

An ADTRAN Solution Overview



Broadband Networks for both Residential and Business Services

Using Next-Gen PON to support
services convergence

What is Driving the Need for Next-Gen PON?

Emerging high bandwidth applications like 4K and 360° video, augmented reality and virtual reality (AR/VR) applications, autonomous vehicles and high-bandwidth enterprise applications are set to consume the capacity levels supported by today's Fiber-To-The-Home (FTTH) networks. At the same time, competitive pressures are leading traditional telcos and Cable MSOs to rollout gigabit broadband leveraging new access technologies such as Gfast, DOCSIS 3.1 and even 5G fixed broadband. New web-scale competitors, municipalities and electric utilities are also aggressively entering into the gigabit battle. All these service providers must identify the technologies needed to ensure their competitive position moving forward to win and retain market share. Next-Generation 10 Gigabit Passive Optical Network (10G PON) architectures offer both the capacity and scale to economically support current gigabit services, as well as multi-gigabit bandwidth demands well into the future.

Converging Multiple Services over a Common Access Services Architecture

The primary value of Next-Gen PON technologies, NG-PON2 and XGS-PON, is the ability to converge residential, business and backhaul services over a common Optical Distribution Network (ODN) resulting in both CAPEX and OPEX savings. In addition, Next-Gen PON offers greater scale, better economics as well as network capacity compared to point-to-point technologies boosting the case to converge all services into a single network. However, the biggest challenge is delivering on the quality, reliability and performance service level agreements (SLAs) fundamental to premium enterprise services and 4G/5G densification needs. Next-Gen PON technologies will provide these traits while also delivering on the price points needed for mass-market residential applications.

Flexible Optics Balance Cost and Scale

A flexible optics approach that allows for a single Next-Gen 10G PON Optical Line Terminal (OLT) module to utilize multiple types of optical transceivers, enabling service providers to support existing fiber-to-the-home (FTTH) subscribers while also providing a path to premium business and mobile x-haul services. Flexible optics range from fixed XGS-PON that supports symmetric 10/10G services for residential, small business or mobile backhaul to tunable Next-Gen PON optics for high-density, premium enterprise, datacenter and 5G x-haul services using ONTs with tunable optics. Any mix of these options can be used on a single Next-Gen 10G PON OLT, allowing for maximum flexibility without compromising future capabilities.

Leveraging the disruptive ADTRAN Next-Gen 10G PON solution set, service providers can economically and incrementally unlock additional 5-10 years of capacity from existing PON deployments, while maximizing future service flexibility and minimizing risk of subscriber churn.

Next-Gen PON standards are being rapidly adopted by the leading service providers and vendors around the world for 10 Gbps symmetric PON over the already established xPON infrastructure.

An Aggregation and Packet Optical Alternative

In the past, there was a clear distinction between transport and access infrastructure, largely governed by the location of functions in the service provider network. With the explosion of bandwidth at the edge of the network, service providers have been forced to co-locate transport elements next to access elements, which is expensive and difficult to manage. For many service providers, this side-by-side deployment model for collocated transport and access network elements is unrealistic.

The ADTRAN Next-Gen PON system with optical networking edge (ONE) packages packet optical networking and multi-wavelength transport elements with access elements in a single solution. Now, service providers can accelerate next generation service delivery and service migration strategies, while reducing cost and complexity in the network.

SD-Access: Design-to-Operate, Lean-to-Operate

SD-Access networks are highly agile with the automation and scalability needed to support mass market residential service deployments. This agility enables telco and cable operators to retain their current market share and compete for new services revenue. Highly programmable SD-Access networks support the adoption of network automation and simplified service orchestration that reduces service provisioning times, human error and IT complexity, while enabling customer self-service capabilities. Rapid service creation and time to market is enabled through an open micro-services architecture which allows network operations and IT development teams to align. This evolution enables operators to vastly lower the cost to build, operate, innovate and maintain the network.

