XGS-PON

10 Times the Speed, 10 Times the Possibilities
Walker Corporate Overview

Presented by: Gus Vasilakis
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ABOUT WALKER AND ASSOCIATES

• Founded in 1970
• Industry leading national telecommunications value-added distributor
• Provider of expert product selection guidance and reliable network deployment services
• Provider of product integration, configuration, installation, and asset management services

• Serving carriers nationwide including wireline, wireless, cable, broadband and enterprise communications providers
• Sales and support call center in NC
• Women-Owned Corporation
• ISO 9001:2015 Certified
WHAT DOES WALKER DO?

**Professional Services**
Deploy broadband networks that deliver Internet, data, video and voice services of communications providers to their subscribers

**Distribution and Logistics**
Source, stock and supply network infrastructure components for easy, single point of contact, one-stop-shopping

**Consultative Services**
Advise communications services providers on product selections for optimum network performance and scale

**Network Architecture and Design**
Design and configure networks for management efficiency, revenue growth and cost containment
TARGET MARKETS

• CATV/MSO
• Competitive Service Providers (CSP)
• Data Centers
• EF&I – Installers, Engineering, Consulting Firms
• Electric Cooperatives
• Government
• Independent Telephone Companies (ILEC)
• Telecom Product Resellers, Channel Partners
• Utilities
• Wireless Carriers
TOP TECHNOLOGIES

- Broadband Access
- Carrier Ethernet
- Ethernet Transport
- Optical Transport
- Security
- Software Networking
  - SDN/NFV
- Switching and Routing
- Timing and Synchronization
- Unified Communications
- VoIP
- Wireless
  - Fixed, Wi-fi, DAS
Longstanding Partnerships

Thank You!

• Walker has been a Zyxel distributor since 2010.
• BBC Magazine and Walker regularly partner on editorial and advertorial content.
• Walker has participated in Broadband Communities Summit for over 8 years.
We see an incredible 42 percent of the U.S. labor force now working from home full-time. A testament to the savage impact of the lockdown recession.
In 2016, the average household had 10 connected devices, and that number is expected to skyrocket to 50 devices by 2020.*

*Source: Intel
Entertainment and video traffic is about 70% of all Internet traffic

IP video traffic will quadruple from 2018 to 2022*

*Source: Cisco Visual Networking Index (VNI)
Even More Connected Devices

Devices will be online in 2022*

*Source: Cisco Visual Networking Index (VNI)

Globally, the Internet traffic in the year 2022 is projected to be greater than all combined Internet traffic from when the Internet was created in 1984 through 2016
The Immersive Experience

Internet traffic is set to skyrocket

In 2022, VR and AR will make up 12 times more traffic than in 2017, totaling 4 exabytes per month

85%

of all internet traffic will be from video, gaming, and multimedia by 2022*

*Source: Cisco Visual Networking Index (VNI)
Why Just Stop at 1Gigabit Broadband?

PON technologies like XGS-PON are built upon existing GPON technology.

When planning for your next Greenfield or looking to upgrade an existing brownfield fiber network, 10G XGS-PON can co-exist on the same Fiber Optics.

The 10G investment cost has been coming down over the recent years, making it ideal for selecting electronics that have support for higher bandwidths.

10G Broadband allows for Service Providers to offer a variety of different service tier packages with 2 Gigabit, 5 Gigabit, and 10 Gigabit Internet access.

Meet today’s high demanding Broadband needs with technologies that deliver upon faster speed and overall performance.
Why 10G Broadband?

Increase demand for higher bandwidths

Improved capacity for more connected devices

Expanding your service tier offering with 10G

Residential and Multi-Dwelling applications

Great for media streaming and online gaming

Ideal for pairing with the latest Wi-Fi solutions
What 10G Delivers

10 times faster than today’s 1Gig network

Symmetrical upload/download speeds

Lower latency

Enhanced reliability and security

10G builds upon today’s highly scalable networks
What is XGS-PON?

XGS-PON is next-generation standard and enables Service Providers to deliver 10 Gbps symmetrical speeds.
Why XGS-PON?

10Gbps - 10 x 1Gbps

Symmetric bandwidth downstream and upstream

Great technology for FTTB applications

Can be deployed to other PON technologies

Property owners can update their buildings with fast reliable fiber
10G Bandwidth Down and Up

Symmetric Bandwidth in both directions
Lower Latency

Lower latency is better because latency is essentially a delay between when you take an action and when you see the result—high latency is when it takes longer to see the results. The less delay, the better.

