Carrier Ethernet Access Technologies

Carrier Ethernet services are defined as abstract services that run over a network irrespective of the underlying transport technology.

However, when investigating access technologies for a specific Carrier Ethernet service scenario, the following considerations should be taken:

- Existence of legacy lines
- Availability of fiber
- Required bandwidth
- Requirement for symmetric or mainly downlink bandwidth
- Resiliency requirements
- Long or short reach
- Need to support TDM circuits

Copper Access

Benefits

Using the existing voice-grade copper infrastructure keeps deployment costs to a minimum, as there is no requirement for new cabling inside or outside the residence or business. Using the multi-pair bonding service providers can offer high performance (10-100 Mbps) service over a reliable infrastructure with resiliency built-in.

Ethernet over Bonded Copper can also lower recurring operational costs for CLECs or ILECs who are operating as CLECs in out-of-region territories. Using bonded copper, Service Providers can deliver Carrier Ethernet services over leased dry copper, which is typically much less expensive than alternatives.

(A) Speeds (B) Technologies (C) Deployment Scenarios

(A) Minimum of 2 Mbps using G.SHDSL Minimum of 10 Mbps over VDSL Up to 100 Mbps (asymmetric)

(B) 2BASE-TL - 10PASS-TS

(C) Remote branch offices - On-net or off-net - SMB - Campus settings - Traffic monitoring

Advantages

Ubiquitous copper availability - Rapid deployment - Low cost unbundled local loop - Resiliency through bonding

Status

DRAFT

Source(s) and Reference(s)

Contributor(s)

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Fiber Access

Benefits

One major benefit of using fiber optic access technology is its ability to future-proof bandwidth and distance requirements. Fiber offers easy scalability to meet and adapt to the increasing customer needs.

Beyond its bandwidth capacity, fiber also offers additional benefits such as being able to transmit over greater distances and its inherent immunity to noise and interference.

(A) Speeds (B) Technologies (C) Deployment Scenarios

(A) 10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps, 40 Gbps and above

(B) Active Ethernet - Ethernet over SONET/SDH - Passive Optical Network

(C) On-net buildings - Greenfield - Dense Metro area - 1Gbit/s or greater bandwidth requirements

Advantages

Highest bandwidth - Noise immunity - Security - Long reach - SONET/SDH leverage existing - Growth potential via xWDM

PDH Access

Benefits

The primary benefit that comes from using T1/E1 for delivering Carrier Ethernet services is that Service Providers are able to reach all of their customer locations, regardless of geography and proximity to their facilities. In addition, the familiarity and turnkey nature of T1 /E1 circuits means services can be turned up quickly, whether access is on-net or off-net, allowing the service provider to recognize revenue sooner and to decouple sales efforts from the infrastructure build-outs associated with many alternative technologies.

(A) Speeds (B) Technologies (C) Deployment Scenarios

(A) DS1/E1 – 1.5/2Mbps to 16 Mbps with bonding

DS3/E3 – 34/45 Mbps to 130 Mbps with bonding

(B) T1/E1, bonded T1/E1, DS3/E3, and bonded DS3/E3

(C) Remote branch offices – Off-net customer locations (out of region, SMB

Advantages

Leverage existing transport - Universally deployable - Lower CAPEX - No reach limitations - Well understood provisioning - Resiliency through bonding

Packet Radio Access

(A) Speeds (B) Technologies (C) Deployment Scenarios

(A) Microwave: 1 Mbps to >1Gbps WIMax: <70Mbps at 50km (31 mile)

(B) Terrestrial microwave - WiMAX - Broadband wireless - Free space optics - WiFi

(C) Remote branch office - Campus setting - No fiber or copper available - Mobility required

Advantages

Installation requires no trenching - Rapid deployment - Some alternatives offer mobility

PON Access

Benefits

PON's immediate benefit is the increase in the bandwidth delivered to the residential and SME /SMB subscriber compared to legacy twisted pair technologies. Other benefits of PON include:

1. Delivery of new bandwidth-intensive applicaiton
2. Significant reductions in fiber infrastructure
3. Large reductions in electrical cost
4. Reduced maintenance requirements

(A) Speeds (B) Technologies (C) Deployment Scenarios

(A) 1 Gbps with EPON 1.25 Gbps upstream & 2.5 Gbps downstream with GPON

(B) EPON / GPON

(C) Work at home - SOHO/SMB - Remote branch office

Hybrid Fiber/Coax Access

Benefits

HFC permits the addition of high-speed data transfer to an existing Cable TV (CATV) system. It is employed by many cable television operators to provide Internet access and Business Services over their existing (HFC) infrastructure.