ADTRAN is accelerating the path to SD-Access across both current multi-service access platforms (MSANs) and next-generation disaggregated access platforms. The ADTRAN Next-Gen 10G PON platforms incorporate open APIs such as RESTCONF and YANG, allowing our solutions to be managed via current element management systems as well as our next-generation Mosaic Cloud Platform.

A Simple, Intuitive Subscriber Experience

The key to winning the broadband battle and building customer loyalty is by implementing a user-driven service model resulting in a simple, intuitive broadband experience. This requires simplifying service delivery with one click service activation, increasing service velocity while decreasing cost of subscriber add. Insight into the subscriber experience is equally important. Service providers must leverage analytics to gather network and subscriber intelligence to significantly improve customer engagement and the quality of experience.

The Mosaic Subscriber Experience Suite, a portfolio of powerful software applications, provide analytics, lower costs, gain visibility to subscriber behavior and build customer loyalty—everything needed to thrive in a competitive marketplace. These software components operate in an open architecture with open interfaces that easily integrate into existing OSS/BSS environments, enabling service providers to quickly monetize their network investments.

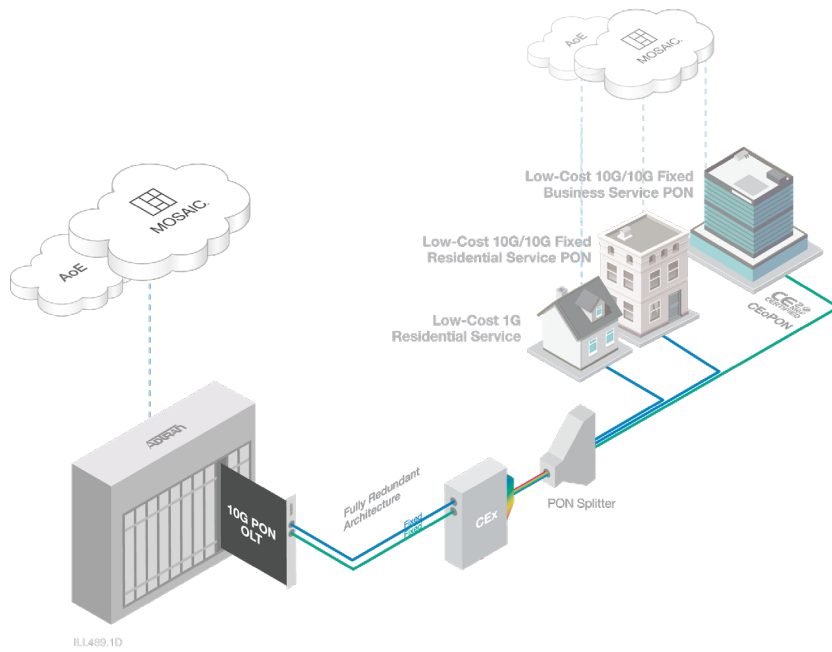


Figure A: Deploy mass market Gigabit or multi-Gigabit converged broadband services using low cost fixed 10/10G optics (XGS-PON).