XGS-PON offers great lower latency with time sensitive applications.
10G Network Reliance

With no active elements such as optical amplifiers, which would require power, are present in the PON Network
10G Security and Protection

10G Security Risk
- Downstream Data Breach
- Re-Programming ONU/ONT
- Rogue device transmitting within the network

10G Security Counter Measures
- Downstream and Upstream AES Encryption
- Registration based authentication
- OMCI based secure mutual authentication
Advanced Encryption Standard (AES) is a symmetric block cipher chosen by the U.S. government to protect classified information.

To register means creating a new user account, that is a record in the database describing how you will prove your identity.

Consistent and repeatable network authentication and authorization mechanisms with OMCI.
10G builds upon today’s highly Scalable Networks

The same Fiber optics that have been used for 1G GPON can be used to deliver 10G XGS-PON
XGS-PON and GPON over the Same Network

XGS-PON can work over your exiting Fiber GPON Network

GPON and XGS-PON make it ideal for offering a Fiber network with no interference from each other of the different Wavelengths uses
The Tech Behind 10G Broadband
Technology is Behind PON

<table>
<thead>
<tr>
<th>Media/size</th>
<th>Broadband download speeds</th>
<th>Fiber download speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5Mbps</td>
<td>20Mbps</td>
</tr>
<tr>
<td>4-minute song (4 MB)</td>
<td>5s</td>
<td>1.5s</td>
</tr>
<tr>
<td>5-minute video (30 MB)</td>
<td>40s</td>
<td>13s</td>
</tr>
<tr>
<td>9-hour audiobook (110 MB)</td>
<td>2m</td>
<td>46m</td>
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<tr>
<td>45-minute TV show (200 MB)</td>
<td>5m</td>
<td>1.5m</td>
</tr>
<tr>
<td>45-minute HDTV show (600 MB)</td>
<td>15m</td>
<td>4m</td>
</tr>
<tr>
<td>2-hour movie (1.0-1.5 GB)</td>
<td>24m</td>
<td>10.5m</td>
</tr>
<tr>
<td>2-hour HD movie (3.0-4.5 GB)</td>
<td>72m</td>
<td>32m</td>
</tr>
<tr>
<td>Misc. Archive (10 GB)</td>
<td>Nope</td>
<td>Slow</td>
</tr>
</tbody>
</table>

EPON
10G EPON
GPON
GEAPON
XG-PON
NG-GPON2
XGS-PON

Active Ethernet
10G Active Ethernet
The Standards Empowering 10G

- **XGS-PON**
  - ITU G.9807.1
  - 2016

- **NG-PON2**
  - ITU G.989
  - 2015

- **XG-PON**
  - ITU G.987
  - 2010

**10G Technology**

- 10G DS
- 10G US
- 2.5G US

ITU G.987
2010

ITU G.989
2015

ITU G.9807.1
2016
# PON Technology Comparison

<table>
<thead>
<tr>
<th>PON Standards</th>
<th>GPON</th>
<th>XG-PON</th>
<th>XGS-PON</th>
<th>NG-PON2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITU-T</td>
<td>G.984</td>
<td>G.987</td>
<td>G.9807</td>
<td>G.989</td>
</tr>
<tr>
<td>Number of Wavelengths per Direction</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4 to 8</td>
</tr>
<tr>
<td>Data Rates per Wavelengths Downstream (Gbps)</td>
<td>2.5</td>
<td>10</td>
<td>10</td>
<td>10/2.5</td>
</tr>
<tr>
<td>Data Rates per Wavelengths Upstream (Gbps)</td>
<td>1.25</td>
<td>2.5</td>
<td>10</td>
<td>10/2.5</td>
</tr>
<tr>
<td>Data Rates in Wavelengths Downstream and Upstream (Gbps)</td>
<td>2.5/1.25</td>
<td>10/2.5</td>
<td>10/10</td>
<td>40/40 80/80</td>
</tr>
</tbody>
</table>
NG-PON2 and XGS-PON

Good option for Large Carriers

- Multi-Dwelling Units (MDUs), Large businesses
- One wavelength can be assigned to a business customer that requires a 10 Gbps application
- Channel bonding enables increased capacity for an individual service, Laser tuning up to 8 Wavelengths

Great option for Small to Mid-size Providers

- Single Family, Multi-Dwelling, Business applications
- Symmetrical Downstream and Upstream data rates
- Works in existing GPON networks, no interference with other Wavelengths
NG-PON2 Architecture
XGS-PON Architecture
Wavelength-Division Multiplexing (WDM) is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (i.e., colors) of laser light. This technique enables bidirectional communications over one strand of fiber, as well as multiplication of capacity.
In downstream transmission, the lasers wavelength measures 1577 nm* while the upstream wavelength measures 1270 nm*.

