IXIA®

Leader in Converged IP Testing

PRESS TOUR

Testing 'time' for Carrier Ethernet

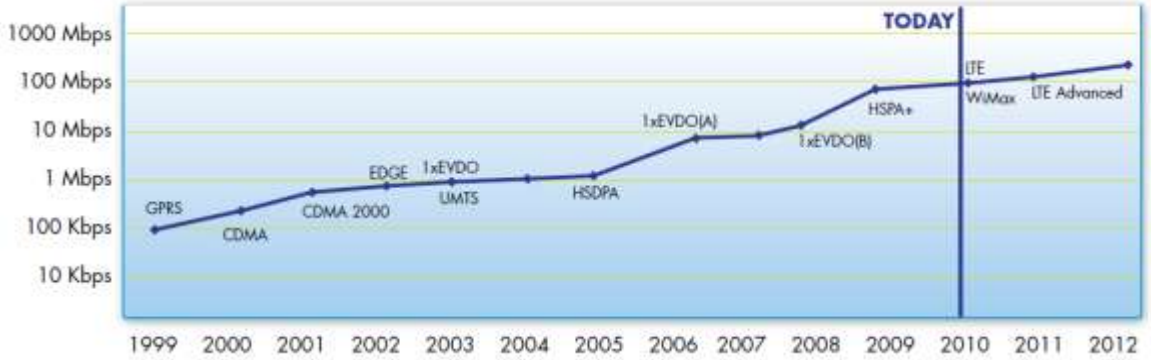
Ixia's Timing over Packet Test Solution helps carriers lower costs and scale wireless services

Wireless Bandwidth Trends

10x growth in cellular data speeds every 3-5 years.

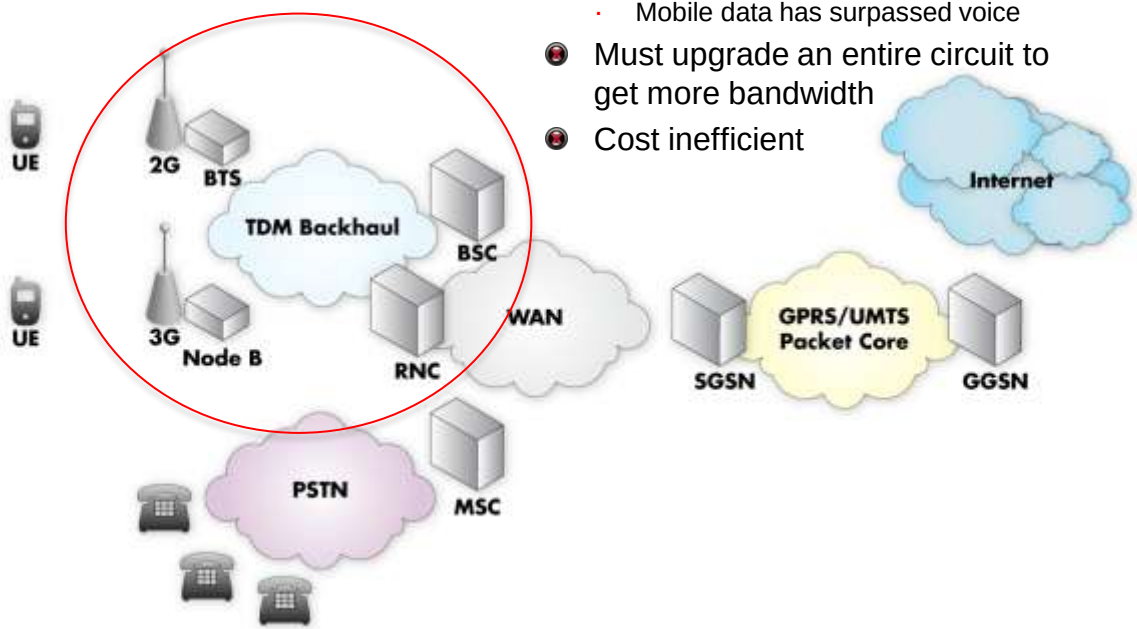
Data traffic expected to hit 1.8 exabytes per month by 2017.

