



CTDI Products: End-to-End Solutions



RF over Glass (RFoG)  
**Executive Brochure**



**Network evolution has positioned cable operators as leading providers of video, voice, and data services. They have leveraged their broadcast video excellence to dominate the residential triple-play market. Competitors are moving quickly to protect their customer base, though, with low-cost fiber networks that deliver gigabits of bandwidth to both residential and business subscribers. To continue their market leading residential position and expand into the lucrative business services market, MSOs must continue evolving their network. CTDI is ready to help.**

## Competition

Just as MSOs have gone after telcos' base of residential voice and data business, the telcos are attacking MSOs' core — residential video services. Using both RF and IP technology, competitors are able to deliver comparable voice, data, and video services over a fiber infrastructure. Their subscribers enjoy the benefits of fiber, and the telcos are reaping the rewards of a high capacity, low-maintenance, and low-cost fiber access network. MSOs are looking for new solutions that capture subscribers with fiber and expand capacity, while lowering network costs.

## Serving Residential Subscribers

Today's HFC networks were built for residential video services. They perform admirably and at low costs compared to copper-based alternatives. However, the explosion in high-definition channels and multiple video streams is taxing the downstream capabilities of even 870MHz systems. Upstream capacity is being strained as well, with increasing demands for higher speed Internet access for gaming, video sharing on websites such as youtube.com, on-line data storage, and an ever-expanding set of other

applications. MSOs are looking for cost-effective ways to add capacity for residential services.

## Attracting Business Subscribers

DOCSIS 3.0 promises to deliver the needs of a small or medium business (SMB), but adding these subscribers to the customer base requires more network capacity. Node-splitting, new modulation and compression techniques, and other methods are being explored as solutions. One supplier even suggests overlaying the existing HFC plant with a second set of amplifiers and passive devices, compounding costs and maintenance issues. MSOs are looking for cost-effective ways to provide business customers with SLA-quality business services.

## Providing Wireless Backhaul

The cellular/wireless backhaul market is a \$1.25B annual market in the US. Telcos have dominated this space for years because of their T1 TDM transport capabilities. MSOs geographically pass over 80% of the cellular towers in the US, but without TDM capabilities, are unable to tap into this lucrative market. MSOs are looking for a TDM solution.



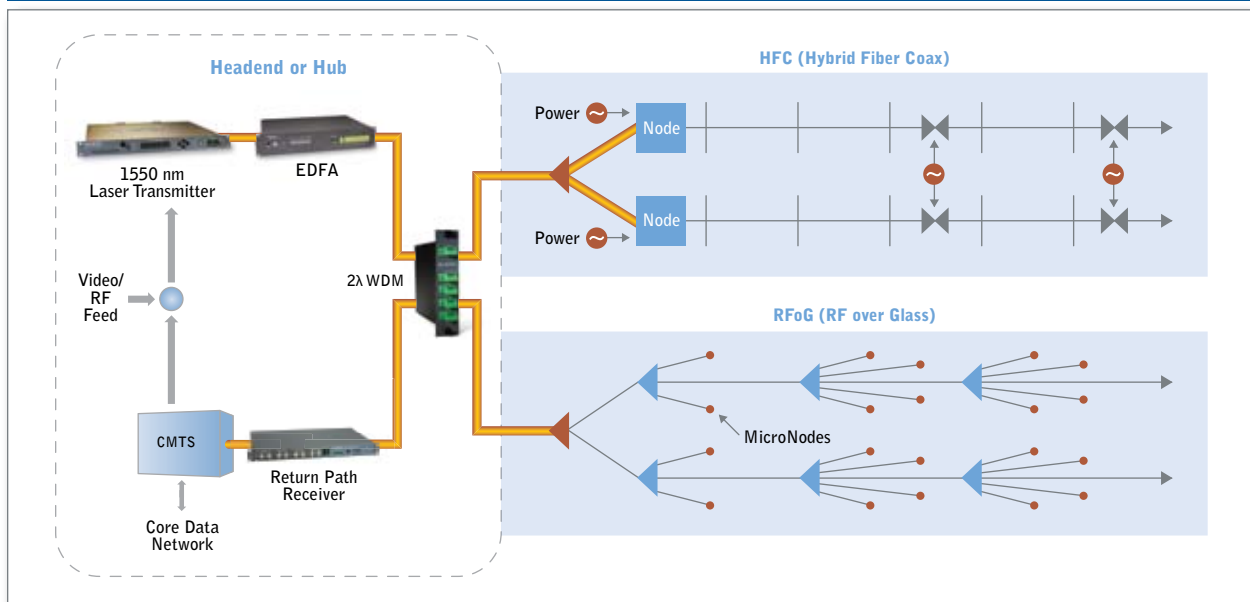
### Offering Business Services

Today's HFC/DOCSIS 2 infrastructure was built to support a few megabits of best-effort service to residential subscribers. While adequate for the many small businesses needing basic data services, even with DOCSIS 3.0 medium and large businesses are not supported with the data speeds and SLA-quality enhanced Ethernet services they require. MSOs are looking for large/corporate business service solutions.

