Recent Advances in Backhaul Technologies

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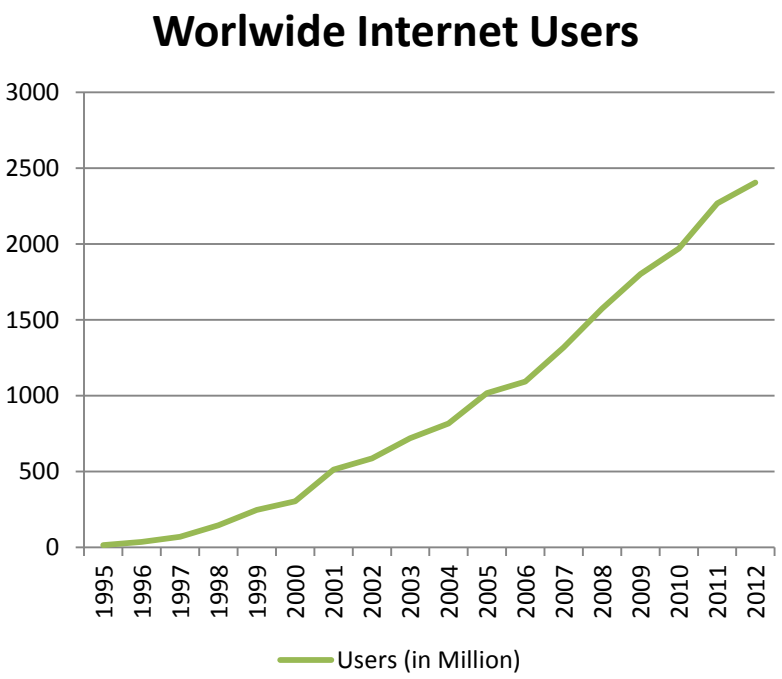
SANOG XXI, Cox's Bazaar

Internet growth



- Internet penetration has improved to 34% of the world population by 2012 covering 2.4 billion people
- Internet penetration in Bangladesh is 3.5% as on Dec 2011

