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FTTH Overview

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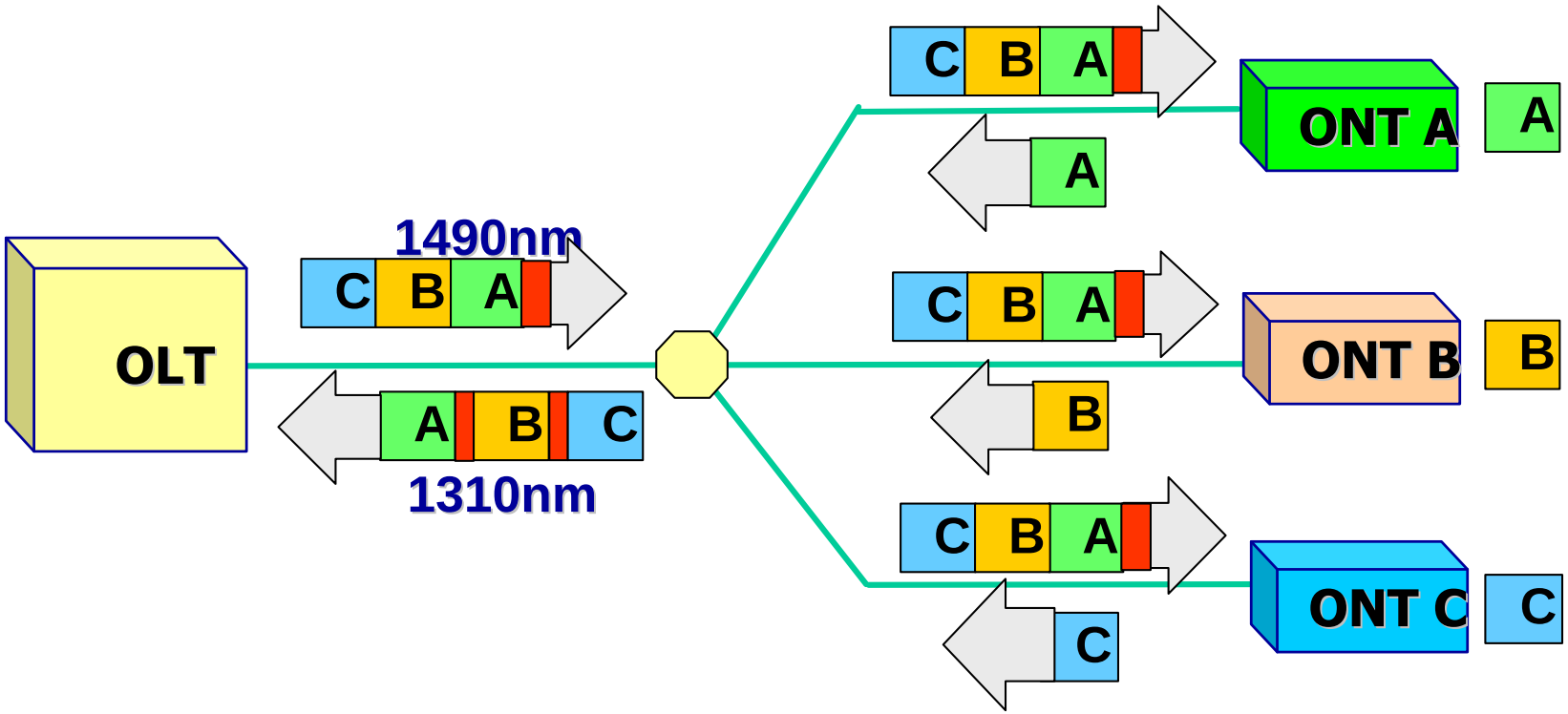
Verizon & AT&T Update

- **Verizon's FiOS (*FTTH*) $23 billion Project by the end of September, service was available to about 8.5 million homes and businesses in 16 states. Verizon plans to make the service available to 3 million additional premises each year through 2010**
- **AT&T U-verse (*VDSL*) Brown Field (FTTH) Green Field $6.5 billion to $7 billion Project by the end of 2007, had 231,000 subscribers, an 83% increase from 126,000 three months earlier.**

Source: Business Week Special Report January 28, 2008,

Compliant PON IP Data Only



Bandwidth Requirements for IPTV

MPEG2

	2 TVs, no DVR	3 TVs, 1 DVR	2 TVs +1 HDTV	2 TVs + 1 HDTV With DVR	4 TVs + 1 HDTV With DVR	2 TVs + 2 HDTV, 1 DVR
Internet	4.0	4.0	4.0	4.0	4.0	4.0
SD Video	8.0	16.0	8.0	8.0	16.0	8.0
HD Video	----	----	18.0	32.0	32.0	54.0
Total Mbps required	12.0	20.0	30.0	44.0	52.0	66.0

