

Considerations for 40 Gigabit Ethernet

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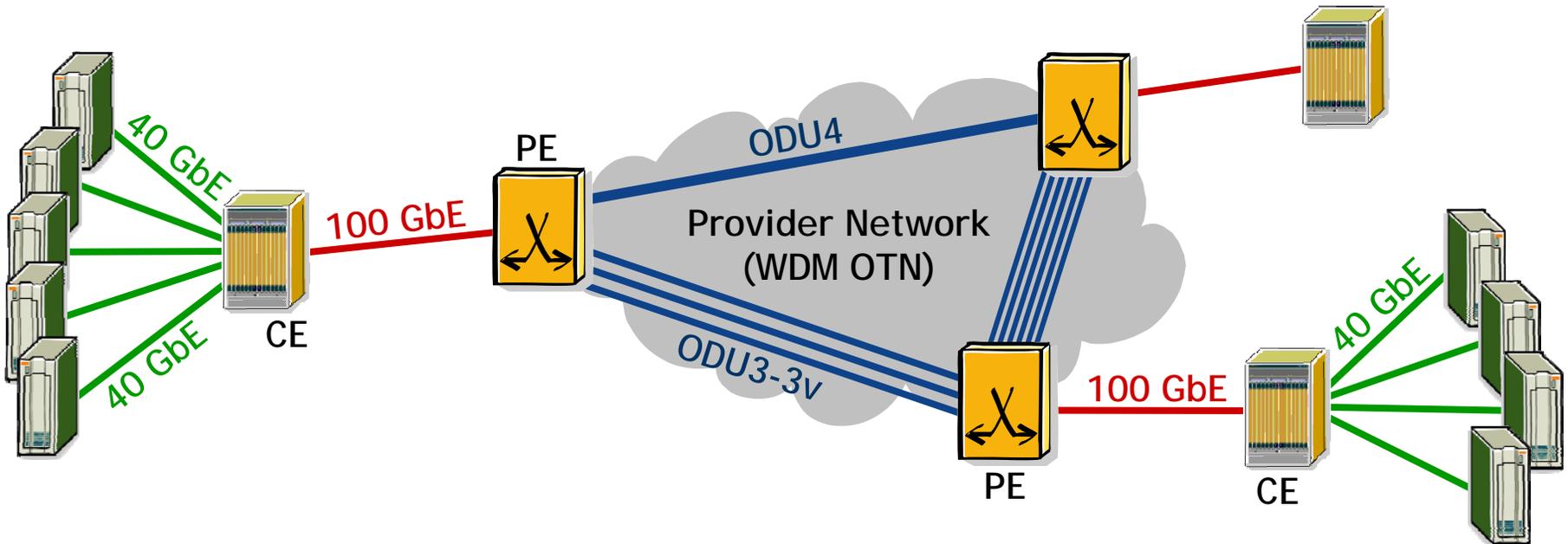
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Supporters

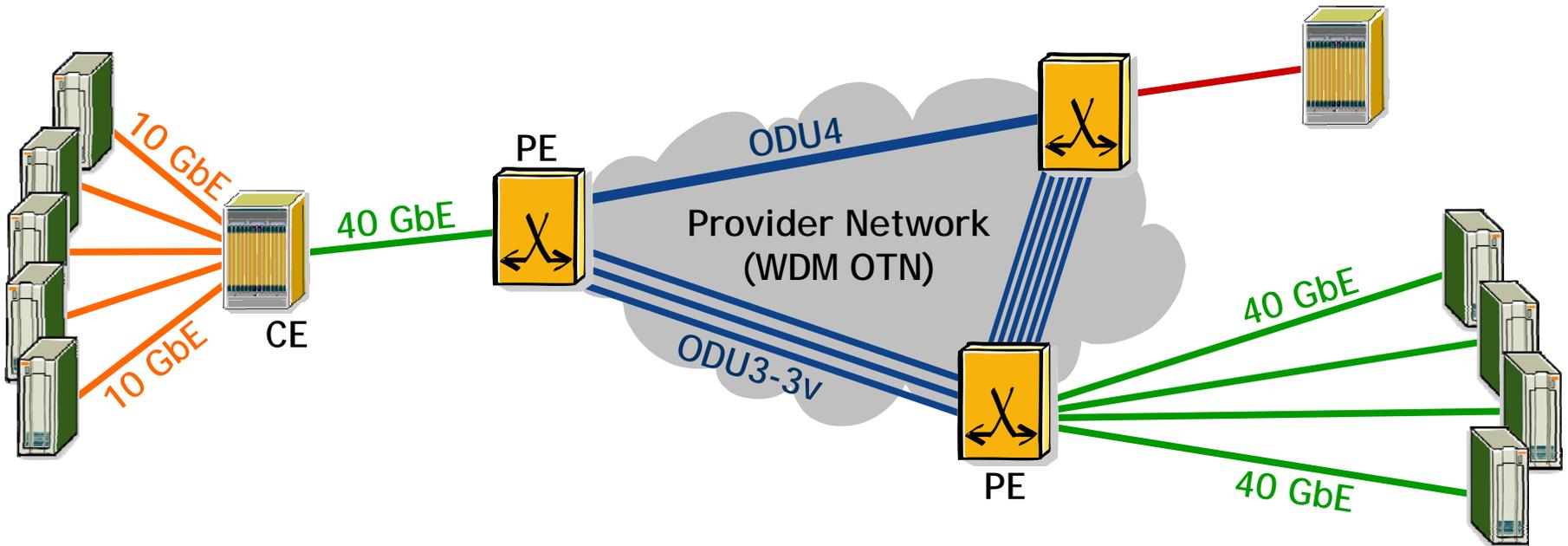
- Ralf-Peter Braun, T-Systems
- Martin Carroll, Verizon
- Ted Woodward, Telcordia
- Thomas Fischer, Nokia Siemens Networks
- Pete Anslow, Nortel Networks
- Gary Nicholl, Cisco