Source: internetworldstats, ITU

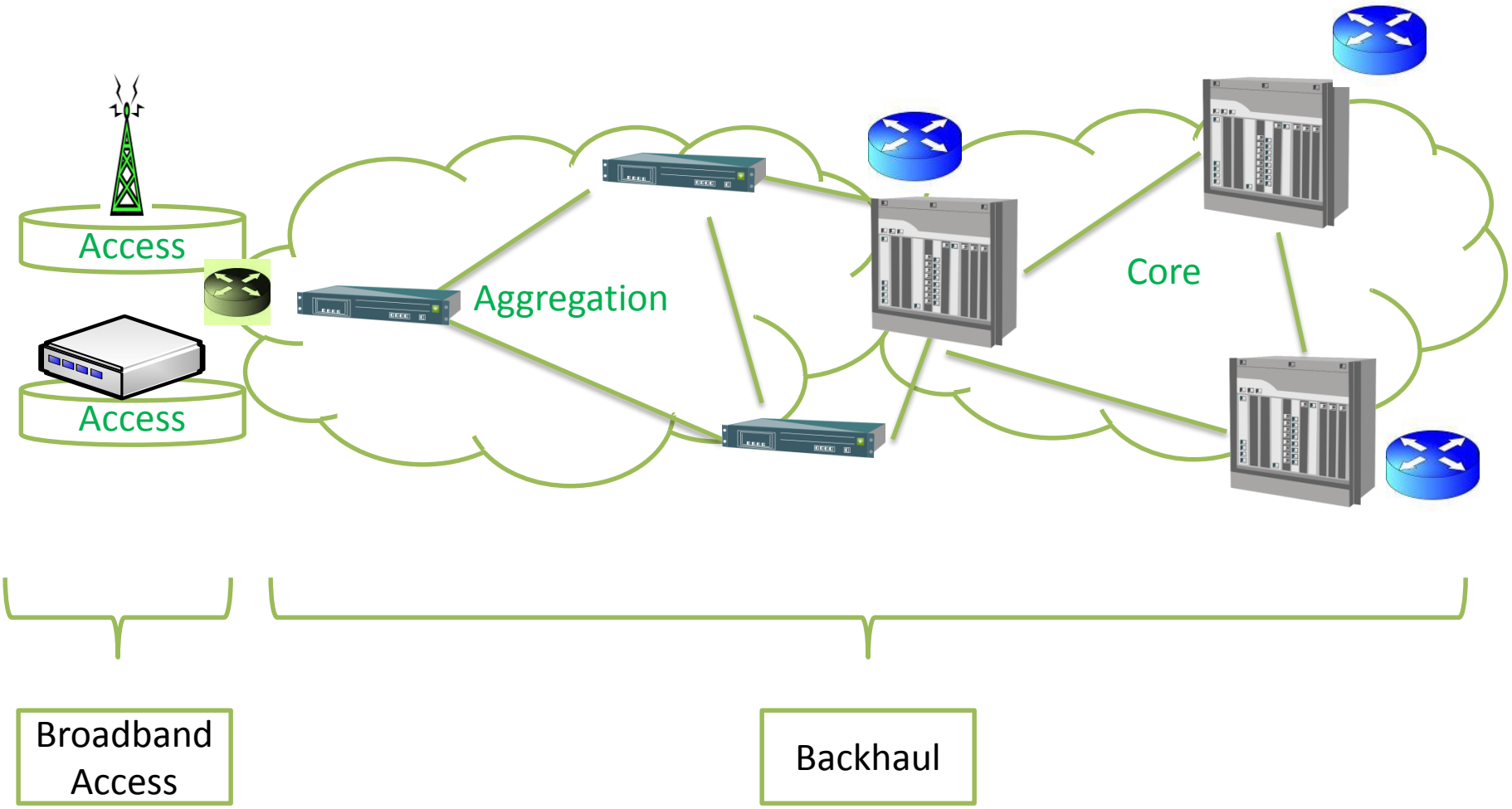
ITU Price Basket (IPB) Ranking

Rank	Economy	IPB		Fixed-telephone sub-basket as a % of GNI per capita		Mobile-cellular sub-basket as a % of GNI per capita		Fixed-broadband sub-basket as a % of GNI per capita		GNI per capita, USD, 2010 (or latest available year)
		2011	2010	2011	2010	2011	2010	2011	2010	
82	Dominica	3.6	4.4	1.9	1.9	3.1	3.0	5.9	8.5	6'760
83	Bulgaria	3.7	3.8	2.2	2.4	6.3	6.3	2.6	2.6	6'270
84	Saint Lucia	3.8	3.8	2.1	2.1	3.9	4.1	5.4	5.4	6'560
85	India	3.8	3.9	2.7	2.7	3.2	3.5	5.5	5.5	1'330
86	Bhutan	3.8	3.9	2.2	2.2	2.3	2.9	7.0	6.7	1'870
87	Colombia	3.8	4.6	1.5	1.3	4.8	4.8	5.2	7.7	5'510
88	TFYR Macedonia	3.8	4.2	3.1	3.1	5.0	6.1	3.4	3.4	4'570
89	Dominican Rep.	3.8	4.1	3.0	3.7	4.0	4.0	4.5	4.5	5'030
90	St. Vincent and the Grenadines	3.9	3.9	2.1	2.1	3.2	3.2	6.4	6.4	6'300
91	Jordan	3.9	4.6	2.6	2.6	2.9	2.9	6.2	8.3	4'340
92	Suriname	4.0	4.0	0.5	0.5	2.9	2.9	8.5	8.5	5'920
93	Brazil	4.1	4.7	2.9	2.9	7.3	7.3	2.2	4.0	9'390
94	El Salvador	4.2	5.3	2.4	2.5	4.7	4.5	5.6	8.8	3'380
95	Armenia	4.3	5.7	1.6	1.6	3.3	3.3	7.9	12.1	3'200
96	Albania	4.6	4.3	2.3	1.9	7.8	7.8	3.5	3.3	3'960
97	Jamaica	4.6	4.4	3.2	2.9	3.2	3.0	7.3	7.3	4'800
98	South Africa	4.8	5.0	4.6	4.9	4.4	4.6	5.4	5.4	6'090
99	Ecuador	4.8	4.8	2.2	2.2	5.3	5.3	7.0	7.0	3'850
100	Morocco	5.1	9.3	0.9	9.0	9.4	13.9	4.9	4.9	2'850
101	Guyana	5.1	8.3	1.3	1.3	3.5	3.9	10.4	19.6	2'870
102	Fiji	5.2	4.9	2.8	2.6	6.5	6.2	6.2	6.1	3'630
103	Paraguay	5.3	5.1	3.0	3.0	4.3	3.8	8.5	8.4	2'710
104	Indonesia	5.5	5.5	2.2	2.4	3.9	3.8	10.4	10.4	2'500
105	Moldova	5.9	5.9	1.3	1.3	8.4	8.4	8.1	8.1	1'810
106	Viet Nam	6.0	6.4	2.3	2.5	4.9	5.8	10.8	10.8	1'160
107	Guatemala	6.1	6.7	2.4	2.4	3.9	3.4	12.0	14.2	2'740
108	Cape Verde	6.3	8.7	3.1	3.1	11.6	11.6	4.3	11.6	3'270
109	Syria	6.4	6.2	0.5	0.5	9.3	8.7	9.4	9.4	2'750
110	Bangladesh	6.5	6.8	2.6	2.3	2.7	4.0	14.3	14.3	700
111	Peru	7.2	8.5	3.1	3.6	11.0	11.0	7.6	10.8	4'700
112	Pakistan	8.2	8.0	4.7	4.3	3.8	3.4	16.2	16.2	1'050
113	Philippines	9.0	9.2	8.4	8.9	5.9	5.9	12.9	12.9	2'060

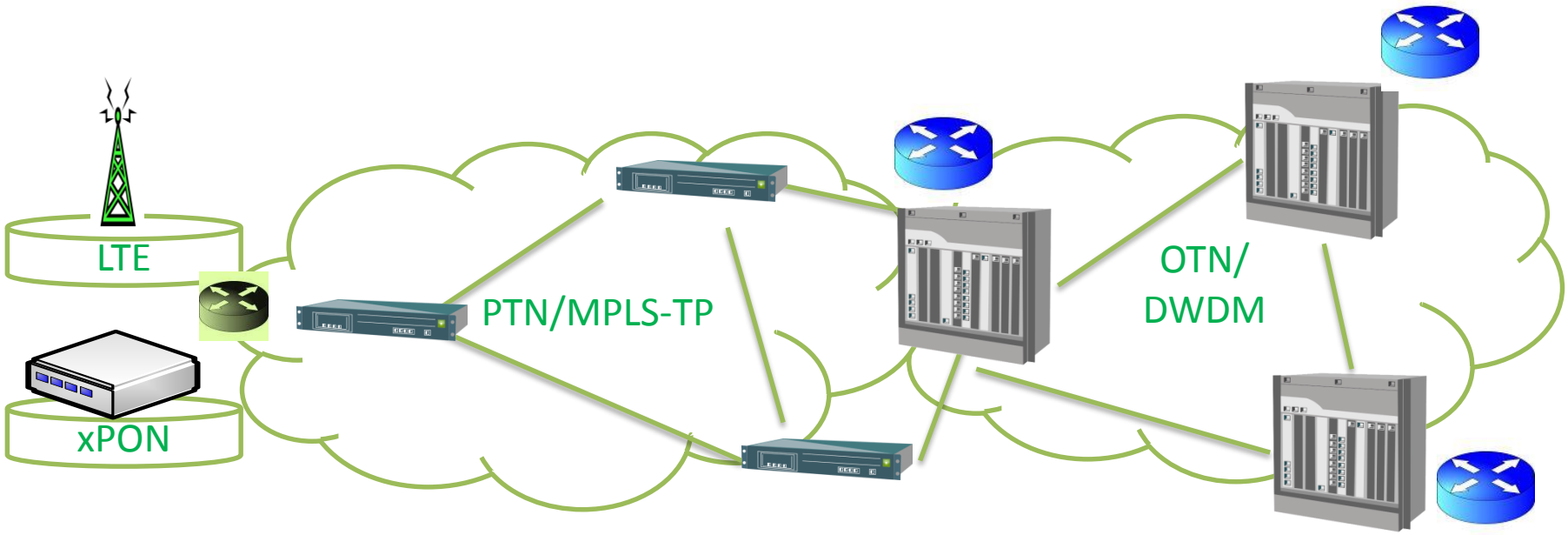
- Bangladesh ranks 110 in the IPB ranking for broadband access and needs to find innovative cost effective way to deliver broadband internet
- How do we build cost effective backhaul for Internet delivery?