MPEG4

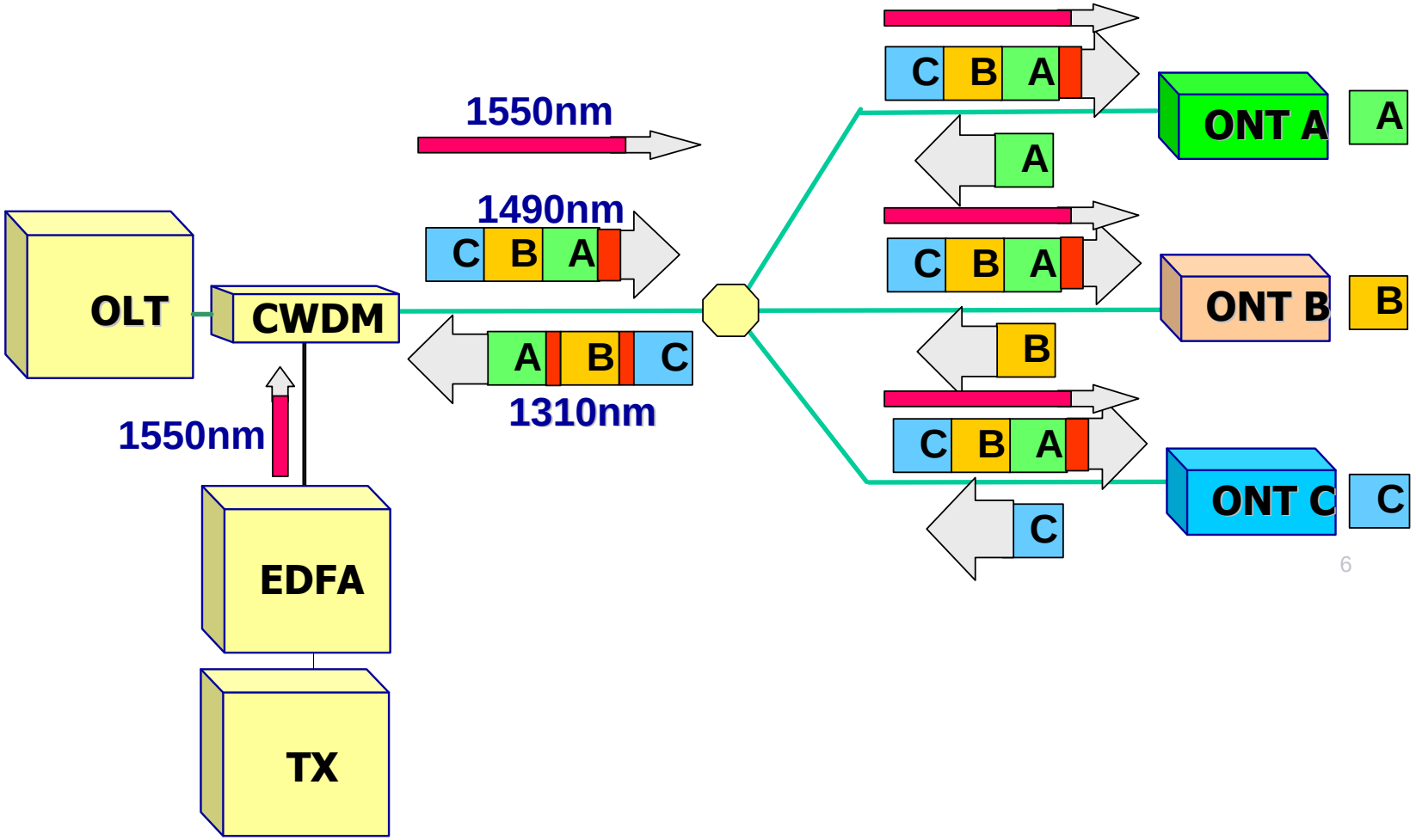
	2 TVs, no DVR	3 TVs, 1 DVR	2 TVs +1 HDTV	2 TVs + 1 HDTV With DVR	4 TVs + 1 HDTV With DVR	2 TVs + 2 HDTV, 1 DVR
Internet	4.0	4.0	4.0	4.0	4.0	4.0
SD Video	4.0	8.0	4.0	4.0	8.0	4.0
HD Video	----	----	7.0	14.0	14.0	21.0
Total Mbps required	8.0	12.0	15.0	22.0	26.0	29.0

Assumptions:

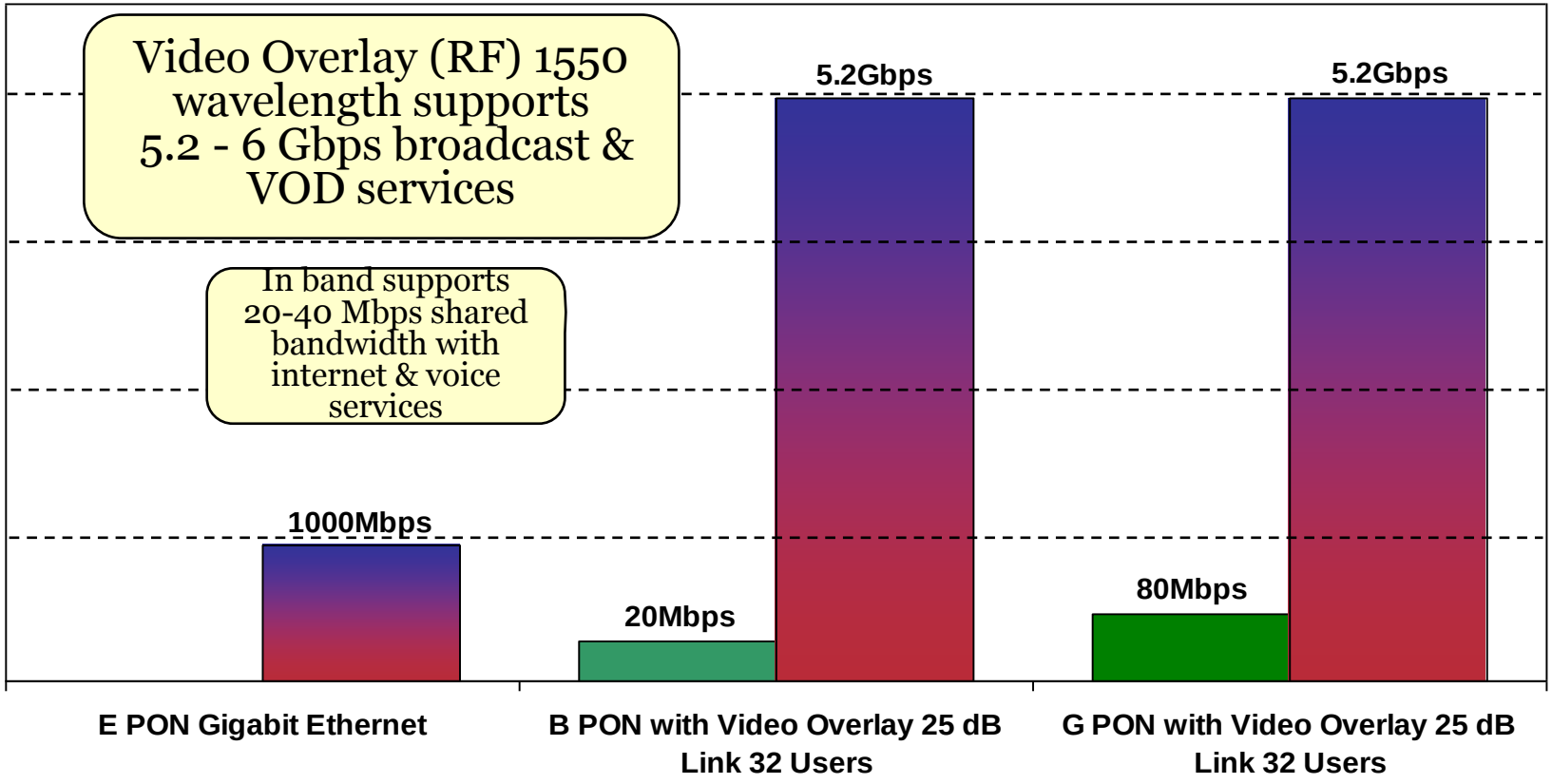
2 Mbps for SD video (MPEG4), 4Mbps for SD video (MPEG2)