### Maintaining Cost Control

To deliver acceptable ROI, MSOs must be able to leverage their current HFC investment while adding the capacity and capabilities required to expand services, markets, and lower operating costs. They cannot afford to simply rip out the current HFC plant — which is performing admirably — and replace it with an all-fiber network. MSOs are looking for an affordable solution.

### Headend/Hub to HFC and RFoG Comparison



**CTDI solves these challenges for MSOs. The CTDI MicroNode RFoG (RF over Glass) network is the foundation for more capacity, lower costs, higher revenue, and expanding revenue with both residential and business subscribers.**



## MicroNode RFoG

CTDI's MicroNode RFoG system leverages MSOs current access network investment. It is completely compatible with HFC/DOCSIS systems. RFoG and HFC operate side-by-side without interference. The MicroNode RFoG solution uses existing:

- Headend and Hub Equipment: QAM modulators, laser sources, EDFAs, return receivers, CMTS
- Optical Distribution Network Equipment: WDM couplers, splitters, splicing, connector technology, fiber management
- Customer Premise Equipment: Set top boxes, cable modems, E-MTAs, wiring
- Operating and Billing Systems – OSS and BSS

By simply transmitting RF optically over fiber instead of electrically over coaxial cable, the MicroNode RFoG system delivers all the capabilities of current HFC/DOCSIS networks with several added advantages.

## Expanded Capacity

By operating to 1.1GHz instead of 870MHz, MicroNode RFoG adds 28% more downstream bandwidth. This expanded capacity allows, for instance, an additional 180 HD video channels.

Upstream capacity is expanded as well. Because of its inherently outstanding noise performance, the lower 10MHz typically lost to ingress noise can be reclaimed for subscriber use. This 37% spectrum increase can be used to offer faster Internet access services or to avoid expensive CMTS expansion.

## Bottomline Impacts

Beyond the technical advantages, the real value of the MicroNode RFoG solution is the positive impact it has on the bottom line. Delivering both cost savings and revenue enhancement, CTDI's MicroNode RFoG system offers long-term ROI improvements. Here are a few ways that is accomplished.

Benefits begin with the deployment of the MicroNode RFoG system — it simply costs less to install. Copper and aluminum prices are spiraling upward while fiber optic cable declines. Amplifiers, power equipment, and passive devices are not needed, so installation costs for those elements are completely eliminated. One CTDI customer replacing an old, outdated HFC plant calculated a 26% savings to install their MicroNode network compared to HFC.

Other deployment expenses are avoided as well. As mentioned earlier, the MicroNode RFoG system is completely compatible with current HFC/DOCSIS headend, ODN, and customer located equipment. So in applications such as node-splitting or plant rehab, existing equipment can be reused, thereby leveraging the embedded investment and avoiding unnecessary equipment spending.

### Superior CAPEX Returns

There are two less apparent factors that lower CapEx. First, the MicroNode RFoG topology is a distributed single-fiber architecture. That means optimized fiber utilization. Other topologies, such as point-to-point or active Ethernet, use more than twice the amount of fiber.

A second factor is that, by deploying a fiber-to-the-home architecture, an optical network is in place for the next 30 years or more. As the access network migrates to future technologies, the fiber is already in place. New deployment costs such as right-of-way, trenching, tunneling, or pole attachment are eliminated.

### OpEx Savings

Operating expenses (OpEx) are greatly reduced with the use of MicroNode RFoG systems. Documented

