



Next Gen NETWORKS

Service Delivery Architecture for OSP Networks



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Carriers are faced with several critical decisions regarding upgrading their networks from traditional circuit-switched services to supporting the increasing array of broadband services customers are demanding today. The ability to deliver a combination of voice, video, and data services will require many modifications to existing infrastructures, challenging every service provider to seek ways to make this migration to broadband as painless as possible in terms of cost, time, and ensuring a future-proof network.

There are both challenges and trade-offs in upgrading existing voice networks to support broadband services. Most importantly, each carrier must decide how far to drive fiber into the network and what, if any, portion of the existing copper plant can still be used. ADC offers solutions that will allow for any business model, whether taking fiber to a node (FTTN) or directly to the customer premises (FTTP).

Depending on the carrier's business model, it may not make the best sense to take fiber all the way to the customer, particularly in brownfield build-outs. This makes FTTN an attractive solution for getting broadband services to customers quickly and cost effectively, while still providing a smooth migration path to FTTP when it becomes necessary.

This paper will provide an overview of considerations and decisions involved in upgrading legacy voice networks to broadband services. It will discuss the current attributes and limitations of today's copper technologies and how they will affect broadband service delivery. It will also provide an overview of the resectionalization process necessary to create smaller serving areas that support the higher bandwidth broadband services require.

Broadband upgrade considerations

While the vast majority of greenfield broadband deployments can take fiber directly to the customer premises at costs that are comparable to copper, this may not be the optimal approach in all business models. The cost of trenching or boring fiber routes, as well as digging up the property of existing customers, makes the ability to use existing copper plants with new copper technologies a more attractive solution.

With that in mind, carriers need to understand the range limitations of broadband copper technologies, such as ADSL2+ and VDSL2. Although the reach could be

as low as 2500 feet or as high as 5000 feet, most carriers today are designing to 3000 feet to prevent the need of continual changes to the infrastructure. Of course, each deployment is unique and must be considered in terms of geography, outside plant design, and up-front costs.

With the ever-increasing demand for more bandwidth, specifically with emerging new video services, carriers must realize that the deployment of more fiber will be necessary in the future. Thus, the ability to smoothly migrate from FTTN to FTTP must be considered as the new broadband network deployment takes shape.

Resectionalizing the network for broadband

Due to the range limitations of deploying broadband services over existing copper infrastructure, the existing voice distribution areas (DAs) will require resectionalization. Large distribution areas that delivered voice services to customers tens of thousands of feet from a central office (CO) will now have to be designed with many smaller sub-areas that have a range limit of 3000 feet.

Resectionalization of any distribution area also creates additional considerations, such as the cost of service delivery and truck rolls that may depend on the size and quantity of the newly-resectionalized areas.

As the network is resectionalized, considerations for the type of service delivery method can be extremely important decisions. For example, how many different delivery scenarios will be required throughout the network, and does the solution have a consistent pattern across the network for service technicians performing the work? From the CO to the crossbox or remote terminal, the same deployment strategy makes it easier for technicians to work in any section of the network, thus reducing personnel and training costs.

A typical CO distribution area is shown in Figure 1. It's not uncommon for the legacy switched networks to serve areas beyond 18,000 feet. However, deploying copper-based broadband services limits the range to about 3000 feet. Customers residing more than 3000 feet from the CO may not receive enough bandwidth for the services requested. This figure shows how to resectionalize a large DA into smaller serving areas to deliver broadband services.