7 Mbps for HD video (MPEG4), 18Mbps for SD video (MPEG2)

Compliant PON Data / Enhancement RF Video (G983 & G984 Compliant)



FTTH Bandwidth Delivery Options - IP and RF



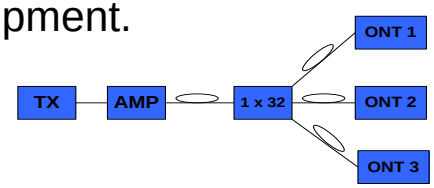
RF Overlay Capacity

870 Mhz Platform, 870 MHz - 55 MHz (below ch 2) = 815 MHz / 6 MHz per Channel Slot = 135 Channes x 38.8 Mbps = 5.2GHz

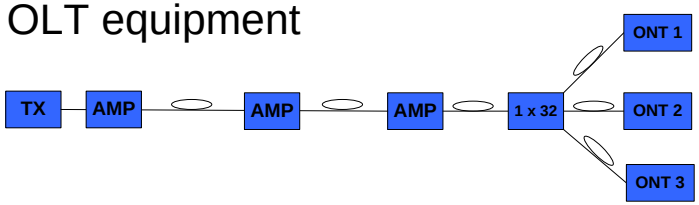
1 Ghz Platform, 1 GHz - 55 MHz (below ch 2) = 945 MHz / 6 MHz per Channel Slot = 157 Channes x 38.8 Mbps = 6GHz

Benefits & uses of a Video overlay

- **Local Modulation Model**
- Is used when the modulators for both Analog & QAM are located in a central facility next to the PON OLT Equipment.



- **Distance Transport Model**
- Is used when the modulation gear is located greater than 20 km from the desired customer service area, The Pre-amps, optical switch & PON-amps are located in the same facility as the OLT equipment



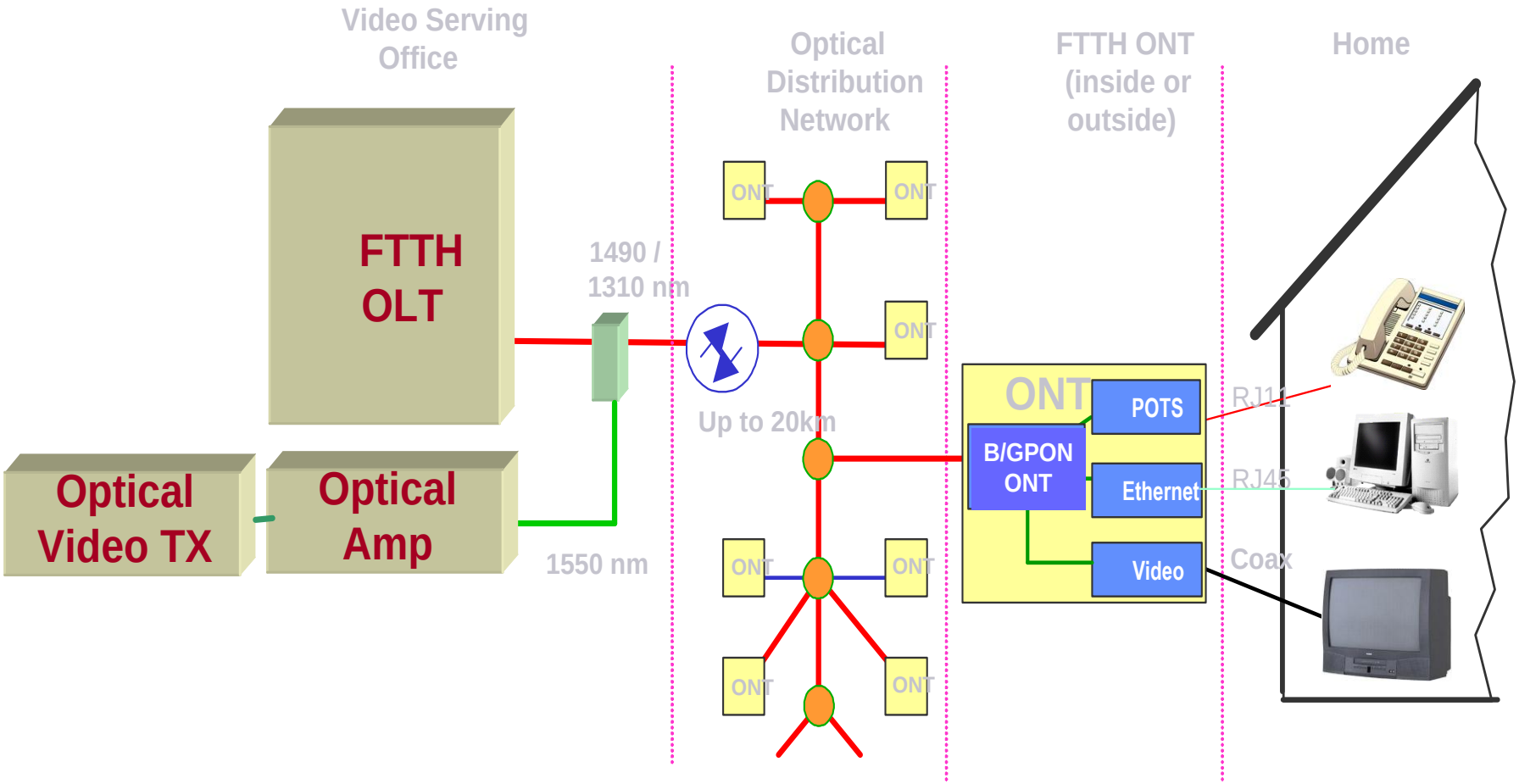
- **NEBS Certified Equipment**.