*Nanometers One billionth (10^-9, or 1 / 1,000,000,000) of a meter. The wavelength of an optical signal is measured in nanometers. The wavelength of a typical optical signal in a long-haul fiber optic transmission system (FOTS) is in the 1550 nm
Splitting the Difference
Extending the Reach 10G

Central Office OLT XGS-PON ODN
62 mi (100km)

Remote OLT GPON ODN
37 mi (60km)
Bandwidth and Service Tiers

XGS-PON to serving 2 Gbps, 5 Gbps or 10 Gbps subscribers
What’s the Cost for 10G broadband?

What is the going Subscriber cost for 10G Broadband?

In the US, as of May 2019. 10-Gbps symmetrical dedicated Internet access costs $4,000-$9,000 per month with a 3-year contract term (Tier 1 Carriers).

Service Providers are offering 10G Broadband with a cost anywhere from:

- $180
- $200
- $300
- $400
- $900
- $7,500
Integration of 10G and Wi-Fi
10G and Wi-Fi 6 Benefits

10G Symmetrical Broadband Access

10G Single Family Unit

10G access for Multi-Dwelling Unit

Improved Broadband access in Small Office Home Office

Wi-Fi 6 provides up to 10G access

Fast Wi-Fi access beyond 1G speed in the home

Wi-Fi 6 leverages the 10G Broadband access can benefit the entire Apartment

Small businesses can take advantage of the High-Speed access with faster Wi-Fi
10G Broadband and Wi-Fi 6 Enhances the Experience
Integrated 10G XGS-PON ONT

**XGS-PON**

**AX6000**

4 x 4 5GHz

4 x 4 2.4GHz

8x

1G LAN Ports

10G LAN

10G LAN

SC/APC Connector

SIP

Two FXS Ports

TR-069

TR-18112

broadband forum
Fiber Cabling and Media

Move from RJ-45 to Fiber

Angle Polished Connector - APC
A singlemode optical fiber cable is designed to carry only a single ray of light.

Angled polished physical contact (APC), also called as "APC Fiber Connector" is best for high bandwidth applications and long-haul links since it offers the lowest return loss characteristics of connectors currently available

SC Multimode - A 2.5 mm snap-in connector

*Support by the GPON and XGS-PON Solutions
Warning! To avoid possible eye injury, do NOT look into an operating fiber-optic module's connector.
Wi-Fi 6 Access Built-In

Provider’s Optical Distribution Network (XGS-PON)

Subscriber’s Home Network (XGS-PON Integrated ONT)
Wi-Fi 6: Making a Difference

AX6000

Eight Radios and Antennas

4 x 4 5GHz  4 x 4 2.4GHz

Speed
Coverage
Capacity
Mesh

4804 Mbps*   1147 Mbps*

*The maximum wireless data is derived from IEEE standard 802.11 specifications. Actual data transfer rate will vary from network environment including: distance, network traffic, building site materials/construction, interference from other wireless devices, and other adverse conditions.
Increase the Bandwidth with 160MHz

Wi-Fi 6 performance increase with the use of Channel Width

20MHz 40MHz 80MHz 160MHz

Channel width doubling to increase 5GHz performance

<table>
<thead>
<tr>
<th>Channel Width</th>
<th>5.17 GHz</th>
<th>5.33 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 MHz</td>
<td>36 40 44 48 52 56 60 64</td>
<td></td>
</tr>
<tr>
<td>40 MHz</td>
<td>38 46 54 64</td>
<td></td>
</tr>
<tr>
<td>80 MHz</td>
<td>42 50 38</td>
<td></td>
</tr>
<tr>
<td>160 MHz</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>
Single Port XGS-PON with an Extender

In-wall Smart panel Install in Basement or Garage

In home Wi-Fi Extender for extended coverage
Single Port XGS-PON ONT

Easy to Swap Out Subscriber End-Point Technology

Fiber Connection Upstream

Ethernet CAT 5e or Higher Downstream

Residential Router

XGS-PON

SC/APC Connector

10G LAN

SIP

UPS

OMCI G.988
Fiber Tray Access

SC/APC Fiber Port

Warning! To avoid possible eye injury, do NOT look into an operating fiber-optic module's connector