Source: Measuring the information society, ITU, 2012

Backhaul network architecture

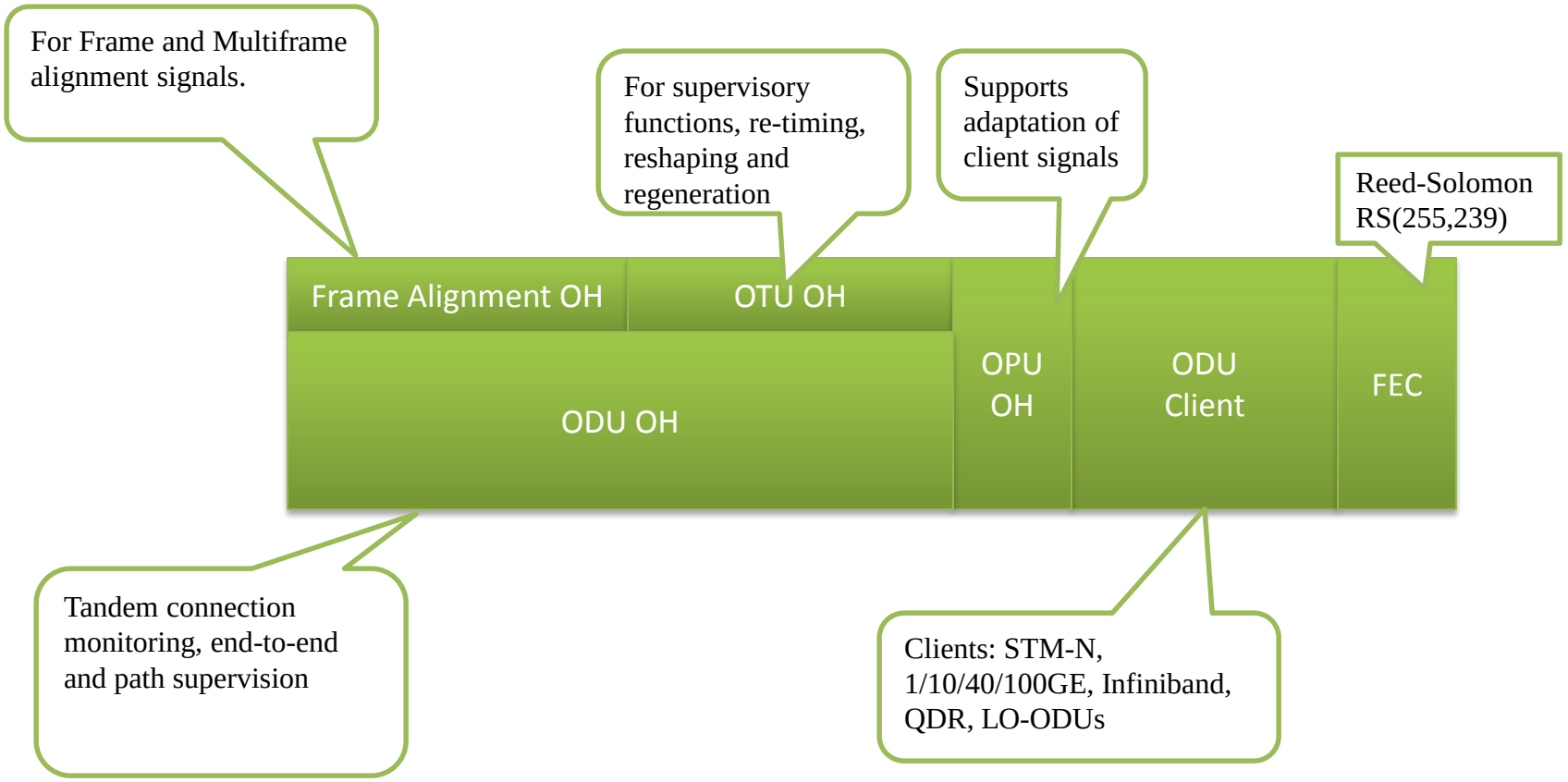


Backhaul Technologies

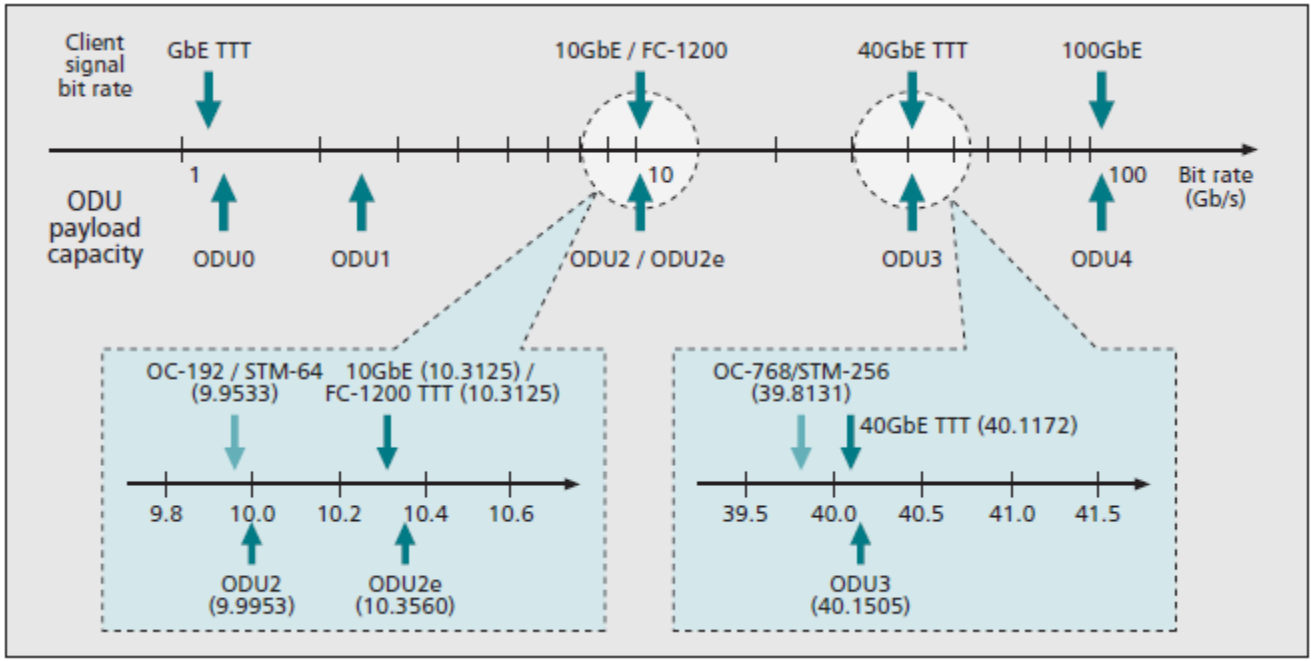


Access: LTE (Wireless), xPON (wireline)
Aggregation: PTN based on MPLS-TP