Source: Reportlink, *September 2009*



TDM Backhaul: Bottleneck for Wireless Growth

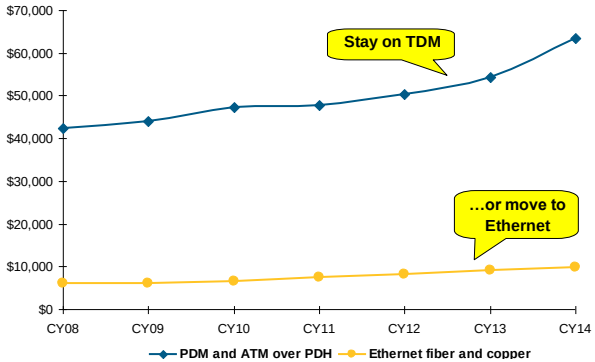
2g = 64 kbps
3g = 256 kbps
LTE = 300 mbps



- Significant growth of bandwidth-hungry mobile devices
  - Mobile data has surpassed voice
- Must upgrade an entire circuit to get more bandwidth
- Cost inefficient

Market Drivers: Carrier Ethernet (CE) Mobile Backhaul

- Carrier Ethernet offers an attractive alterative to TDM mobile backhaul
  - Lower cost per connection
  - Granular bandwidth
  - Well standardized
  - Global support
  - Broad acceptance
  - Proven momentum
  - Higher speed Ethernet

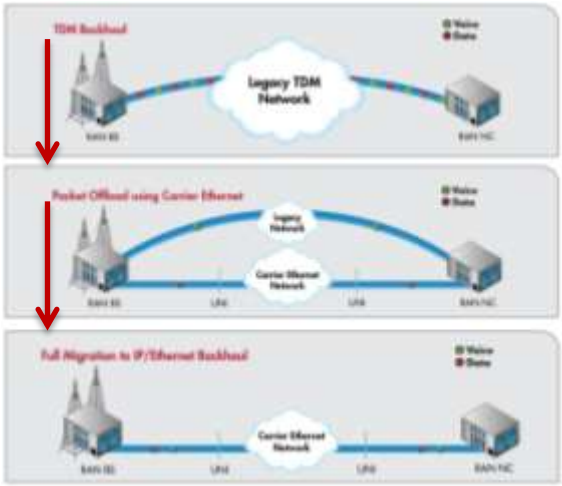


PDH vs Ethernet: Annual Mobile Backhaul Service Charges per Connection

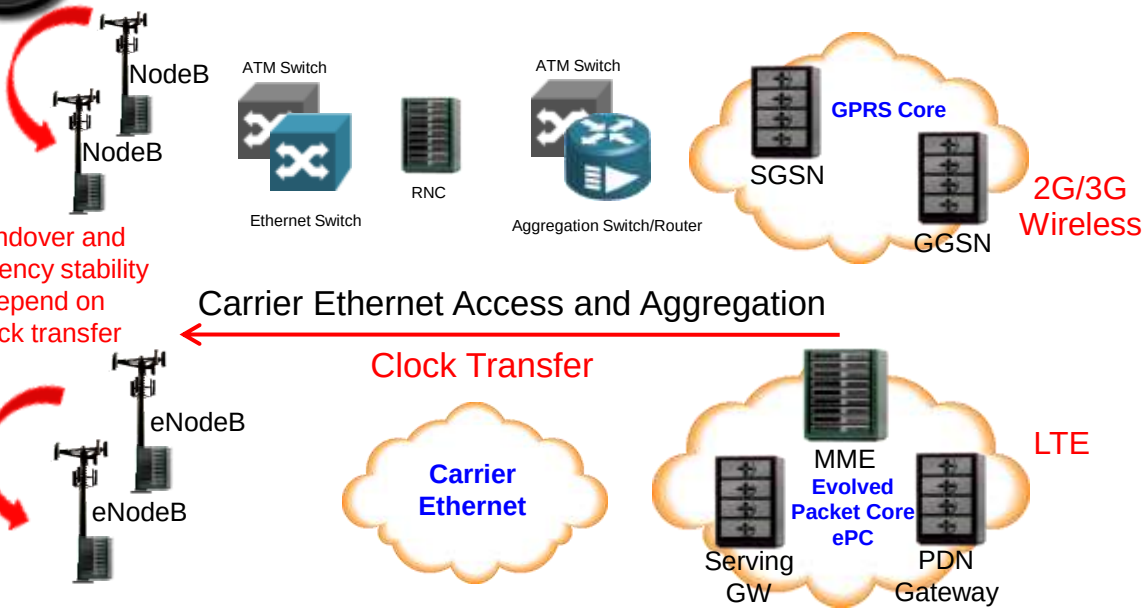
Source: Mobile Backhaul Equipment and Services, Infonetics, July 16th 2009