Current View of Future 40 GbE Application Space



- 40 GbE will be only used inside blade servers, or
- 40 GbE will be only used as a server-switch interface, where 'switch' is considered to be customer equipment (CE)
- 100 GbE will be used as uplink switch-switch interface, where one of the switches is provider equipment (PE)
→ network operators will never see a 40 GbE client interface
- Backhauling of 100 GbE clients only

Possible Usage of Future 40 GbE



- 40 GbE server interfaces hooked up to PE switch
- 40 GbE uplink from CE switch to PE switch
→ 40 GbE used as an aggregation interface of 10 GbE (or 1 GbE) access IFs
- Backhauling of 40 GbE clients required

Ethernet Backhauling via OTN

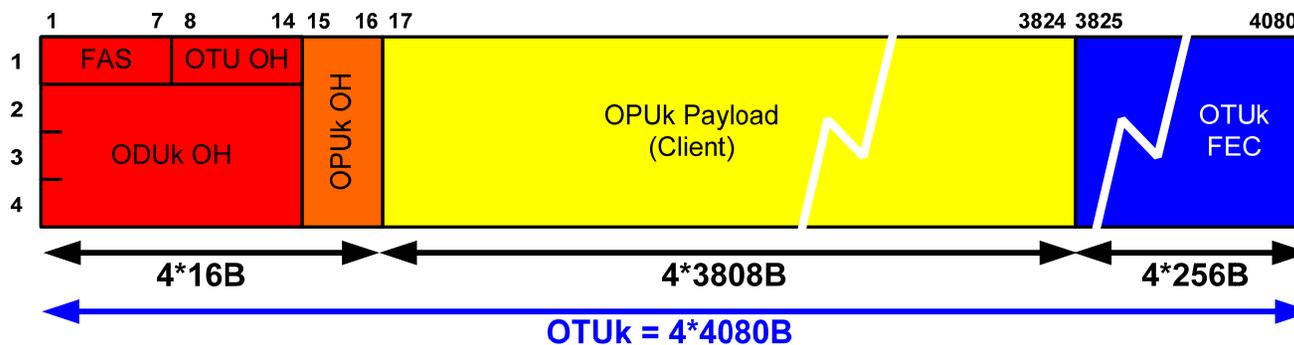
- Optical Transport Network (OTN, ITU-T G.709) is today's standard in WDM transport networks
- Two requirements for backhauling of client signals:

1. Frame-based mapping

- remove interpacket gap + preamble, map only Ethernet frames via GFP-F
- rate adaptation possible (only information rate is transported)