Core: OTN/DWDM with ODUFlex capability

OTN Overview

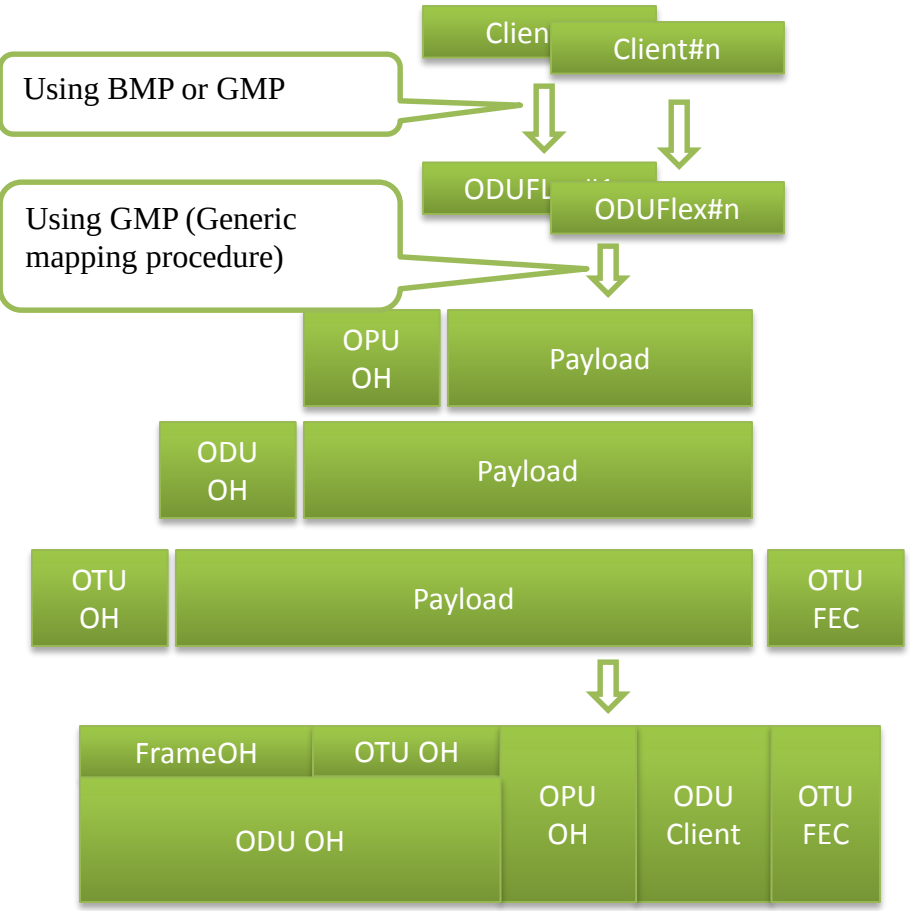


Client Mapping



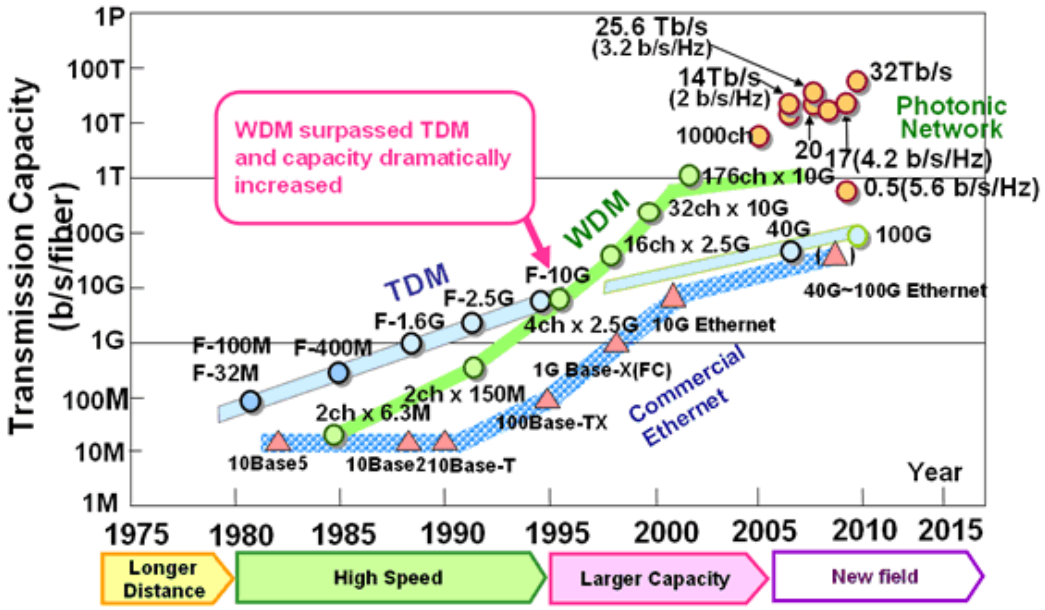
Supports client mapping of 1GbE, STM-16/OC-48, STM-64/OC-192, 10GbE, FC-1200, STM-256/OC-768, 40GbE, 100GbE into ODU-0/1/2/3/4

