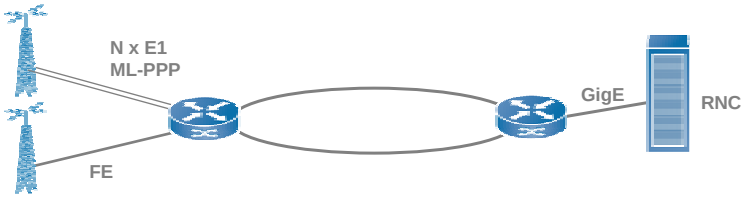
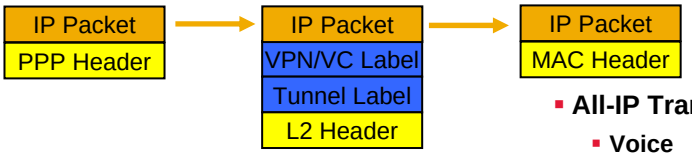
- **Future migration to all-IP**

3G Backhaul Using MPLS
Migration to R5





VPN or IP-PW Encapsulation

- All-IP Transport
  - Voice
  - Data
  - Signalling
  - Management

Summary

- The Challenge of mobile backhaul
- "Wireless over Pseudowires"
- Reference Designs
- Synchronisation
- Future migration to all-IP

- Any Questions?