Growth: CE Mobile Backhaul

- 100% of global Service Providers claim to be deploying IP/Ethernet backhaul in 2010 (Infonetics)
  - Most current deployments are ‘hybrid’ using retaining TDM for voice due to clock synchronization requirements
  - Unlike SONET/SDH, Ethernet has no native clock transfer mechanism
- 65% of service providers plan to move to a single Ethernet mobile backhaul for carrying all traffic
  - First require assurance that timing over packet (ToP) technologies meet clock accuracy and network synchronization requirements



Timing over Packet Technologies for Ethernet Mobile Backhaul



- Synch Ethernet distributes a clock signal for frequency synchronization
- IEEE 1588v2 enables both frequency, phase and time-of-day synchronization
- Improve clock accuracy and stability over Ethernet from 100ppm to +-4.6ppm

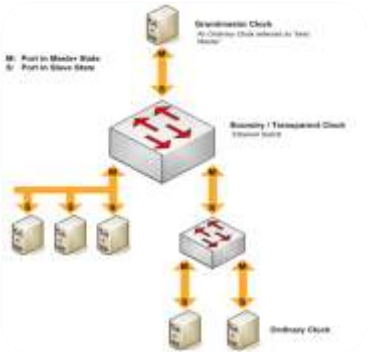
Synchronous Ethernet vs. IEEE 1588

Synchronous Ethernet (SyncE)

- Physical Layer
- Synchronizes only frequency
- Not impacted by network load
- Every switch/router path must support SyncE
- Synchronization Status Message (SSM) carries clock quality level (1pps)
- Network devices must be able to recognize, select, and propagate highest quality clock

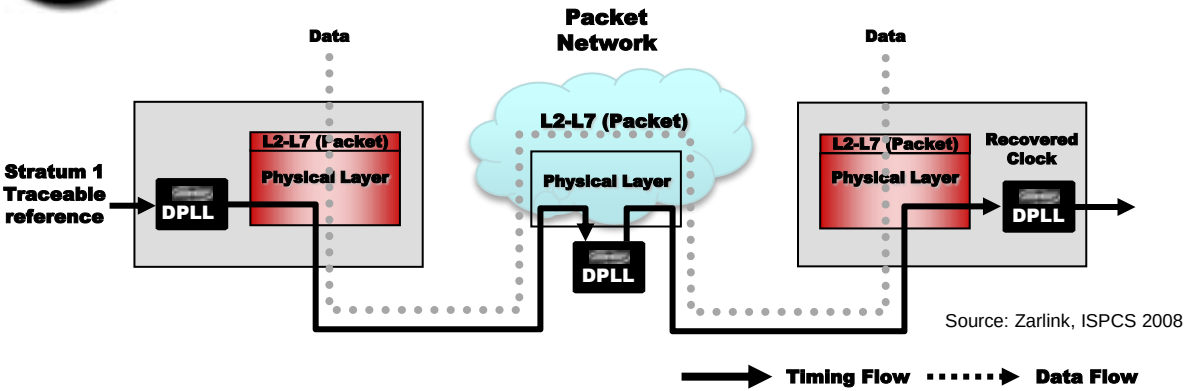
IEEE 1588v2 Precision Time Protocol (PTPv2)