With its large coverage and available performance, HFC/DOCSIS technology is a valuable asset for Cable TV/MSO providers to deliver Ethernet-based services to the SOHO/SMB and high-speed Internet access to residential customers.

(A) Speeds (B) Technologies (C) Deployment Scenarios

(A) Up to 100 Mbps with DOCSIS 3.0

(B) DOCSIS 2.x/3.x

(C) Work at home - SOHO/SMB - Remote branch office

Advantages

Extensive coverage - High performance options - Deep penetration into residential and suburban geographies

Example(s)

Example 1

When planning Carrier Ethernet service for a small office/home office (SoHo) that is located in a new neighborhood, it is likely that there is fiber to the premise already available. Since this is a residential area, it is also quite possible that HFC is in place. However, HFC has limited upload bandwidth, which can be sufficient if the SoHo only requires access to Internet services. A higher symmetrical bandwidth service would be offered via direct active fiber.

Example 2

A SoHo requires access to Internet services. This SoHo is located in an urban location. It is likely that there is no fiber to the premise and digging fiber is not feasible from a cost and time perspective. More probable options include Ethernet over bonded copper, or wireless Internet access services through WiMAX or LTE technologies.

Example 3

A remote farm requires services for enabling video delivery and weather information. Since the requirement is for high bandwidth of 20 Mbps, the solution would be packet microwave which is ideal for remote locations. Such rates would exclude 3G/CDMA access, leaving WiMax or Point-to-Point microwave as possible alternatives.

Case Study – Ubiquitous Ethernet Services in Action

EnvoEnvo is an environmental science company located in North America. They specialize in data collection and analysis. Their instruments measure hydrology, chemistry, strain, pressure, chromatography, vibration, temperature, particulates, aerosols, and other critical variables of interest to business, industry and government. Monitoring services are provided for clients large and small throughout the southeast US in both urban and rural areas. Data throughput requirements range from a few hundred kbps to 500Mbps depending on the application. They also have truck-based mobile facilities used for temporary installations.

A ubiquitous, flexible, secure and diverse network is required to support all of EnvoEnvo's customers. EnvoEnvo's IT Director, working with the local cable operator in northern Florida created a network that meets his challenging requirements. Because most of the EnvoEnvo equipment has Ethernet ports, over time he has created a large Ethernet WAN to collect data from remote locations.

The local cable company manages the primary network. It was able to reach many of the customer monitoring locations with an EPON network that supports business and residential subscribers in the region. In some cases the MSO contracts with the local ILEC or CLEC to reach locations using bonded T1s and SONET and in some cases mid-band Ethernet over bonded copper pairs. To meet the needs of extremely remote off-net locations, the IT Director created a wireless system for the mobile facilities that can be connected to most service provider's facilities. The core regional network aggregates these signals for transmission over the MSO fiber on dedicated CWDM wavelengths.

Sample Access Connections into EnvoEnvo's E-LAN Service

B/W	Access Media	AccessTechnology	ServiceProvider	Application
500kbps	Wireless	Wifi	CLEC	Hydrological pressure measurement
100Mbps	Fiber	Ethernet	MSO	Remote imaging & chemical analysis
4Mbps	Copper - Twisted Pair	EFMCu	ILEC	Water, air, wind, temperature
50Mbps	Fiber	Ethernet	MSO	Motion and air quality measurement
10Mbps	Fiber	Ethernet	MSO	Motion and air quality measurement
500kbps	Wireless	Broadband Wireless	Wireless Operator	Hydrological pressure measurement
10Mbps	Copper – T1	Ethernet over Bonded T1	ILEC	Air quality measurement
150Mbps	Fiber	Ethernet over SONET	CLEC	Remote imaging & chemical analysis
2Mbps	Copper - Coaxial	HFC/DOCSIS	MSO	Chemical analysis
500Mbps	Fiber	Direct Fiber Ethernet	MSO	Remote imaging & chemical analysis
6Mbps	Wireless	Microwave	MSO	Solar, humidity, wind and other
3Mbps	Copper - Coaxial	HFC/DOCSIS	MSO	Chemical analysis

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