- Both the LM & DT Models are a low cost proven solution of transporting video to the customer
- The video overlay Typically transports =<78 Analog Channels of Video

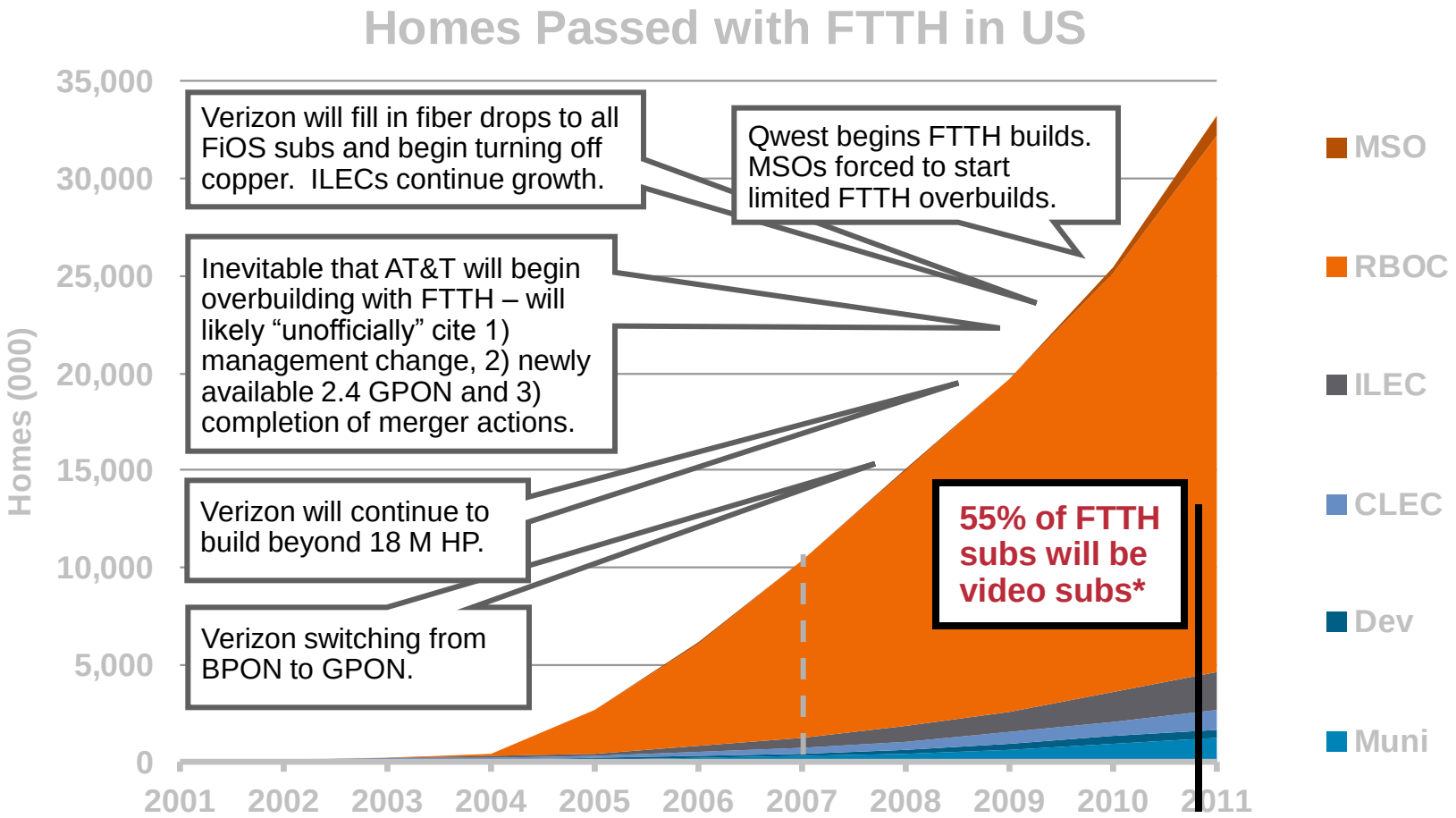
  30 Channels of High Definition Video

  300+ Channels of Standard Definition Digital Video
- No Set top box needed with Analog Tier (*large capital investment savings*)
- User friendly CATV like video delivery
- The 1550nm WL is inserted with the 1490/1310nm by using CWDM filter
- Greatly reduces the back office complexity of a IP Video solution
- Resolves many in home wiring problems experienced with IP video solutions