- Protocol Layer
- Synchronizes frequency and time-of-day
- Subject to network load
- 'Version 2" introduces Transparent Clocks and Boundary Clocks



Can be used together, or separately

SyncE Technology - PHY layer



- Exactly the same as 10/100Mbps /1G Ethernet, with the clock stability increased from 100ppm to 4.6ppm
- Uses the PHY clock
  - Generates the clock signal from the “bit stream”
  - Similar to traditional SONET/SDH/PDH PLLs
  - Requires new hardware
  - Each node in the packet network recovers the clock

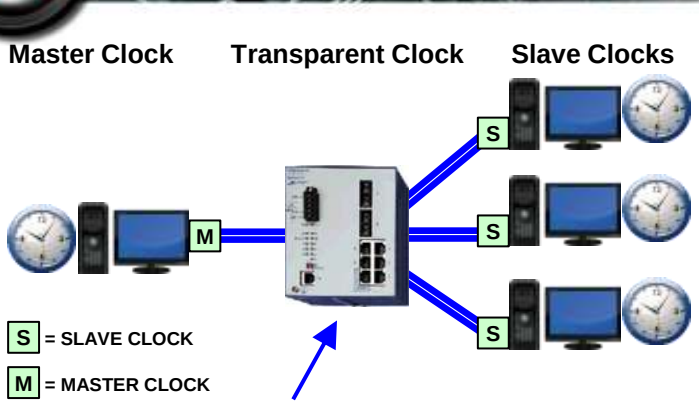
SyncE Technology – ESMC

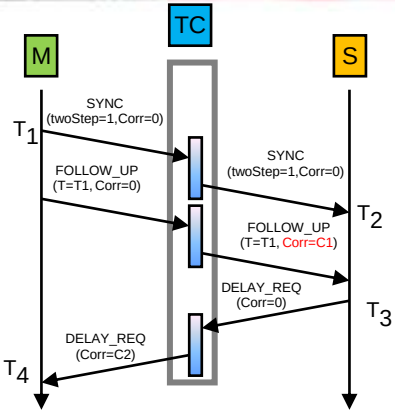
Ethernet Synchronization Messaging Channel (ESMC)

- Simple, stateless, unidirectional protocol for communicating the current reference-clock quality between nodes
- Modelled on SONET/SDH S1 Byte
- Only one message type:
  - SSM (Synchronization Status Message)
  - Sent at 1pps
  - One significant field: QL (clock Quality Level)

	Clock	Message	SSM code
E1 quality level (2048 kb/s)	EEC1	QL-EEC1	1011
T1 quality level (1544 kb/s)	EEC2	QL-EEC2	1010

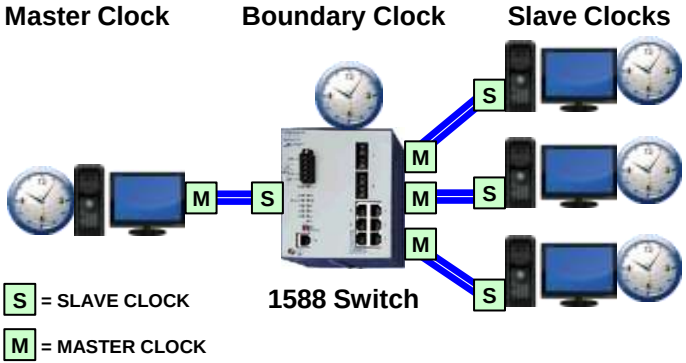
IEEE 1588v2 Transparent Clocks





- Ethernet switches between the Master and Slave introduce asymmetric and variable packet delays, which impair accuracy!
- Transparent Clocks (TCs) are switches that insert a Correction Factor into PTPv2 packets
- This mitigates the effect of the switch's own packet residence time (forwarding delay)
- However
  - Correction factor errors are real
  - May impair slave clock tracking
  - Ixia measures CF error and latency asymmetry in real time

