Nebula Ethernet Optics for Access Networks

GFAST™ Gigabit Ethernet /PON for Broadband Services

The newest member of Nebula's family of Ethernet over fiber access products, the GFAST Gigabit Ethernet /PON system lets service providers deploy fiber profitably by delivering high-speed business communications and consumer broadband services on the same cost-effective infrastructure.

Conserve Energy and Space with High Density

The GFAST GigE /PON System lets service providers deploy FTTHome or FTTNode in a multidrop configuration, supporting up to 32 customers on a single fiber with neighborhood connections. A high density solution designed to meet carrier operating reauirements, the GFAST system supports up to 640 customers from a single EtherOptic Central Office shelf.

Carry Business and Consumer Traffic

The GFAST Optical Line Terminal (OLT) and Optical Network Unit (ONU) are designed to GE PON standards and offer service providers a reliable, cost effective way to build out an optical infrastructure for Ethernet/IP-based services. In addition, the GFAST GigE /PON system uniquely incorporates industrial strength bidirectional encryption, making it suitable for secure communications. This unique feature allows service providers to serve both business and consumer customers on the same fiber, a critical advantage in ensuring profitability.

Define a Wide Range of Services

The GFAST system includes rich traffic shaping and Quality of Service (QoS) features to support a broad range of IP services, such as secure VLAN and Voice over IP for business customers, and video, IP TV and broadband internet access for consumers.

GFAST GigE/PON Highlights

- Secure Business IP services: Ethernet/VLAN services and VoIP
- Residential broadband services: internet access, voice, IP TV,
- Low investment, low risk fiber deployment strategy

- Traffic marking, classification and shaping operate on eight QoS queues per customer, supporting different service offerings on the same fiber.
- Automatic bandwidth sharing across queues (and customers) supports guaranteed service quality and guaranteed minimum bandwidth services, which can burst up to available capacity without impacting other customers' QoS.
- Two-way encryption transforms PON technology into a viable solution for business services.

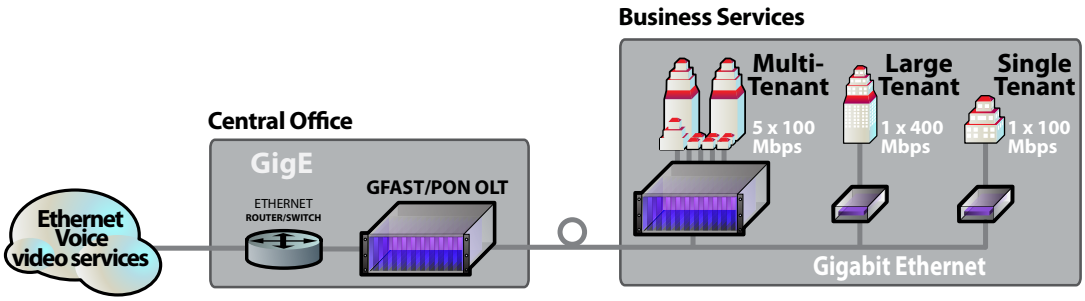
The GFAST GigE /PON family uses the proven Nebula EtherOptic platform, broadly deployed today in major carrier networks for Ethernet delivery. Designed with carrier deployment and operational needs in mind, the Nebula EtherOptics platform provides:

- Incremental provisioning to support profitable growth, where capital spending takes place in response to customer orders,
- Addition of individual line cards to the EtherOptic shelf without disrupting existing services,
- Easy integration into existing management systems for operations and service support.