FSAN G983 & G984 Video Transport



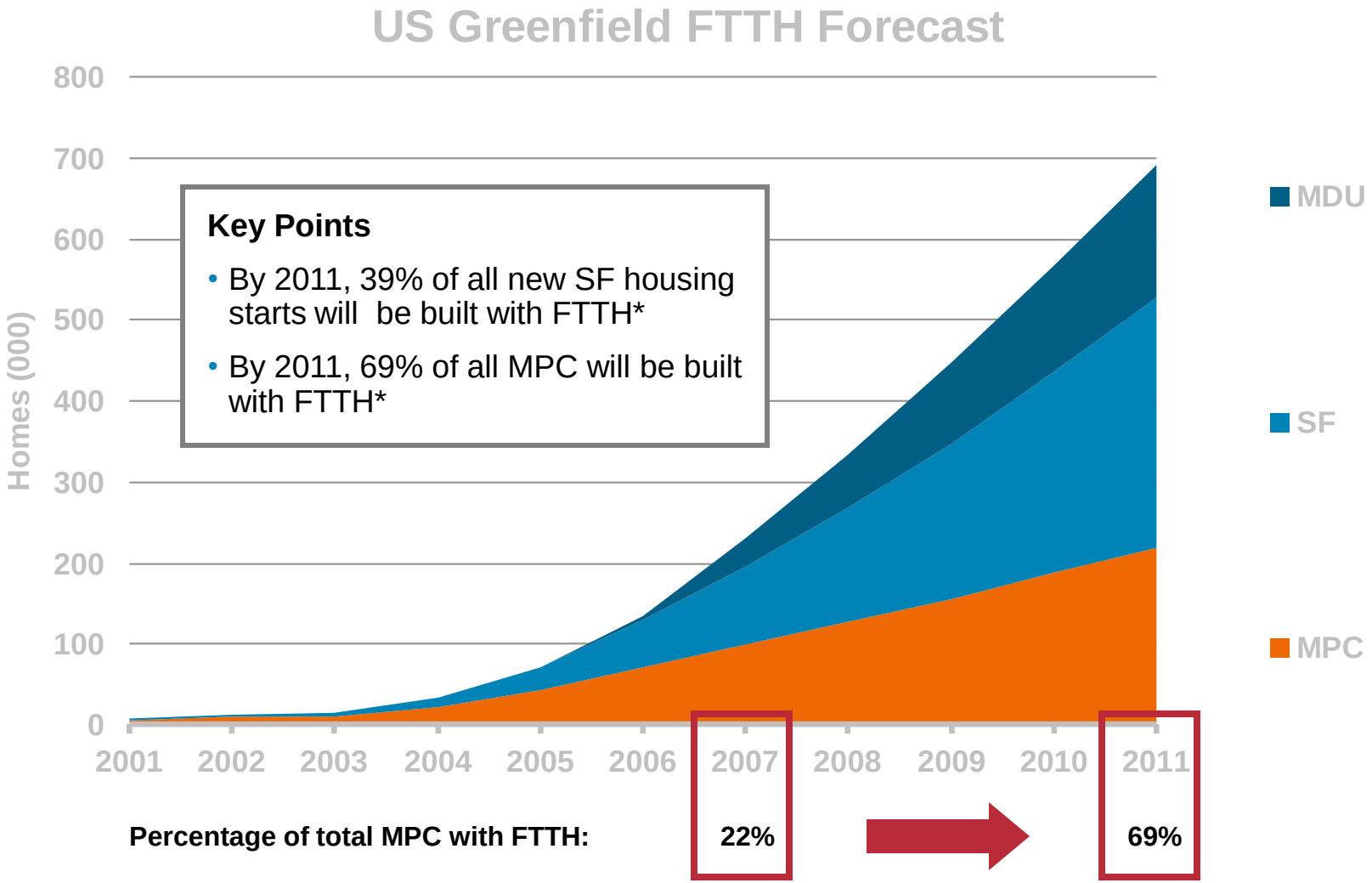
FTTH Growing Rapidly



Percentage of homes passed with FTTH:	**9%**	**12%**	**16%**	**20%**	**26%**
Percentage of homes connected:	**2%**	**3%**	**4%**	**6%**	**10%**

Source: *FTTH: Advanced Broadband*, RVA, 2007, * Infonetics 3Q, 2006

FTTH Increasing Percentage of Starts



*Source: FTTH: Advanced Broadband, RVA, 2007, * ABI Research, December 2006*

Prisma D-PON Catalyst

Pressure from MPC

Compete or abdicate?

Future proofing

Are PONs in the future?

HFC Foundation

- **Significant investment in…**
  - **CMTS base**
  - **Operations (OSS)**
  - **Billing (BSS)**
  - **CSR training**
- **DOCSIS has very long legs**
- **Enormous RF video base**
- **HFC CPEs**
- **History of incremental upgrade – not complete overbuild**

Prisma D-PON Solution

Fiber Future

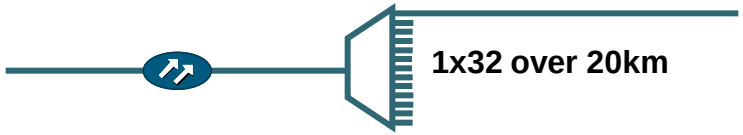
- **Increased competition from and consumer acceptance of FTTH and satellite video**
- **MPC builder pressure to deploy FTTH as amenity**
- **Future proof architecture – never touch the plant again**
- **No upgrade required for transition from DOCSIS 2 to DOCSIS 3 or to add VoIP**
- **Significantly more upstream bandwidth**

MSO PON Considerations

- **Future proof OSP**
  - **Only upgrades on ends, never touch OSP again**
  - **FSAN OSP 1x32 split 20 km architecture ensures longevity**
- **Simple Greenfield additions with minimal Hub change**
  - **Looks and behaves like HFC RF network**
- **Leverage Existing MSO Back Office**
  - **Seamless transition with existing HFC OSS / BSS / CMTS**
- **Bandwidth**
  - **DOCSIS 3.0 capable today**
- **Ease of subscriber installation**
  - **'Look' like coax - Install like coax (minimal splicing)**
  - **Utilize existing HFC CPEs**

