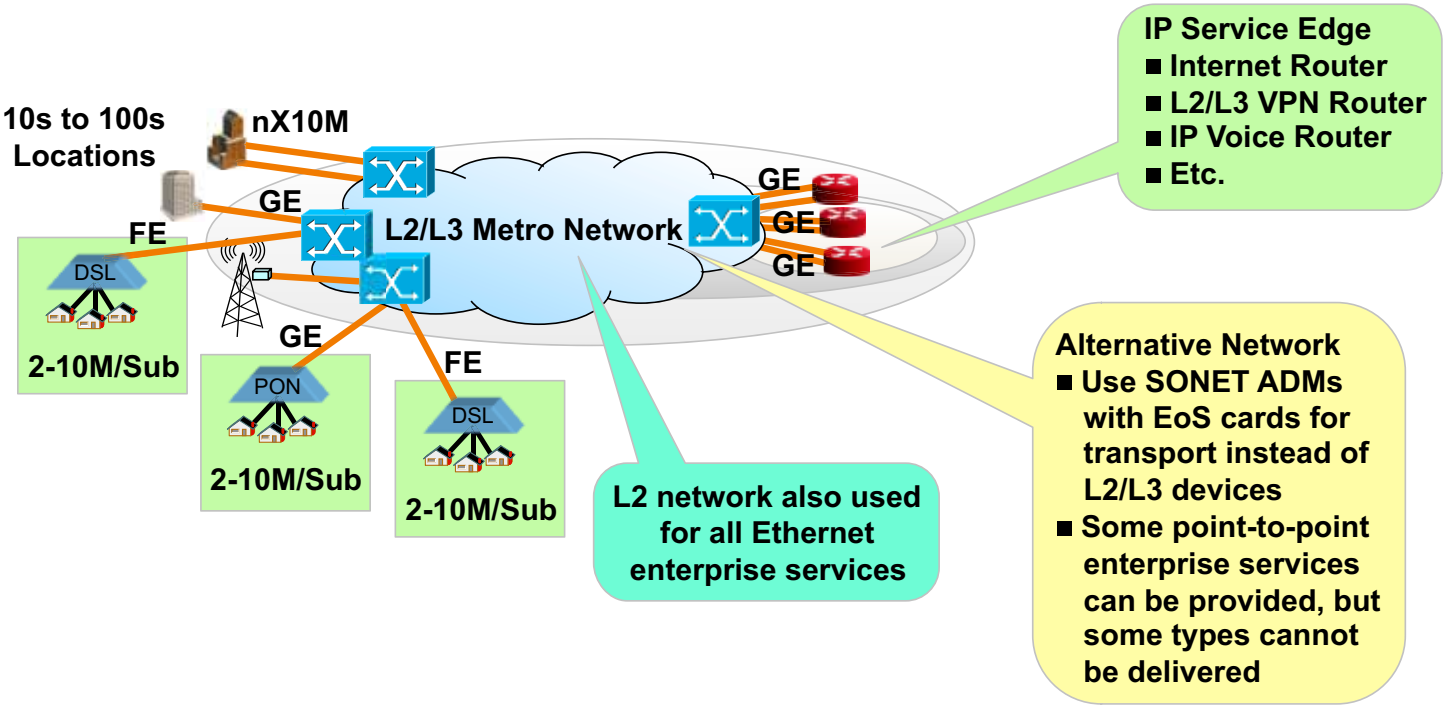
Deploying Reliable Rural Broadband

Reliability is one of the major challenges facing operators seeking to deploy broadband access to underserved and unserved areas. A broadband access network connects individual subscribers to a service provider for voice, Internet access and, often, video service. Carrier Ethernet, built over a SONET infrastructure or deployed using native Ethernet technology, is the common backbone architecture for residential broadband backhaul networks.



Reference Architecture for Broadband Access

In these networks, small Layer 2 devices (such as Ethernet switches), or Layer 3 devices (such as IP routers), are placed in the backbone for Ethernet distribution. These backbones commonly have several service attributes.

- **Oversubscribed:** Many of these networks may be oversubscribed 40-fold or more. This reflects the philosophy that not all of the subscribers will be using their full edge bandwidth at any given time. While generally true, increased use of Internet-based video and other high-bandwidth applications are putting such assumptions to the test.
- **Low first cost model:** The business case for many Tier 2/3 providers assumes that the initial deployment cost will be kept low and the bulk of their revenue will come from monthly recurring charges (MRC).
- **Some areas not served:** This type of network architectures is seldom extended to remote rural locations. Such locations are typically served by wireless providers or by lower-speed linear technologies
- **Bundled service:** These services are often bundled with a separate satellite or cable TV package that does not traverse the residential broadband backhaul network.

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Internet Access Examples

Example	Service Bandwidth	Typical Oversubscription Rate	Comments
Basic Residential Internet Access	CIR = 500 kbps EIR = 1 Mbps	10:1 to 50:1	Traffic expected to be low priority and very bursty in nature Not designed for VoIP or sustained video/music downloads
Gold Residential Internet Access	CIR = 1 Mbps EIR = 10 Mbps	4:1 to 10:1	Traffic is not bursty, assigned highest priority for low latency Handles VoIP and sustained downloads well
Platinum Business Internet Access	CIR = 10 Mbps EIR = 20 Mbps	4:1 to 10:1	Traffic is not bursty, assigned highest priority for low latency Handles VoIP and sustained downloads well Usually offers some EVPL or ELAN service

(CIR = Committed Information Rate, EIR = Excess or burst Information Rate)

Let's take a simple example based on the services in the table above. In this example, the service provider is building a residential broadband backhaul network to support 5,000 Basic residential customers, 500 Gold customers and 100 Platinum business customers.

The Basic customers represent 5,000 x 0.5 = 2,500 Mbps (2.5 Gbps) of Committed Information Rate (CIR) at the access edge. However, the intent is to oversubscribe the backhaul network 40:1 for these customers, so the core needs 62.5 Mbps of bandwidth to support this oversubscription level.

The Gold customers represent 500 x 1 = 500 Mbps of CIR at the access edge. This traffic is oversubscribed 8:1, so the core needs an additional 62.5 Mbps of bandwidth for this customer set. Prioritizing Gold-subscriber traffic above that of the Basic customers will ensure that the high oversubscription level of the Basic customers does not negatively affect the Gold subscribers.

Finally, the Platinum customers represent 100 x 10 = 1,000 Mbps (1 Gbps) of CIR at the access edge. This traffic is oversubscribed 4:1, so the core needs an additional 250 Mbps of bandwidth for this customer set. Again, prioritizing Platinum-subscriber traffic above that of the Basic and Gold customers Platinum subscribers.

In our example, the backhaul network needs a minimum of 400 Mbps of capacity to support this customer set. That means it will probably be deployed using Gigabit Ethernet (GigE) technology using native Ethernet with the Rapid Spanning Tree Protocol (RSTP) or Multiple Spanning Tree Protocol (MSTP), a Resilient Packet Ring (RPR), or G.8031.

It is important to note that this 400 Mbps bandwidth requirement is a design minimum for this configuration. Depending on the degree of internal protection required in the design, and issues like the use of multicast within the core, the actual requirement could easily be twice this amount or more.

Conclusion

Broadband Internet access is the big focus item for RUS-funded service providers and drives subscriber service tiers:

- Subscriber service tiers are often defined by bandwidth, oversubscription and degree of "burstiness."
- Backhaul requirements can still be substantial depending on the tiers and market penetration.

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