Release for Fiber Tray and Fiber Cable
Single – Port XGS-PON ONT

Provider’s Optical Distribution Network (XGS-PON)

Subscriber’s Home Network (Ethernet Multi-Gig WAN Port)
Easy Deployment with Any Home Wi-Fi Router

**Bridge Mode**

Two Box XGS-PON ONT Bridge Solution

Subscribers
Apartment 10G Broadband Access

Prosperity Owners can offer 10G Broadband

In-apartment Single-Port or Integrated XGS-PON ONT

Shared connectivity with multiple occupants

Prosperity Owners can offer 10G Broadband

Works great for over-the-top media streaming

Optional voice services over a digital network
XGS-PON ONT SFP Transceiver

10G Deployment Applications

Flexible Installations Options

SFP+ form-factor design

XGS-PON symmetric bandwidth

Fully manageable with OMCI G.988
XGS-PON SFP Transceiver: Transforming your Solutions

Any of these solutions can be converted into a functioning XGS-PON ONT

Fiber Media Convertor  Ethernet Router/Gateways with SFP Cage interface  Any Web or Layer 2 Managed Switch with SFP uplink Interface
Bridging the Gap Between Technologies

SFP+ ONT Transceiver + Media Converter + 2.5G Internet Home Wi-Fi Router
10G Secured Communications

Provide a fast and secured connection with 10G and XGS-PON to Firewall appliance

XGS-PON SFP Transceiver ONT turns the Firewall into a security ONT

The flexible SFP design allows you to transform your customer’s office space and communications
10G Small Business Broadband Enhancements

LAN
10G Office
Symmetric Bandwidth
Latency
Cloud Services
10G Remote Home Office
The Home Office Challenge
10G Home Office Network

Dual-Personality Home Network

1Gbps LAN Ports

10Gbps LAN Port

10G Connection

IP Camera surveillance

Remote Graphic Artist

UHD media streaming
VoIP with Life-Line Battery Backup

SIP

One FXS Port

Phone Port

SIP (Section Initiating Protocol, RFC 3261)
Codec: G.711 a/μ (64K), G.726 (24/32K), G.722

UPS Battery Back Up

UPS Connector Cable
VoIP with Life-Line Battery Backup

SIP

Two FXS Ports

Phone #1

Phone #2

UPS Molex Connector

UPS Battery Back Up

UPS Battery Back Up Connector Port

SIP (Section Initiating Protocol, RFC 3261)
Codec: G.711 a/μ (64K), G.726 (24/32K), G.722
Managing your 10G Opportunity
Optical Management Control Interface (OMCI G.988)

OMCI allows service providers to create a variety of applications and services utilizing the PON (Passive Optical Network), including voice, video and data, and features inherent flexibility.

- **Management OMCI (G.988)**
  - ONT management and Control

- **Transmission Convergence (TC)**
  - Service Adaptation Sublayer
  - Framing Sublayer
  - PHY Adaptation Sublayer
  - ONT Ranging, Registration, and Activation

- **Physical Media Dependent (PMD)**
  - ODN Architecture Transceiver Characteristics
How OMCI Works

Central Office

OLT

Registration (PLOAM)

Config, Management information

Status and alarm updates

ONT

Subscribers
Interoperability Between Vendors

In the Past....

- No real option for expansion
- Unable to have secondary Vendor devices
- Closed software eco-system doesn’t allow for innovation from outside resources
- “One Size Fits All” approach limits what you can do with your network and service offerings
- Proprietary management platform increases the likelihood of “swivel chair” managing support systems instead of tired and true industry standards
Selecting the Right Solutions for the Job

Un-Bundled 10G Solutions are now available

Unbundling PON in the EU

“Un-Bundled Solution” Allow for Multi-Vendor Solution
Interoperability with OMCI G.988
Remote Management

Manage | Internet | Wi-Fi | LAN | Home Network

TR-069
TR-143
TR-181i2

TR-069

FW

FW
What we discussed

Why 10G Broadband?

Why Just Stop at 1Gigabit Broadband?

10G Bandwidth Down and Up

Securing 10G

10G builds upon today’s highly Scalable Networks

XGS-PON and GPON over the Same Network

The Tech Behind 10G Broadband

Bandwidth and Service Tiers

10G and Wi-Fi 6 Benefits

10G Broadband Deployments Enhancements

10G Remote Home Office

Managing your 10G Opportunity
Thank you

Interested in learning more? Contact us
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