Prisma D-PON Solution

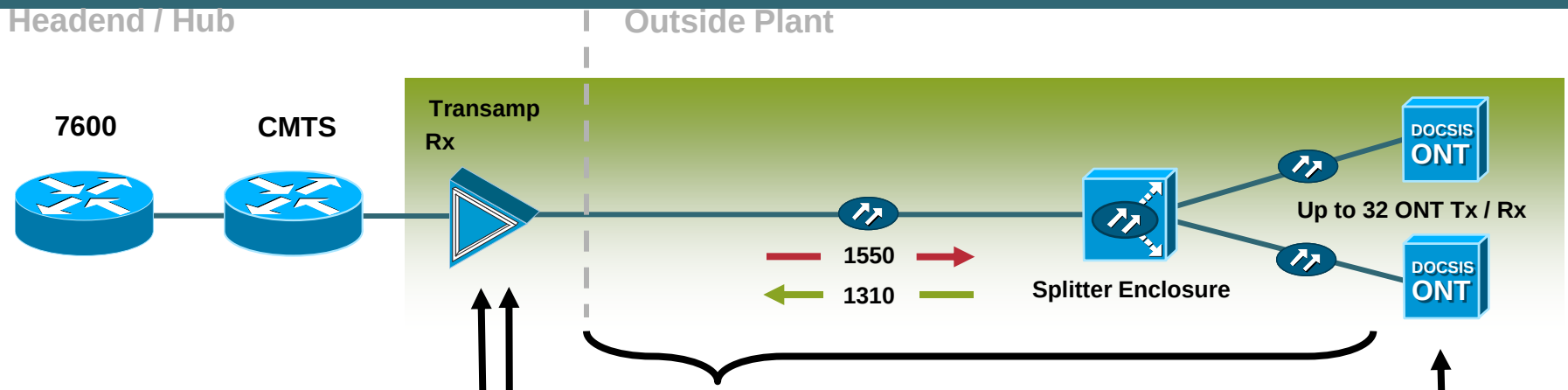
Transamp



D-PON ONT

- True MSO PON Solution
  - **Provides MSOs with a seamless operating transition from HFC networks to FTTH while maintaining existing OSS & BSS systems**
  - **FSAN PON OSP architecture allows low cost future upgrade path to any industry standard FTTH solution (architecture not proprietary)**
- No Back Office Change
  - **Leverages DOCSIS control, D-PON can share same CMTS shelf with existing HFC plant**
- All the Benefits of HFC – None of the Limitations
  - **Downstream supports standard CATV 78 Analog / 75 QAMs**
  - **D-PON transmitter will reach 20 kms even with a 1x32 home split and full DOCSIS 3.0 upstream loading**
  - **Does not require deployment of additional field EDFAs**
  - **Supports DAVIC or DOCSIS, SA or Motorola**

Prisma D-PON Components



Transamp

- **1550 nm broadcast forward optics with combined EMT and EDFA components**
- **Maximizes rack space in a 2RU chassis**
- **Cost effective FTTH PON transport**

PON

- **FSAN 1x32 PON OSP architecture**

Rx

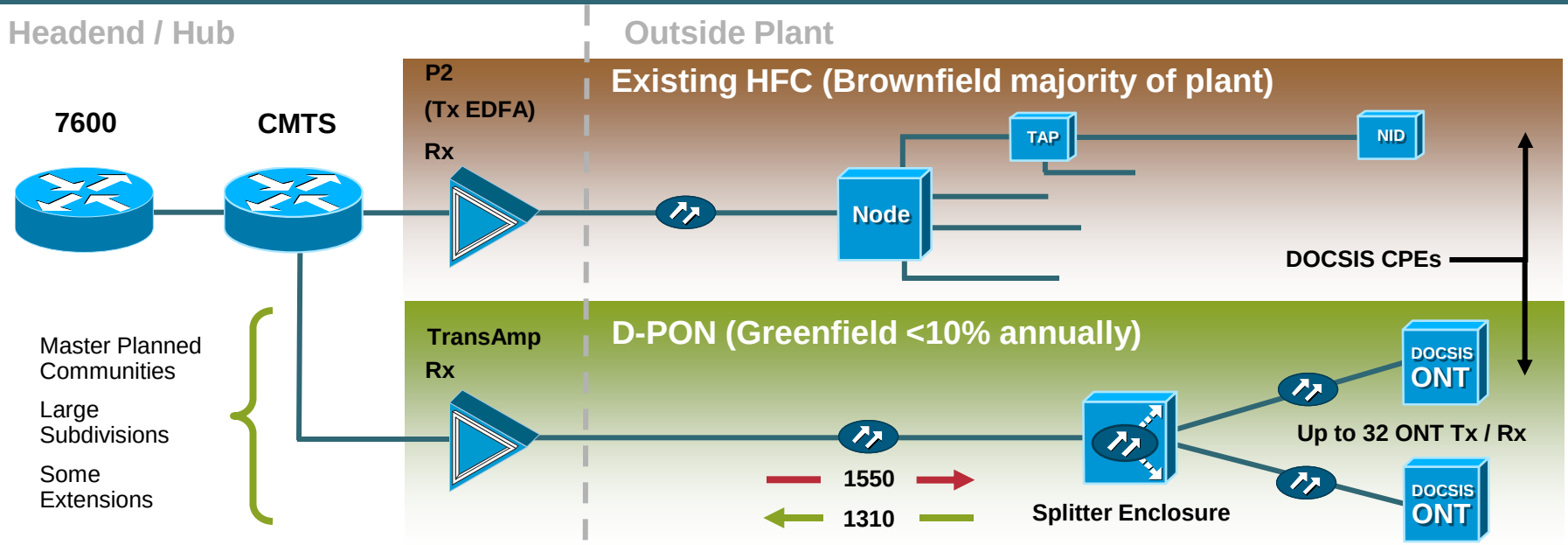
- **Prisma II Rx modified for D-PON solution**

D-PON ONT

- **Receives at 1550 nm & transmits at 1310 nm on same fiber**
- **DOCSIS control for collision resistance & ingress suppression**
- **Advanced return technology enables 20 km reach**