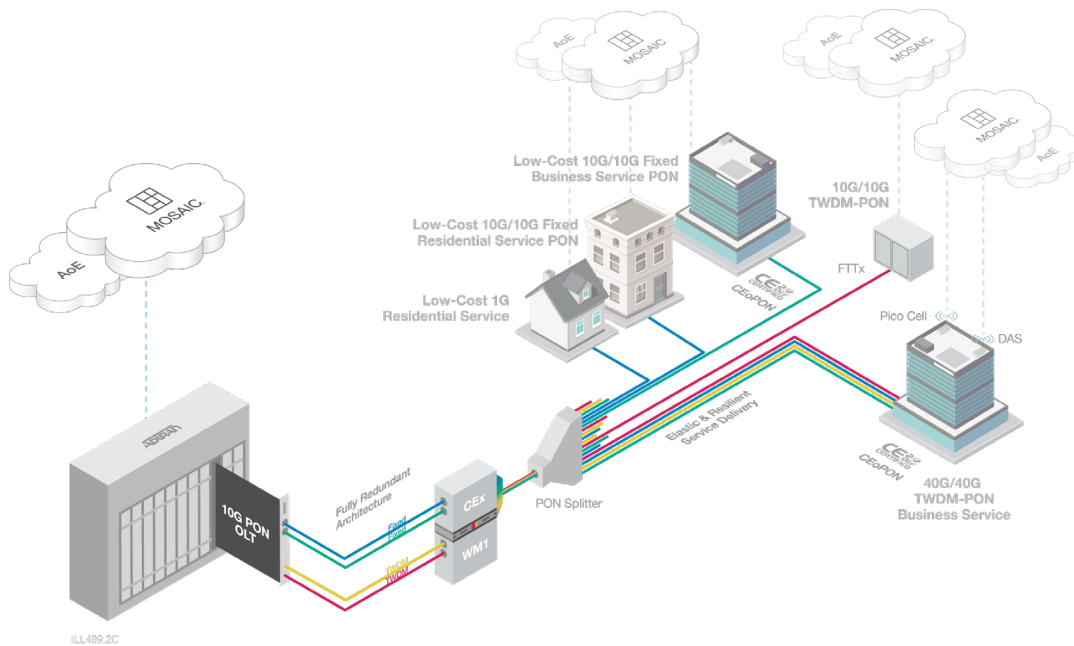


Figure B: Introduce highly competitive Carrier Ethernet over PON (CEoPON) to support premium SLA-based enterprise services using higher performance TWDM-PON optics.