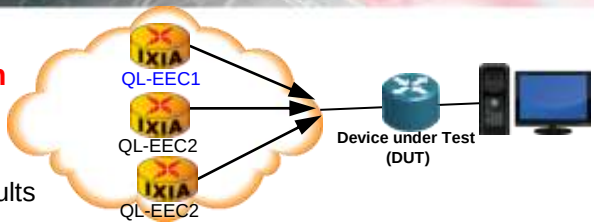
IEEE 1588v2 Boundary Clocks

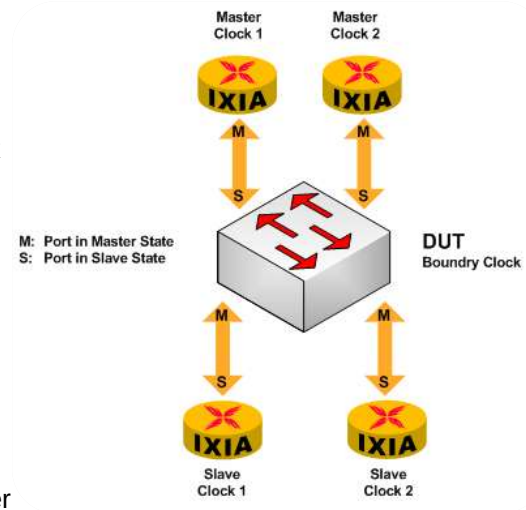


- Boundary Clocks (BCs) act as slaves to one domain, and masters to other domains
- This scales better in large systems and also mitigates the residence time problem
- However
  - Scalability is a huge challenge when there are many slaves and other control-plane traffic
  - Best Master Clock Selection can go wrong, leaving slaves in disagreement about the time

Testing Timing over Packet

- **Conformance and functional validation**
  - Verify correct protocol exchange
  - Validate best clock selection
  - Ensure synchronization with expected results
- **Multi-vendor Interoperability**
  - Ensure different vendor implementations can interwork
- **Scalability & Stress Tests**
  - Test capability and capacity of a boundary clock or PTP enabled network in achieving synchronization across many nodes (1000's)
  - Test device or networks under high data and message rates
- **Multi-dimensional Testing**
  - Simulate real-world mobile backhaul network conditions (mixture of device types, traffic and protocols) in a controlled lab environment
  - Verify synchronization and multi-traffic traffic forwarding performance in the context of broader network protocols and traffic





Benefits of Test

- Cost-effective alternative to building large test beds of actual equipment.
  - Test each chip, device or multi-device system under real-world conditions and ‘at scale’, in a reliable and repeatable fashion
- Used to evaluate and compare different vendor equipment for network upgrade
- Evaluate the tradeoffs between timing performance and scalability
  - Critical for network capacity planning and service verification
- Reduce risk of missed call handovers and network downtime
- Accelerate the deployment of CE mobile backhaul

For more information

- Ixia Carrier Ethernet Solution Page
  (brochures, whitepapers, posters…)
  www.ixiacom.com/solutions/testing_carrier_ethernet
- Ixia Black Books
  www.ixiacom.com/blackbook
- Webinar: Testing Challenges with Mobile Backhaul
  http://downloads.ixiacom.com/multimedia/WEBINARS/Mobile_Backhaul_Webinar/mbh-ixia.html
- European Advanced Network Test Center (EANTC)
  www.eantc.com
- Metro Ethernet Forum
  http://netevents.tv/output/meftv/webinar/register/register.aspx?id=2

THANK YOU