Availability Expected Late CY08

Prisma D-PON Target Market

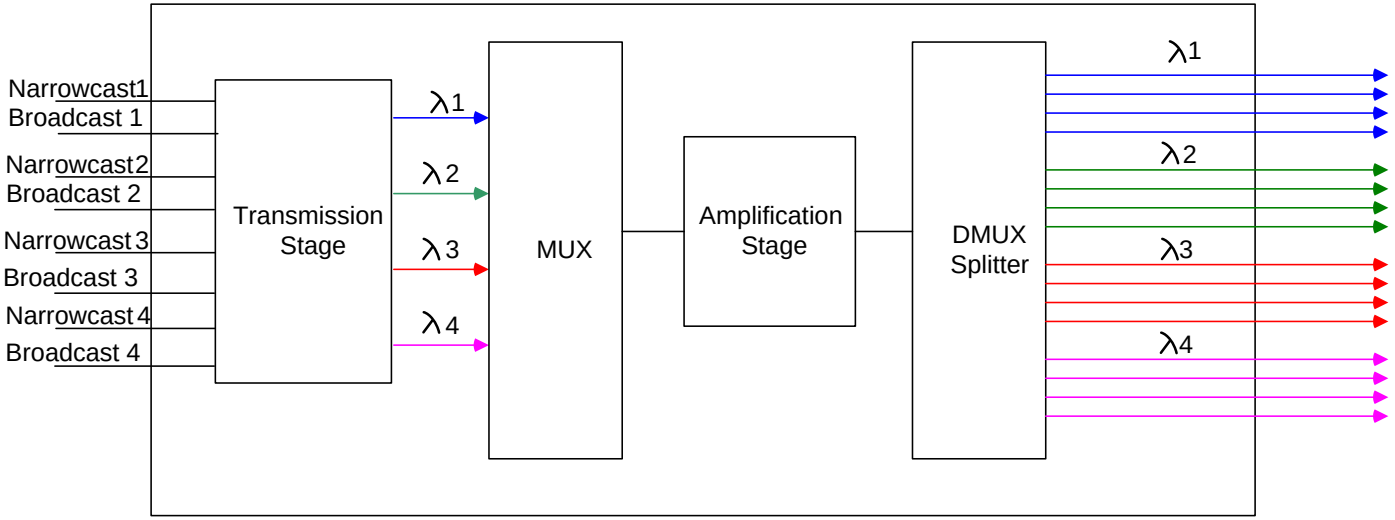


- **D-PON target market is any Greenfield network build where the Service Provider will be using a DOCSIS control plane**
- **D-PON solution allows for incremental upgrades on a future proof architecture while leveraging the existing back office infrastructure**

D-PON Lives Side-by-Side with Existing HFC Networks Today

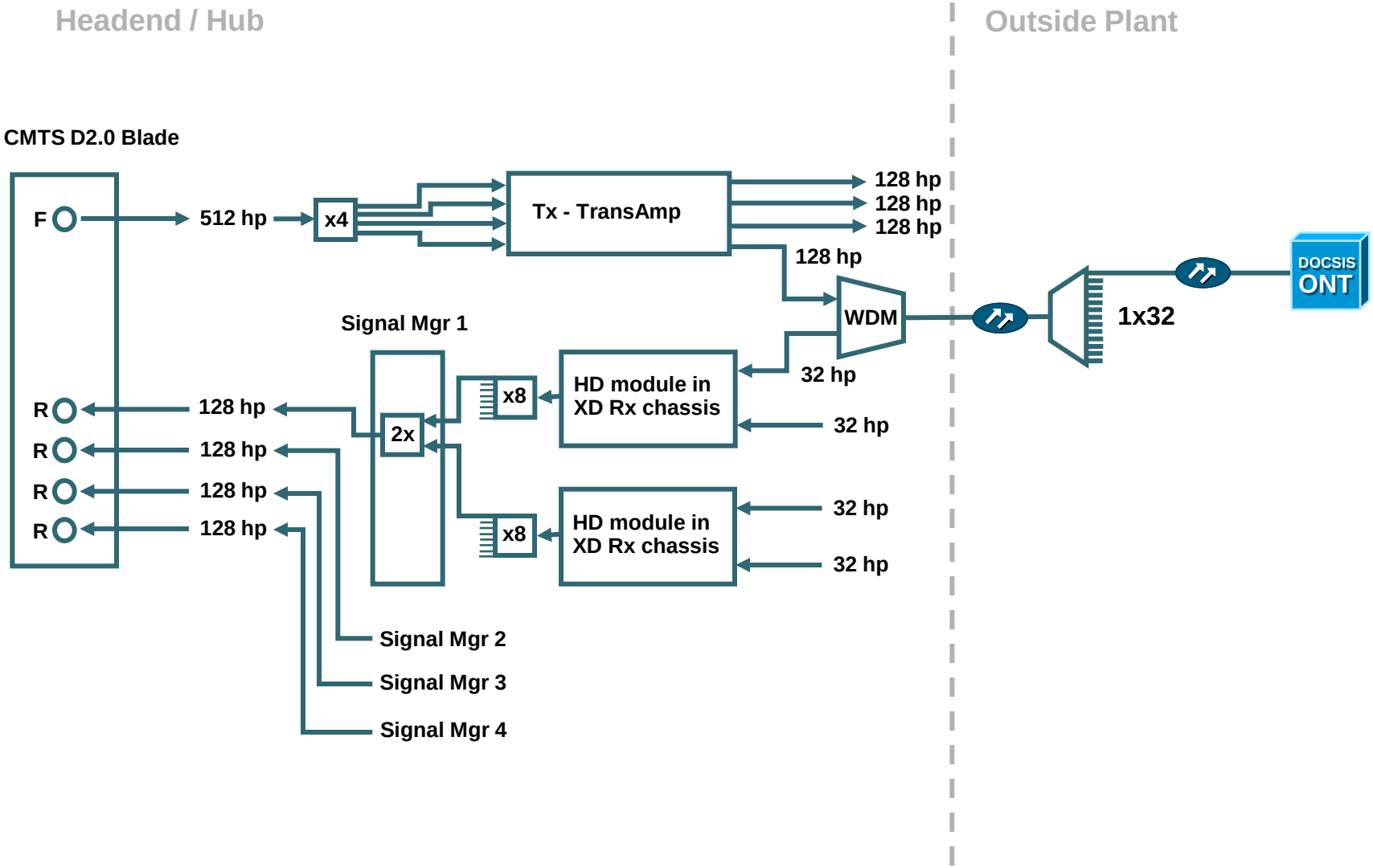
Prisma TransAmp

- **Small 128 home service groups**
- **Full 78 analog 75 QAM loading**
- **48 CNR to the home**
- **Cost effective 1550 transport**