Expanding to Gigabit Ethernet Services

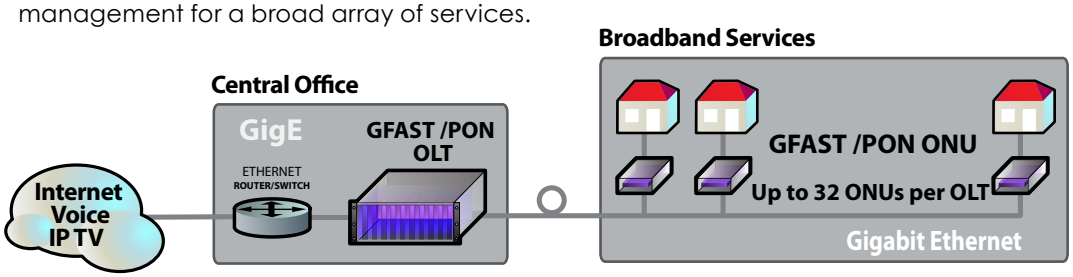
Broadband Business Service

Integrated encryption makes GFAST GigE /PON a secure and robust solution for business services. Extensive service definition capabilties allow service providers to offer not only voice, data and video services, but also a full suite of information, communication and entertainment services with service quality levels matched to specific service requirements. Multidrop flexiblity easily supports both individual and multitenant offices on a single fiber run.



Broadband Residential Service

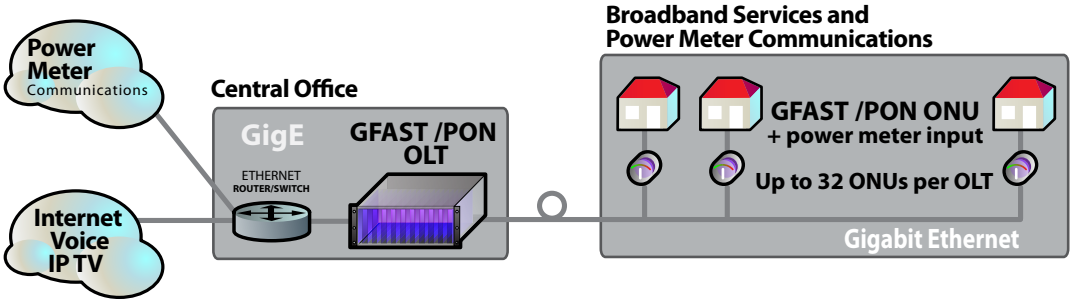
The GFAST GigE /PON products provide a cost-effective way to deliver and grow broadband services for residential customers. VLAN-based traffic classification and shaping provides effective and efficient bandwidth allocation and management for a broad array of services.



Broadband Services Integration

For service providers considering new business models and innovative integrated services, the GFAST PON ONU's flexible architecture provides a unique opportunity.

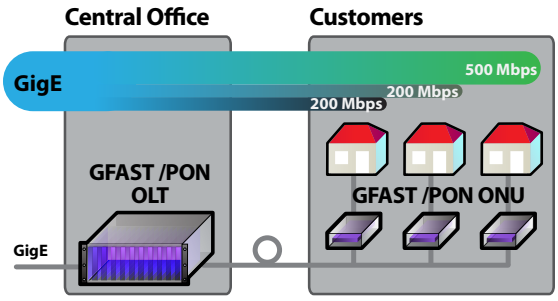
For example, service providers combining power meter data collection and broadband service delivery can deploy the GFAST ONU/P, which combines automated meter reading (AMR) communications with channelized IP services. The GFAST meter extension ring provides an externally accessible optical end-point for direct plug-and-play to the existing meters and new automated meters with Ethernet interfaces.



GFAST GE PON Technology

Rich Broadband Service Offerings

The GFAST GigE /PON system has sophisticated Quality of Service (QoS) and traffic shaping features that give service providers the granular control necessary to offer a broad range of communication, information and entertainment services. Service providers can take advantage of the advanced bandwidth sharing features to ensure optimal bandwidth utilization and offer 'bursting' options to customers. For example, best-effort services can be policed to maximum bandwidths, while high-priced services are allowed extra bandwidth when available, and voice services are guaranteed to receive the required bandwidth and immediate, low latency forwarding.



Secure IP Services — Recent investigation has identified that simple downstream encryption is insufficient to prevent eavesdropping and masquerading by coresident ONUs. The GFAST platform employs bidirectional encryption to ensure all communication is secure.

Traffic Queues—All traffic for each customer is classified and queued into a set of eight buffers (per customer) according to the QoS classification of the traffic. Priorities can be set for each queue.

Bandwidth Assignment and Sharing—The GFAST system assigns bandwidth based on a subscription-time variable. Bandwidth sharing can be enabled or disabled for each queue. Bandwidth is allocated with a weighted round robin (WWR) servicing algorithm that provides guaranteed minimum bandwidth to each Class of Service. When there is no congestion, minimum bandwidth is not policed and any queue can use available bandwidth.