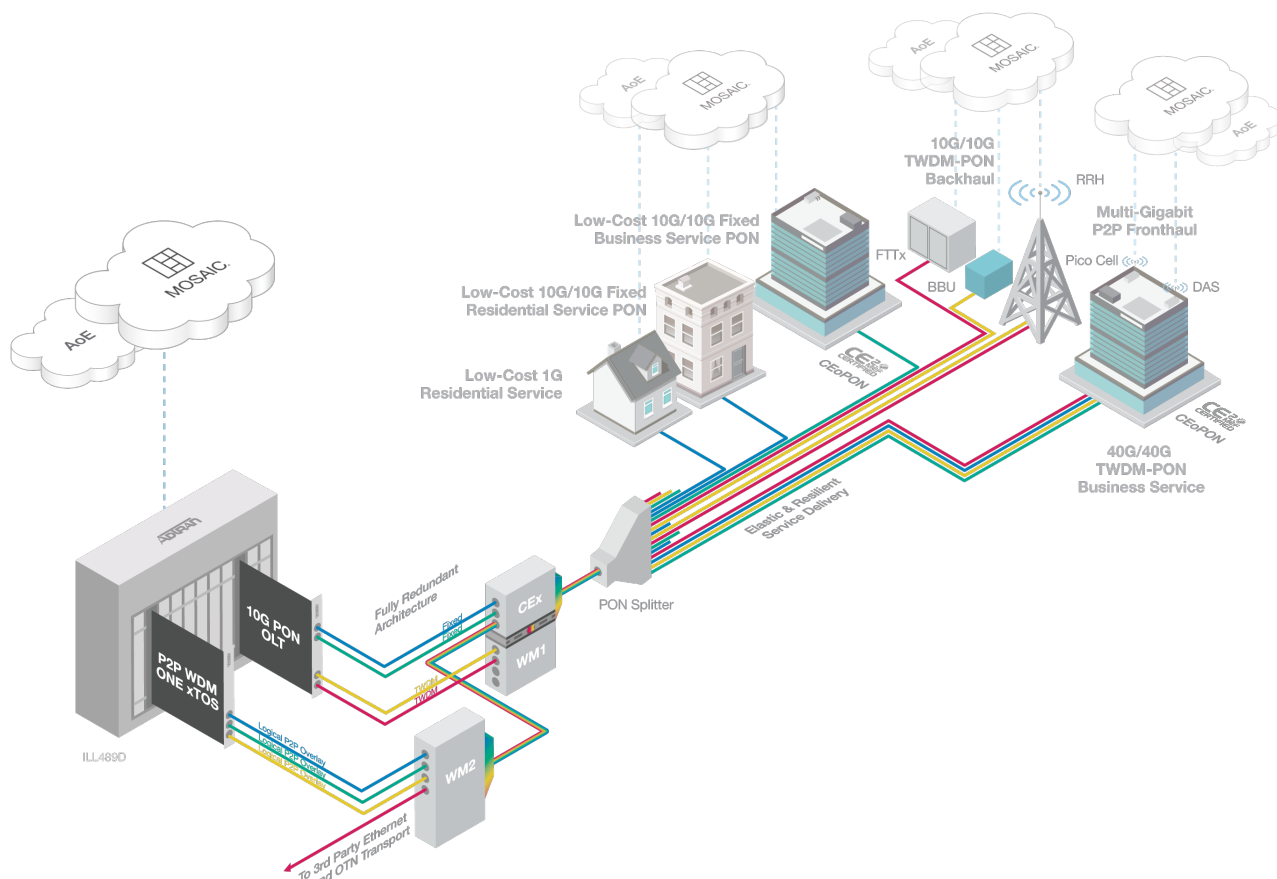


Figure C: With support for ultra-low latency and network timing synchronisation the same fiber network serving enterprise access services can be used to support x-haul services advancing 5G densification initiatives.



Technology	Direction	Nominal λ (nm)	Wavelength Range (nm)
Fixed XGS-PON, 10G EPON, XGPON1	Upstream	1270	1260-1280
GPON, XGS-PON Optional Wavelength	Upstream	1310	1290-1330
GPON, XGS-PON Optional Wavelength	Downstream	1490	1480-1500
TWDM NG-PON2	Upstream	N/A	1528-1540
RF Overlay	Downstream	1555	1550-1560
Fixed XGS-PON, 10G EPON, XGPON1	Downstream	1577	1574-1580
TWDM NG-PON2	Downstream	N/A	1596-1603
P2P DWDM	Both		1603-1625

A Highly Viable Business Case

Next-Gen 10G PON is key to delivering on the scale, latency, and reliability needs to converge residential, business and 5G backhaul services, while unlocking capacity to meet bandwidth needs well into the future. All the key elements to build a 10G access network - the OLTs, business and residential ONTs, management platforms and lower cost optics - are now in place. With growing 10 Gigabit deployments worldwide, Next-Gen 10G PON is ready for primetime.

ADTRAN Total Access 5000 Quad 10G OLT

- 10Gbps symmetric XGS-PON (software-upgradable to NG-PON2)
- Supports Residential Triple-Play, Premium Enterprise and 4G/5G Backhaul
- Provisioning interfaces identical to GPON for ease of migration and integration
- Class B+, G (XGS-PON) and N1 (NG-PON2) optics
- Mosaic Cloud Platform management and micro-services support

ADTRAN Total Access 5000 SM200 Switch Module

- Nx100G Uplinks
- 4x QSFP28 ports per SM (2x 100G, 2x 40G)
- Up to 40km optics
- 40G/100G ERPS ring support
- 40G per slot backplane



ADTRAN Total
Access 5000
Quad 10G OLT

ADTRAN Total
Access 5000
SM200 Switch

ADTRAN 602 Premium Business-Class 10G ONT

- Small 1RU half-rack form factor
- Carrier Ethernet 2.0 (CE2.0) and MEF 2.0 services are supported allowing for SLA-based services
- Modular Mosaic OS software with OpenOMCI management

ADTRAN 602X SMB 10G ONT

- Integrated Business NID functionality for SLA based Carrier Ethernet Services
- Pluggable LAN UNI for up to 10G copper/fiber handoff
- Modular Mosaic OS software with dual OpenOMCI and Netconf/YANG management

ADTRAN 621X Residential 10G ONT

- Cost effective platform for residential 10G service delivery
- Integrated 1G & 10G copper Ethernet LAN interface
- Incorporates industry recognized ADTRAN enterprise class VoIP
- Modular Mosaic OS software with OpenOMCI management