2. Bit-transparent mapping

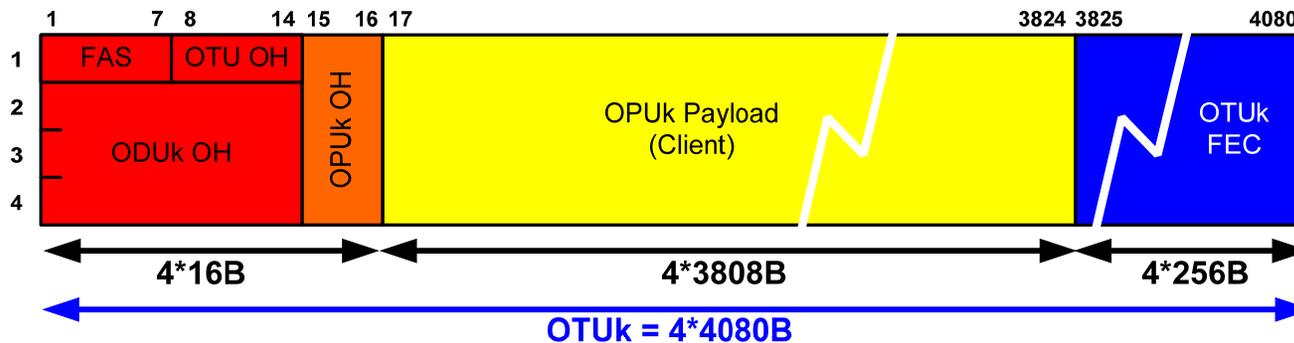
- map Ethernet client signal as TDM signal into OPUk (every single bit)
- Ethernet line rate (incl. PCS) has to fit into payload container



Existing OTN Rates & Mapping of Client Signals

OTUk	OTUk Line Rates	Payload Rates	Client Signals
OTU1	2.666 Gb/s	2.488 Gb/s	<ul style="list-style-type: none"> ■ CBR 2.5G (OC-48, STM-16)
OTU2	10.709 Gb/s	9.995 Gb/s	<ul style="list-style-type: none"> ■ CBR 10G (OC-192, STM-64) ■ Frame-based mapping of 10 GbE LAN ■ OTN multiplexing of ODU1s
<i>OTU2e overclk</i>	<i>11.096 Gb/s</i>	<i>10.3125 Gb/s</i>	<ul style="list-style-type: none"> ■ <i>Transparent mapping of 10 GbE LAN (proprietary)</i>
OTU3	43.018 Gb/s	40.151 Gb/s	<ul style="list-style-type: none"> ■ CBR 40G (OC-768, STM-256) ■ OTN multiplexing of ODU1s & ODU2s

- Optical Transport Network (OTN, ITU-T G.709) does not (yet) define bit-transparent mapping
- OTN is not SONET/SDH, i.e. not a synchronous network
- Any service can be mapped into OTN, e.g., TDM, Ethernet, ATM, IP, etc.



Difference between 40 GbE and 100 GbE (Provider Perspective)

40 Gigabit Ethernet

- 40G transport networks have been on the market for six years now
- 40G (OTU3) transport equipment is shipping today in growing volumes
- By 2010 there will be large installed OTU3 WDM infrastructure in most provider networks
- **Bit-transparent backhauling of 40 GbE clients will be required with existing OPU3 payload rates !**

100 Gigabit Ethernet

- **No existing 100G transport network**
- ITU-T SG15 decided in March 2007 to extend G.709 to the next higher rate
- ITU-T SG15 is monitoring the HSSG/TF activities and will define an ODU4 rate that is sufficiently large for bit-transparent backhauling of 100 GbE

Impact on the Definition of a 40G MAC Rate

- Existing 40G OTN payload rate (OPU3) = 40.150519 Gb/s
- Clock tolerance for OTN = ± 20 ppm
→ min. OPU3 = 40.149716 Gb/s
- 40G MAC rate @ PCS layer
incl. 100 ppm clock tolerance
has to fit into min. OPU3 container !
- Assume 64B/66B PCS & 100 ppm clock speed-up
→ max. acceptable 40G MAC/PLS rate = 38.933 Gb/s

1. A maximum rate of ~38.9 Gb/s at the MAC/PLS interface, assuming a 64B/66B PCS layer, would be acceptable for OTN transport networks !
2. The 40G MAC rate could be a 'round number', e.g. 38.0 Gb/s, as long as the PCS encoded line rate does not exceed the existing OPU3 rate !

Is this another 10G LAN PHY ↔ WAN PHY Proposal ?

- No, it is not !
- **Only one 40G MAC rate would be acceptable**
 - transceiver/transponder vendors do not want to double testing
 - switch/router vendors do not want to develop different line cards
 - transport equipment vendors don't want to repeat the pain of dealing with proprietary overclocked OTN schemes
 - service provider don't want to see clients with 40G interfaces that do not allow bit-transparent mapping
- **But, this 40G MAC rate has to be compatible with existing 40G transport networks, especially by 2010 or beyond**