ODUFlex



- Flexible bandwidth option through two types of ODUFlex @ 1Gbps granularity
  - ODUFlex (CBR)
    - Clients are mapped to this using bit-synchronous mapping procedure (BMP)
  - ODUFlex (packet)
    - Packet based clients are mapped using GFP-F
- G.7044/G.HAO allows hitless increase/decrease in ODUFlex capacity

Higher Data Rate: 40G, 100G,…



- Through advanced high speed DSPs based on DP-QPSK (Dual Polarization QPSK) modulation and coherent Detection
  - Electronic dispersion compensation for optical Chromatic Dispersion (CD) and Polarization Mode Dispersion (PMD)

Source: Fujitsu

MPLS-TP: Scalable mapping of Ethernet

G-ACh Associated Label [GAL] (Label 13) distinguishes between control and data packet in a LSP and section. Additional message added in MPLS-TP

Generic Associated Channel with control channel nimble

Control Messages

LSP Label			TC	S	TTL
GAL			TC	S	TTL
0001	Ver	Reserved	ChannelType		
PID			MCC/SCC		
MCC/SCC Message					

field contains an identifier of the payload protocol using the PPP protocol identifiers

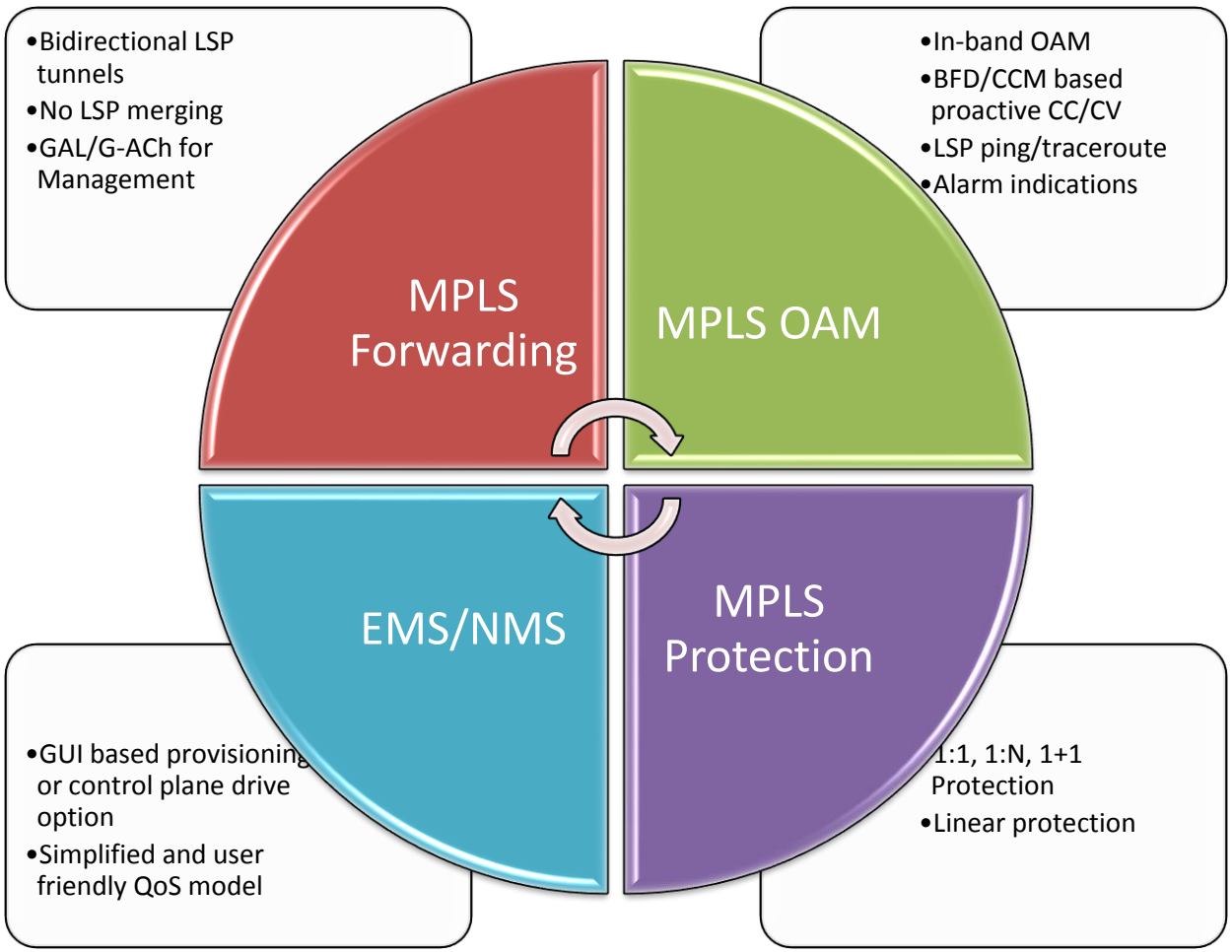
Management communication channel/ Signaling Communication Channel distinguished by ChannelType=0x0001/2