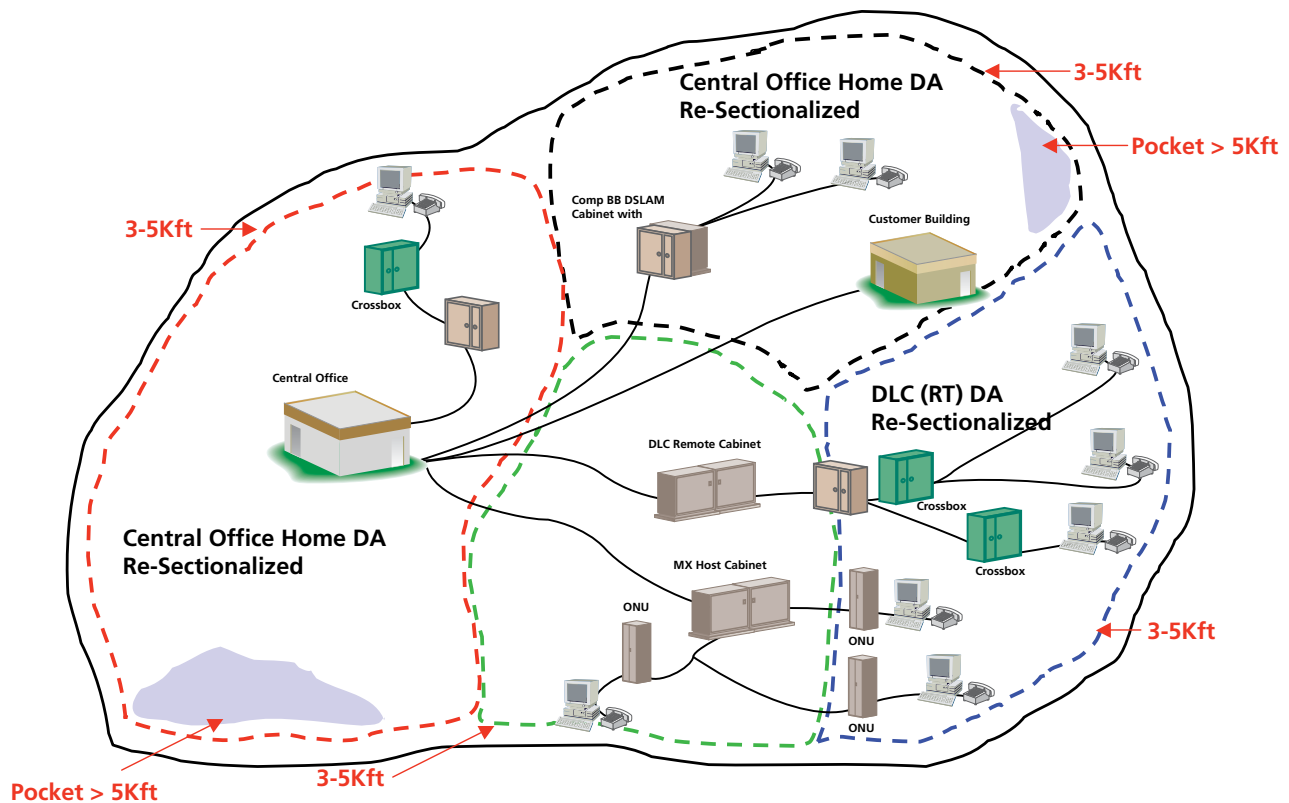


Figure 1: Resectionalizing the Distribution Area

Depending on the size and density of the distribution area, the resectionalization approach and quantity of smaller serving areas may vary. The number of remote terminal (RT) cabinets; the number of cross boxes; and the existence of mini huts, controlled environment vaults (CEVs), or multiple dwelling units (MDUs) within the original DA will help determine the correct strategy. Other considerations are also important – What is the density of subscribers within the DA? Can one focus on a certain area where most of the potential broadband customers reside? How much fiber cable already exists in existing DA?

For simplicity, we will look at an existing DA that originally was fed beyond 12,000 feet from a CO over copper infrastructure. We will focus on three primary areas that would encompass most typical resectionalization processes.

The first area is the CO sub-distribution area. The new CO home DA serves existing customers on copper within 3000 feet of the CO. The second area is called the remote terminal (RT) digital loop carrier (DLC) sub-distribution area. This area would use DLCs to support customers beyond the CO reach, but within 3000 feet of the RT.

Finally, the low density areas, or “what’s left” after resectionalizing the DA. In most cases, there will be distribution cable remaining that has customers being served, even as cables taper as you move deeper into the distribution area. This scenario could exist where a neighborhood was expanded on either side of its original planned area. Typically, new equipment must be added to reach these customers since the only existing infrastructure is the cable itself

Each of these typical resectionalization processes has its own attributes and challenges for the carrier.

CO Home DA

With a CO Home DA, all customers are fed by copper directly from the CO. The DSLAM is located within the CO and services are activated through a main distribution frame (MDF) jumper – removing and rerouting jumpers as required. Although this would seem to be fairly straightforward with plenty of space and bandwidth from the CO, there are some challenges involved within this DA.

The DSLAM in the CO may require upgrading to support the new broadband technology, typically ADSL2+ or VDSL to VDSL2. Even though DSLAMs are typically less than 10 years old, the new ADSL2+ and VDSL2 technologies used for the triple play are not always spectrally compatible with original DSL flavors.