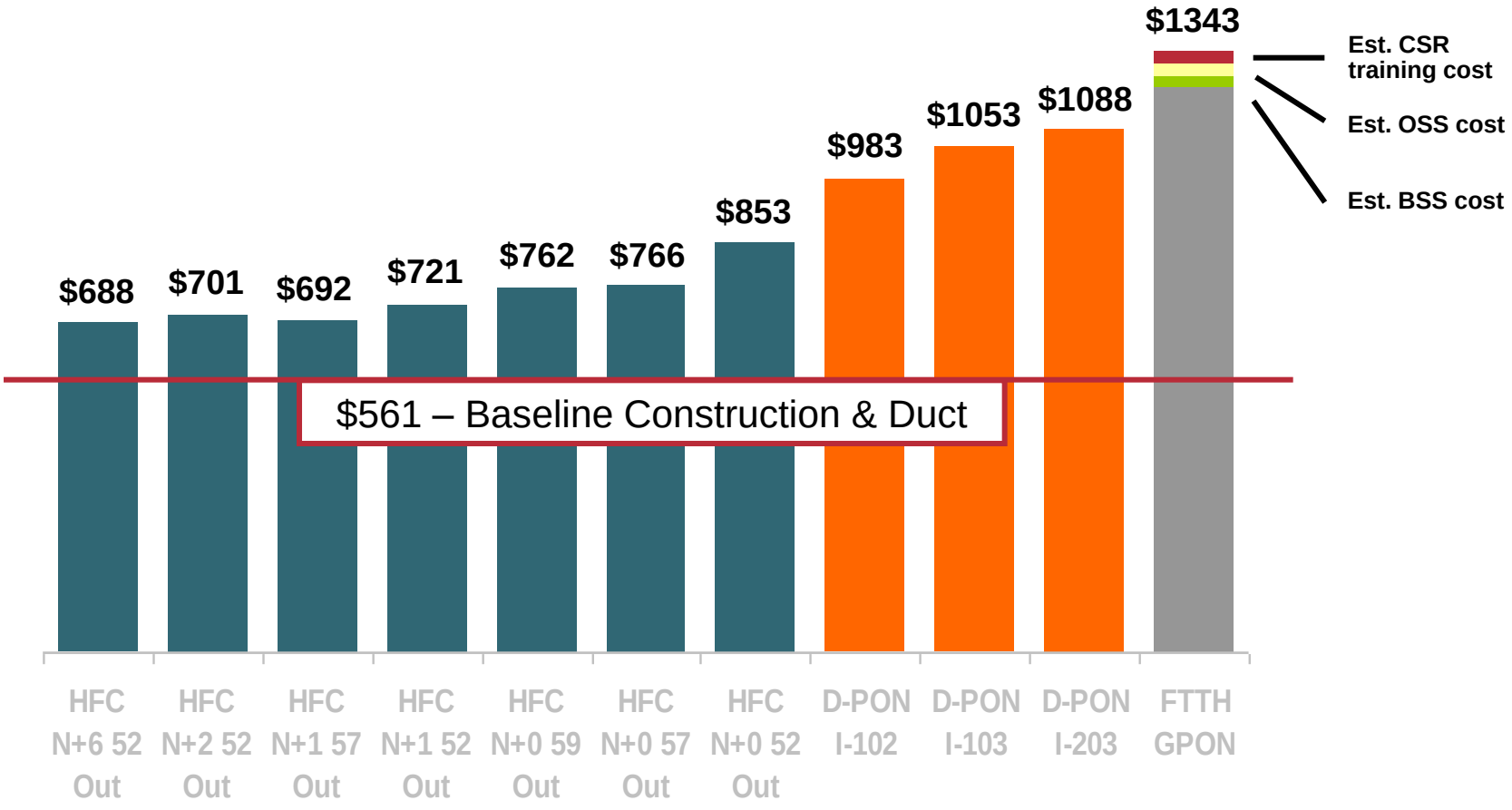


Cost-Effective 1550nm Transport for PON Architectures

Prisma D-PON System Architecture



Prisma D-PON Versus Other Solutions



What do you deploy in a Greenfield build?

PONS 70% take rate, EMTA not included in DPON

Back Office Cost to Deploy Telco PON

1) Tier 2 / 3 Method

Est. CSR training cost **2%**

Est. OSS cost **2%**

Est. BSS cost **2%**

- Initial training cost is a one time cost
- OSS / BSS cost are full initial cost and partial annual costs

20,000 subs at $1108 at 6% = $1.3 M

6% of OSP Cost

2) MSO BSS Vendors

- New and separate non-DOCSIS OSS solution (18-24 months and millions)
- New integrations between the BSS and the OSS
  - assuming 2 BSS & 2 OSS vendors, that would be 4 new integrations
  - integrations would cost $1.2 M, plus $15k per deployment location for each integration (anywhere from 20 to 100 depending on MSO)
  - integrations would cost $1.2 M, plus $15k per deployment location for each integration (anywhere from 20 to 100 depending on MSO)

Tens of Millions

3) Universal OSS/BSS

- New network agnostic OSS / BSS platform
- Approximate cost:
  - $5-10 management system based on historical provisioning analysis
  - Software development for this effort = $20/MAC address
  - Ongoing support for these systems = $20/MAC address

20,000 subs at $40 / MAC at 1.5 MAC addresses / sub = $1.2 M

$40 / MAC address

Theoretical Max Capacity Comparison

Apples-to-apples comparison of through put

				Downstream		Upstream		
Technology	Standards	Framing	# of Subs per Fiber	Full Bandwidth / PON DS	Mbps /Sub DS	Max Bandwidth / PON US	Mbps / Sub US (Mbps)	Reach
GPON*	ITU-T G.984.2	ATM / Ethernet	32 / 64*	2.5 Gbps	78 / 39 Mbps	1.25 Gbps	39 / 19.5	20 km
GEPON	IEEE 802.3ah	Ethernet	32	1.25 Gbps	39 Mbps	1.25 Gbps	39	20 km
Docsis PON	None	DOCSIS	32	6 Gbps *	6 Gbs – 185 Mbps	100 Mbps **	110 - 3.4 ***	20 km

- **A PON is equal to 1 32-way splitter**
- **All networks are currently traffic engineered to lower thru put per customer – today most Telco SP cap bandwidth to service level purchased, 5, 15, or 30 Mbps**
- **Notes**

  *** = 1GHz equates to 156, 256 QAMs @ 38Mbps each ~ 6Gbps**

  **** = 1 user on the upstream network receives all of the available bandwidth with Docsis 3.0 channel bonding (64QAM, 27.7Mbps with 4 channels bonded = 110Mbps)**

  ***** = all 32 users on the upstream network simultaneously drive data rates down to 3.4 – can increased by adding CMTS blades or by changing to a mid-split**

D-PON with DOCSIS 3.0 can be Competitive to a Telco PON Solution

Summary

- **SA believes a HFC-based PON is a natural HFC evolution conclusion**
- **FSAN PON infrastructure appears to offer the most future-proof capability and a low-cost, competitive plant**
- **An HFC-based PON, coupled with DOCSIS 3.0 and new technology developments offers DOCSIS a long runway**
- **SAs Access Business Unit is committed to development of products in this space**