Data Messages

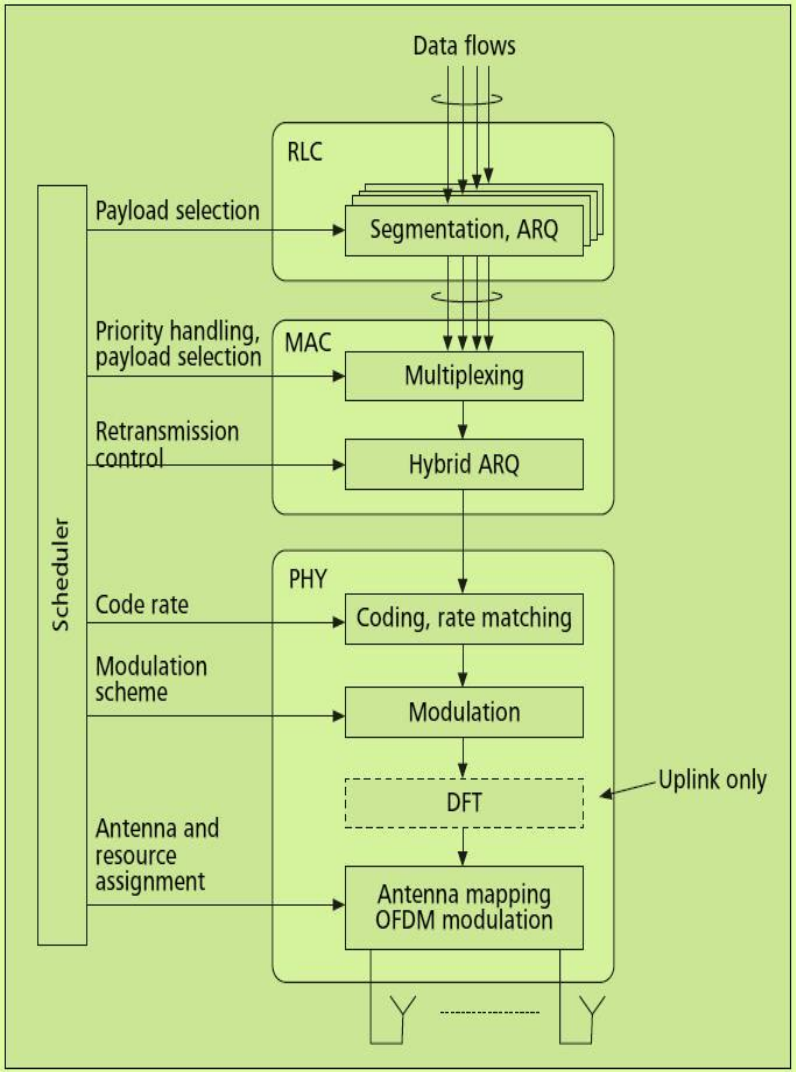
LSP Label	TC	S	TTL
Payload (EthernetPW, SAToP,…)			

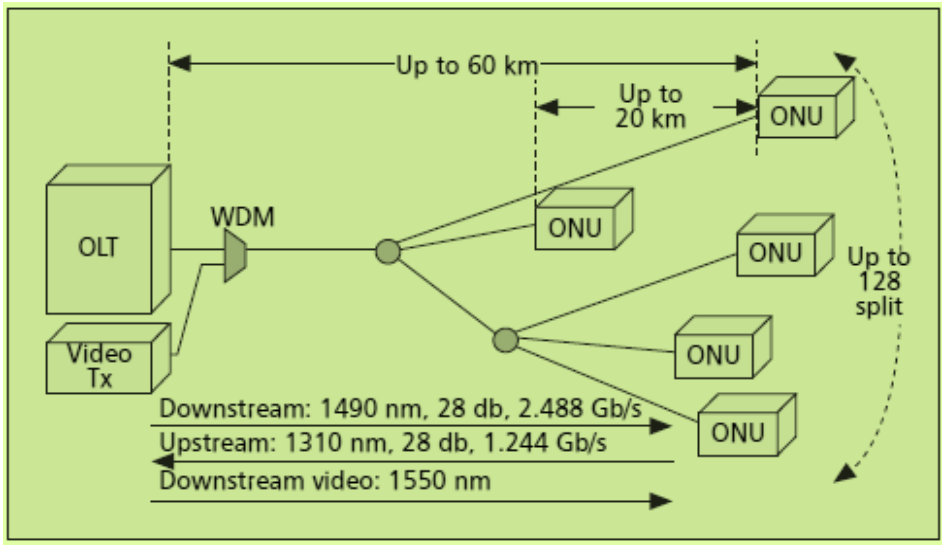
Maps Etherent or TDM packets over PW , same as MPLS data plane