ADTRAN 602 10G
Business Class ONT



ADTRAN 602X 10G
Small Business ONT



ADTRAN 621X 10G
Single Family Unit ONT

Additional Network Elements

Co-existence Element (CEX)

- Six SC/APC or SC/UPC interfaces; wavelength pairs are down/up:
 - ♦ Common (output to the field/splitter)
 - ♦ Input from OTDR
 - ♦ GPON – 1490/1310nm or (NG-PON2 Fixed - 1490/1310nm)
 - ♦ XGPON1/10GEPON/XGS-PON – 1577/1270nm
 - ♦ WM1 (NG-PON2 TWDM - 1596-1603/1524–1544nm)
 - ♦ RF video - 1550–1560nm
 - ♦ WM2 (NG-PON2 P2P - 1603–1625nm)
- All these services may be combined onto a single fiber via the CE

Wavelength Multiplexer 1 (WM1)

- Nine SC/UPC interfaces; wavelength pairs are down/up:
 - ♦ Common (output to CEX)
 - ♦ TWDM ch 1 (1596.34/1532.68)
 - ♦ TWDM ch 2 (1597.19/1533.47)
 - ♦ TWDM ch 3 (1598.04/1534.25)
 - ♦ TWDM ch 4 (1598.89/1535.04)
 - ♦ TWDM ch 5 (1599.75/1535.82)
 - ♦ TWDM ch 6 (1600.60/1536.61)
 - ♦ TWDM ch 7 (1601.46/1537.40)
 - ♦ TWDM ch 8 (1602.31/1538.19)
- Combines the (up to) eight TWDM wavelength pairs into a single output going into the CEX



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Acronym	Description
10/10G	10 Gbps Upstream/10 Gbps Downstream Rate
API	Application Programming Interface
BBU	Baseband Unit
CEx	Coexistence Element
CO	Central Office
CORD	CO Reimagined as a Data Center
DAS	Distributed Antenna Systems
DOCSIS	Data Over Cable Service Interface Specification
DPU	Distribution Point Unit
DWDM	Dense Wavelength Division Multiplexing
EPON	Ethernet Passive Optical Network
ETOS	Ethernet Transport Optical Switch
FANS	Fixed Access Network Sharing
FC	Fiber Channel
FSAN	Full Service Access Network
FTTH	Fiber to the Home
FTTx	Fiber to the X (Cabinet, Curb, Node)
GPON	Gigabit Passive Optical Network
ITU	International Telecommunications Union
LTE-A	Long Term Evolution - Advanced
Mbps	Megabits Per Second
MDU	Multi Dwelling Unit
NG-PON2	Next-Generation PON (4 to 16 Wavelengths)
ODL	Open DayLight
OND	Optical Distribution Network

Acronym	Description
OLT	Optical Line Terminal
ONOS	Open Networking Operating System
ONT	Optical Network Terminal
OTDR	Optical Time-Domain Reflectometer
OTT	Over the Top
P2P	Point to Point
PON	Passive Optical Network
QSFP+	Quad SFP (4x10Gbps)
QSFP28	Quad SFP (4x28Gbps)
RF	Radio Frequency
RG	Residential Gateway
ROI	Return on Investment
RRH	Remote Radio Head
SBU	Small Business Unit
SDX	ADTRAN Product Model
SET	Subscriber Edge Tunable
SFP+	Enhanced Small Form-Factor Pluggable
SFU	Single Family Unit
SLA	Service Level Agreement
ToR	Top of Rack
TWDM	Time and Wavelength Division Multiplexing
WDM	Wavelength Division Multiplexing
WDM PON	Wavelength Division Multiplexing Passive Optical Network
WM	Wavelength Multiplexer
XFP	10 Gigabit Small Form-Factor Pluggable
XGS-PON	10 Gigabit (XG) Symmetric Fixed Wavelength PON
XG-PON1	10 Gigabit Passive Optical Network