DLC (RT) DA

The next resectionalization area we will look at is the DLC (RT) DA. In the 1980s, carriers deployed DLCs as a means of multiplexing T1s to enable 24 plain old telephone service (POTS) lines from just four copper wires. The copper was taken from the CO to a DLC where it was multiplexed at a 12:1 ratio. Copper was also replaced with fiber to achieve very large numbers of POTS channels out to the customer base. This was a very lucrative means of stretching the network to reach more customers, sometime as far as 15,000 feet from the DLC remote terminal, thus increasing revenues for telephone service providers.

However, this poses a problem with upgrading to broadband network capabilities that can only reach 3000 feet over the same copper infrastructure. Many of these embedded DLC and remote terminal distribution areas must now be resectionalized into smaller 3000-foot sections. Current network configurations cannot be used without stranding a large percentage of customers. Carriers are left with the choice of either handing stranded customers over to competitors or finding a way to re-engineer the network to service every customer.

Thus, the DA must be resectionalized to meet the 3000-foot loop length requirement for broadband services. Again, existing DSLAMs may also require upgrading to co-exist with new broadband copper technologies, such as ADSL2+ and VDSL2. The existing DSLAM service delivery method, typically direct terminated into the cross box, may not have enough binding posts to terminate the new DSLAM. This creates a significant problem where space may be limited in existing cabinets.

Pair bonding is another challenge; the method of electronically connecting two copper outputs from the DSLAM to essentially double available bandwidth requires two individual pairs. For example, with a 12 Mbits/sec circuit out of the DSLAM, pair bonding would produce a capability of 24 Mbits/sec. However, even though pair bonding may be supported by the terminal and/or crossbox, there are other places within the network where cables taper down to the point where access to additional copper pairs is non-existent. Also, pair bonding is usually a trade-off. For example, bonding every customer from a particular DSLAM that supports 192 circuits, for instance, would only leave capability to actually support 96 customers.

Many of the remote terminals lack the space to support a DSLAM without adding another cabinet. Therefore, if there is no room in the existing remote terminal cabinet, a new broadband cabinet must be deployed, resulting in multiple cabinets at some locations.

Another consideration is the thermal temperatures within the remote terminal cabinet – adding any extra heat-generating devices could create problems, even if the space is available. In essence, the real challenge is to get the DSLAMs deeper into the network without creating cabinet “farms.”

Low density areas

Once the distribution area is resectionalized several times, there will likely be several low density areas remaining. These are pockets of customer that are typically far from the CO or RT cabinet. Since carriers do not wish to turn these customers over to competitors or deny service, they must consider how to economically provide the same broadband services offered to other customers.

The same model for the DLC will probably not make economic sense. Rather, new and possibly smaller remote terminals and DSLAMs may have to be installed to reach these outlying customers. This may even require deploying new fiber from the CO in areas where fiber is not available.

Pair counts may not be available for bonded DSL strategies – a typical problem in low density areas. There simply is not enough copper distribution plant to achieve pair bonding. In this scenario, it's very common to have only a 25-pair cable serving at capacity. That leaves no room for pair bonding and could even require additional copper facilities. An economic solution may be necessary for deploying new power and fiber requirements. By placing these smaller and, in some cases, hardened DSLAMs very deep into the network, optimum bandwidth can likely be achieved without the need for pair bonding. This helps the cable taper issue.

The solutions

ADC has developed service delivery solutions that address the challenges associated with upgrading and building out traditional circuit-switch networks to support today's broadband requirements. These solutions focus on consistent, reliable, high-performance service delivery approaches that achieve the same "look and feel" in all areas of the network. ADC solutions meet the needs of service providers to achieve faster time to market, future-proofing, streamlined service delivery, lower up-front and operational costs, simpler training for field forces, scalable in size and an easy migration path to FTTP.

While service providers decide on the most cost effective, reliable method delivering today's voice, video and data services to customers, they must investigate the pros and cons of both FTTP and FTTN solutions to determine how far to push the fiber. Cost parity between copper and fiber has made FTTP the choice for Greenfield scenarios.

However, overbuilding existing networks with pure fiber may be cost-prohibitive for many providers, making FTTN an attractive alternative – particularly if it provides a smooth migration to FTTP in the future. Whatever the choice, ADC offers service delivery solutions that support a consistent approach and provide carriers with an efficient, cost effective, and future-proofed broadband network.

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