MPLS-TP Attributes



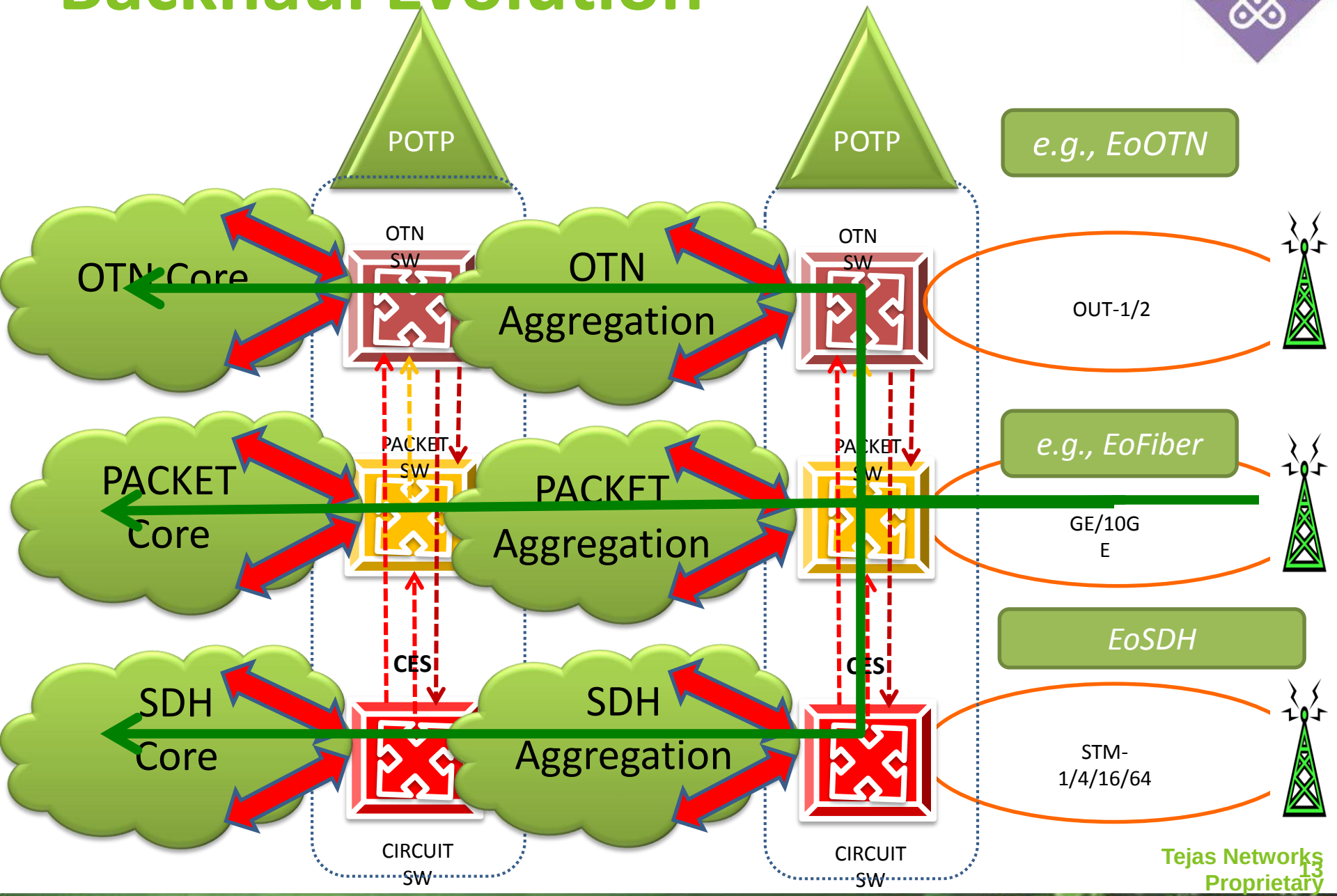
Broadband Technologies: LTE, xPON



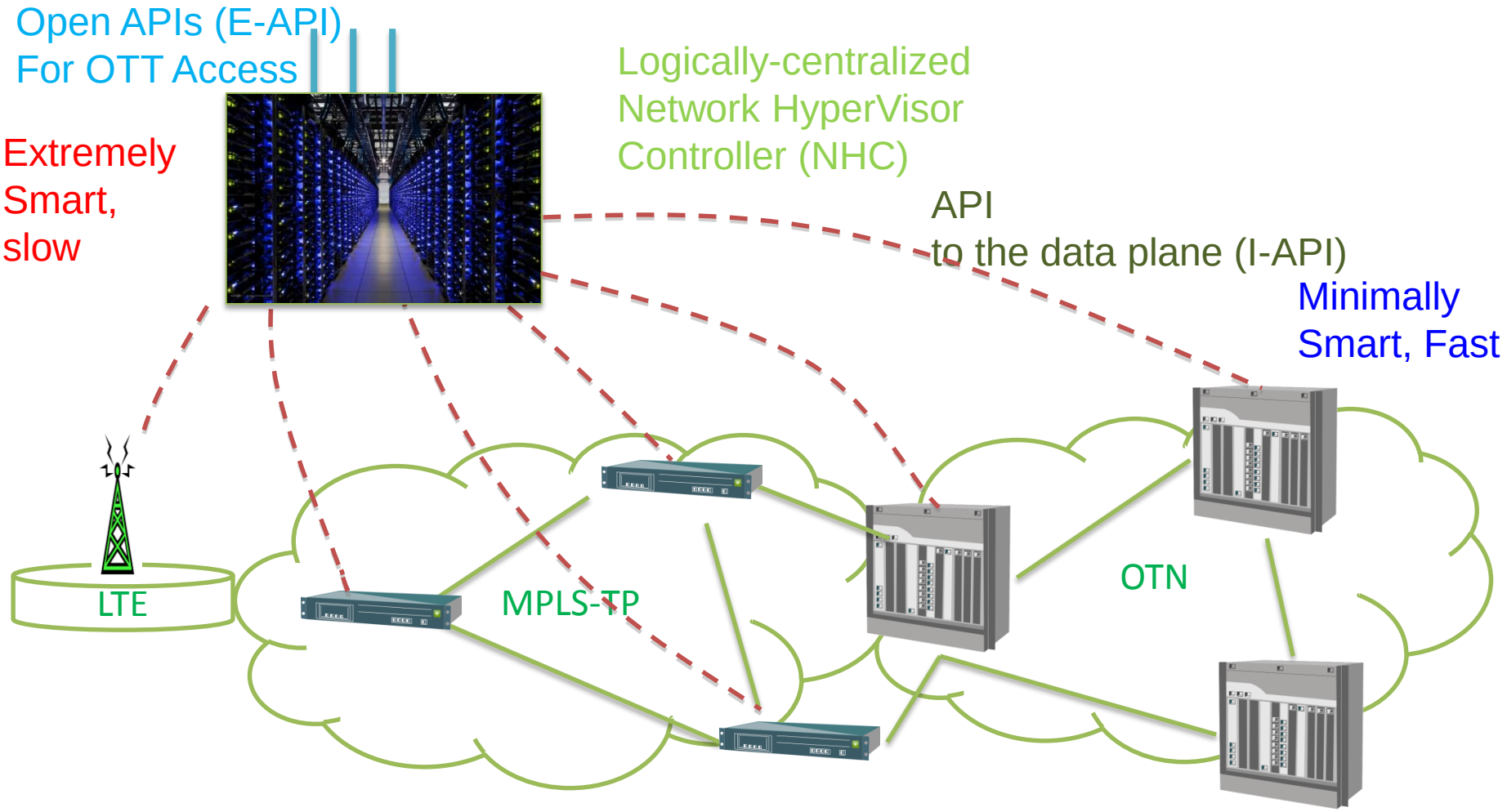


Copper deployment is minimal in private sector and makes sense to either go BWA way or over GPON

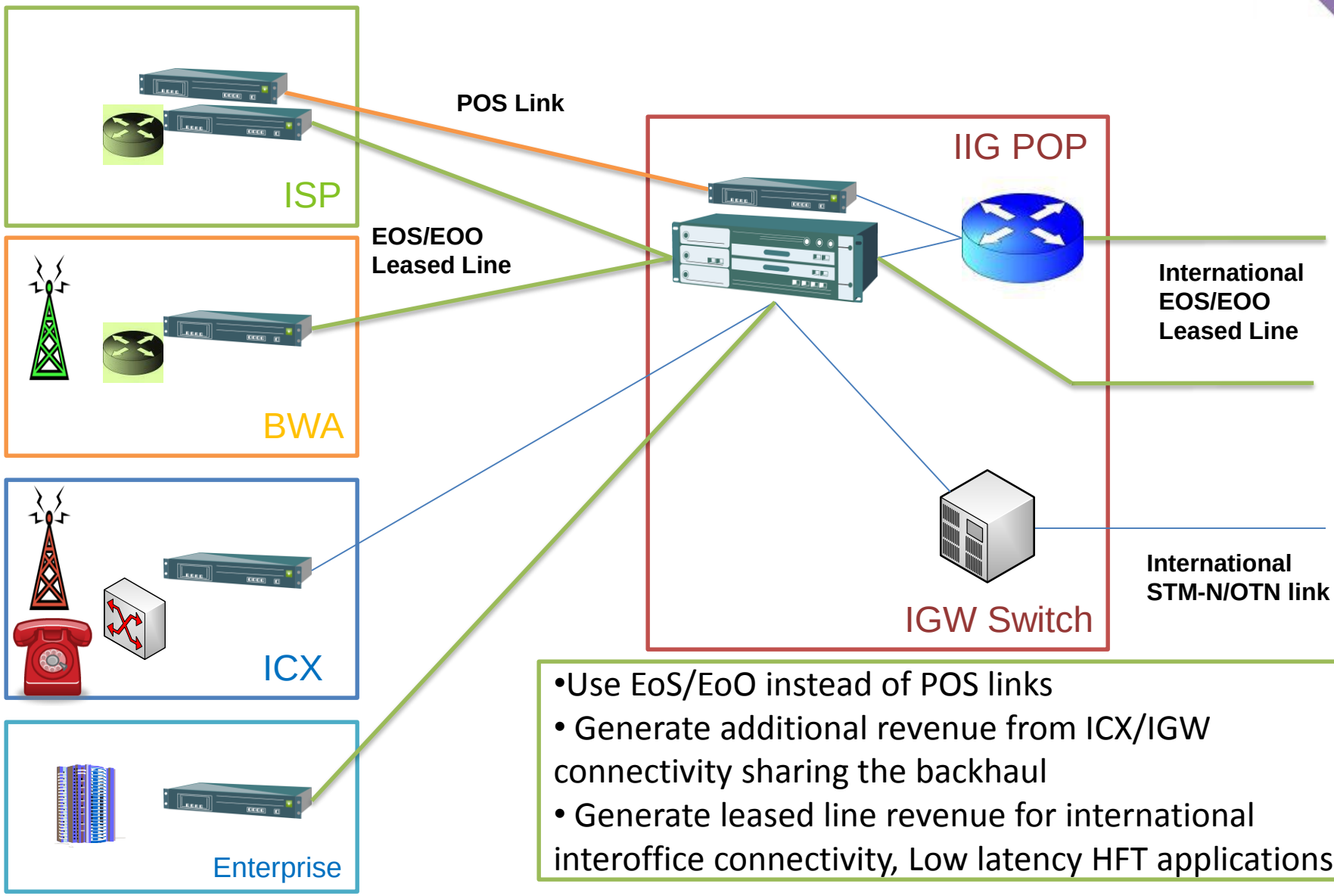
Backhaul Evolution



Carrier SDN based control plane



Internet backhaul architecture



- Use EoS/EoO instead of POS links
- Generate additional revenue from ICX/IGW connectivity sharing the backhaul
- Generate leased line revenue for international interoffice connectivity, Low latency HFT applications

Architectural Advantages

Scalable

- From few Mbps to 100s of Gbps rather than 1-10Mbps, 45 Mbps, 155Mbps
- Layer-2 scalability through MPLS-TP

Granular

- Scalable @ 2Mbps granularity upto 100 Mbps through GFP/VCAT
- 1Gbps granular beyond 100 Mbps using ODU(GFP), ODUFlex
- Sub Mbps granularity through MPLS-TP based statmuxing

Seamless

- Provided hitless addition and deletion of bandwidth through ITU-T G.7042/LCAS and ITU-T G.HAO/G.7044
- Can be integrated with Carrier SDN to provide bandwidth flexibility to OTTs virtual network

Summary

- Recent advances in backhaul allows operators to provide scalable and cost effective internet through use of OTN and MPLS-TP technologies
- Backhaul technologies provide IIG/IGW operators to generate additional revenues through newer services.