Optimal bandwidth use is further supported by frame splitting and early discards. Early discard enables protocols such as TCP to converge to the full available bandwidth. Downstream traffic is switched to the right customer based on an internal VLAN tag in each frame. The GFAST OLT manages upstream bandwidth, allocating it in six-kilobyte windows to each GFAST ONU. The ONU can split customer frames across multiple windows, ensuring that all of the allocated bandwidth is usable. Traffic shaping is implemented in hardware for maximum throughput and minimum latency.

QoS—Many different QoS configurations are possible. For each QoS, the traffic is at first shaped, and then policed to the subscribed bandwidth for that QoS. Weighted Round Robin (WWR) queue servicing ensures that the GFAST Fractional GigE network delivers high-priority traffic immediately, without starving lower-priority traffic.

Designed for Carrier-Grade Operations

The GFAST GigE /PON System is designed on the Nebula EtherOptics platform which has been in use in carrier networks for more than a decade. Nebula has evolved the EtherOptic platform to meet carriers' demanding operational requirements while keeping the system highly affordable. Operations features support easy, non-intrusive deployment, upgrade and management.

Deploy and Configure—The GFAST OLT and ONUs are configured using a Telnet or SSH session. Commands configure the QoS features and other network modes and parameters, including the associated packet types, the bandwidth assigned, and the buffer depth before applying policing policies for each of the eight queues. The devices can be reconfigured while in operation, ensuring that changes to one customer's service do not cause downtime for others. Upgrading the unit's software can be done remotely, eliminating truck rolls, and meeting the combined goals of sustainablility and reducing service support costs.

Management —The GFAST OLT and ONU are SNMP-managed devices. The management system in each is reached by using a VLAN number on the service provider's interface. Statistics are kept for both the Ethernet interface and individual queues. Devices can be queried for status and to download statistics.

Reliability—The GFAST OLT has two Ethernet interfaces, one of which can be configured to provide an automatic failover in the event that the equipment connected to the primary interface fails.

GFAST Gigabit Ethernet /PON System Details

GFAST Gigabit Ethernet Units and Cards

GFAST Multichannel unit	A 20 slot cabinet designed for CO and customer premise environments. Fits in a 3U 19" rack. Convection cooled. In a CO, can be configured with up to 20 GFAST OLT line cards (a total of 20 GigaBits/sec: 20 x 1 Gigabits/sec over individual fibers) supporting up to 640 individual endpoints (20x 32 ONUs). In a multi-tenant customer premise environment will support up to 20 endpoints (ONU's)
GFAST GigE Customer Premise Unit	GigE unit or line card in single-channel unit, or dual-channel unit if redundant links are desired

Components

GFAST GigE Line Card (OLT)	Each GFAST-OLT can serve up to 32 GFAST ONUs with a total bandwidth of up to 1 Gbps
GFAST GigE Network Card (ONU)	Each ONU supports a single Ethernet connection at up to 1 Gbps bandwidth

GFAST Optical Line Terminal (OLT) and Optical Network Unit (ONU) Technical Specifications

Component	GFAST OLT	GFAST ONU
Frequency	1310 up/1490 down	
Transmit	+3 dBm	0 dBm
Receive	-30 dBm	-25 dBm
Typical Application	10 km/32 way split	

Connections	• 1 SC optical connectors
	• 2 RJ45 twisted pair ports
	  • Customer LAN interface
	  • Management
		• 1 SC optical connectors
		• 1 RJ45 twisted pair port

Indicators	• Power • Carrier detect • Secure PON Link Act • Ready/Error • Port1 Link/Act • Port2 Link/Act	• Power • Carrier detect • Secure PON Link Act • Ready/Error • Port1 Link/Act
Option Settings	• WDM Emulation Mode • FOIRL Emulation Mode • Configuration Mode • Restore Factory Default • Test Mode	
VLAN	Maximum 4096	
Data Rates	Up to 1 Gbps	
Management	SNMP managed device	
Environmental	Operating Temperatures -20 to 150° F (-5 to 65° C) Humidity (Relative) 10–90% non-condensing	
Dimensions	1 slot (0.8 inches) wide, 3U (5 1/4 inches), 7.3 inches deep	

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