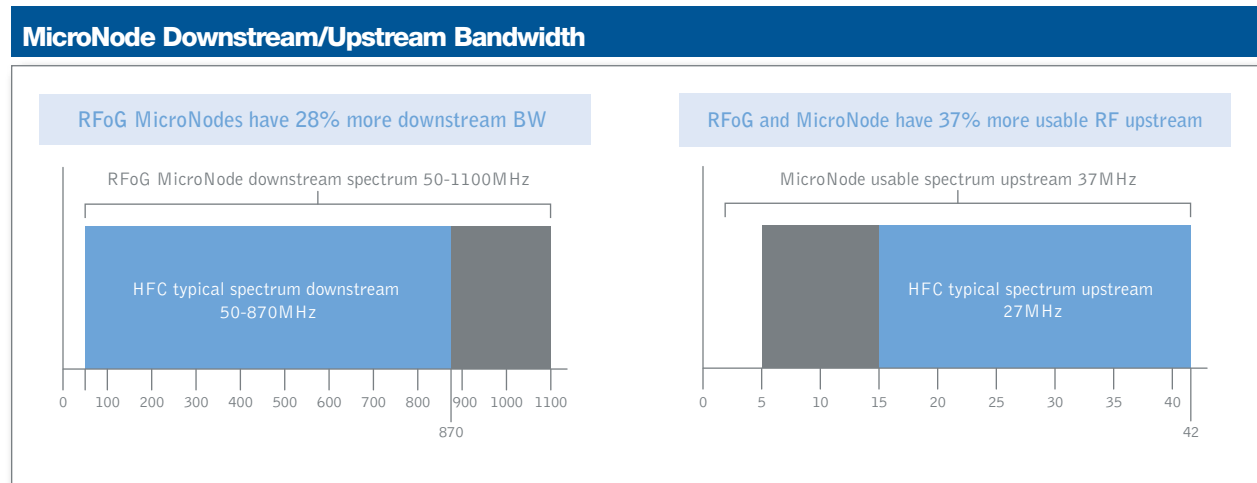
savings of 93% are being enjoyed by CTDI customers using the MicroNode solution.

The savings comes from several sources. First, there are no RF amplifiers, so there are no mandated CLI and sweep regulatory tests. Those expenses are completely eliminated.

### Power Savings

Since the outside plant fiber network is completely passive, power needs change dramatically. Amplifiers no longer exist to be powered. Sourcing power at remote locations and rights-of-way permits are curtailed. Backup power capacity needed for emergency generators and standby batteries is a fraction of HFC requirements. Dispatches to supply power during outages are limited to only key hub sites.

The greatest savings in OpEx are realized over the life of the fiber plant. Optical networks have less maintenance than coax/copper-based networks. Studies have shown fiber requires only 10-20% of the maintenance. 80-90% less plant maintenance over 30 years is clearly appealing. Perhaps more importantly, 80-90% fewer outages translates directly into higher customer satisfaction and retention rates.



**While CapEx and OpEx cost savings are critically important, revenue enhancement is vital. The CTDI MicroNode RFoG solution enables additional revenue for residential, SMB, and large/corporate businesses.**



## **Residential**

As noted earlier, MicroNode RFoG delivers more bandwidth for more services in both upstream and downstream directions. For residential subscribers, this means more video channels are available — 180 additional HD channels and beyond. It also means more upstream bandwidth for Internet access. That added spectrum can be used in several ways — tiered services based on speed, faster access for subscribers, or to avoid expensive expansion of the CMTS system.

## **Small and medium business (SMB)**

The same upstream/downstream expansion that helps residential subscribers enable additional SMB revenue. More bandwidth means that more traffic can be handled with less congestion, improving the ability to ensure that business customers get the availability they require.

## **Wireless and Cellular**

MSOs are increasingly turning to the multi-billion dollar cellular and wireless backhaul markets for new revenue. MSOs geographically serve more than 80% of the cellular tower sites in the US, so this market is well within their grasp when their network supports backhaul services. While 3G and beyond technologies require data transport, today's cellular backhaul network is based on T1/E1 TDM protocols. The MicroNode RFoG solution is completely compatible with DOCSIS methods for data and TDM transport, enabling backhaul revenue.

With high-density applications — for example, where 16 or more TDM circuits or multi-megabit data transport are required — a better solution often is to offload the TDM backhaul traffic from the DOCSIS-based network. The MicroNode RFoG system simplifies that chore with the “Hybrid RF PON” solution discussed below.



## Enterprise

Large business and corporate-level accounts offer equally large revenue opportunities along with more demanding service requirements, but the MicroNode RFoG network makes service delivery easy. These accounts often require services beyond the capabilities of DOCSIS, even DOCSIS 3.0. Data rates to 1Gbps, enhanced Ethernet services, and extensive TDM services are not practical for DOCSIS-based systems. To address these accounts, MSO have been forced to resort to alternatives that require expensive separate parallel networks. But the RFoG fiber infrastructure makes a separate network unnecessary. The single-fiber RFoG architecture can deliver complete large corporate services along with backhaul, SMB and residential services. CTDI terms this network topology "Hybrid RF PON."

With CTDI's Hybrid RF PON system, MSOs can provide large corporate accounts with both rich Ethernet and TDM services such as:

- Private Line Services
- T1 Aggregation
- Ethernet Private Line and Virtual Private Line
- Ethernet VPLS (TLS)
- Hosted VoIP Services
- Managed Services (Hosted IP PBX)
- IP Centrex

## Infrastructure Simplicity

The key to these advanced services is that both MicroNode RFoG and Hybrid RF PON use the same optical network.

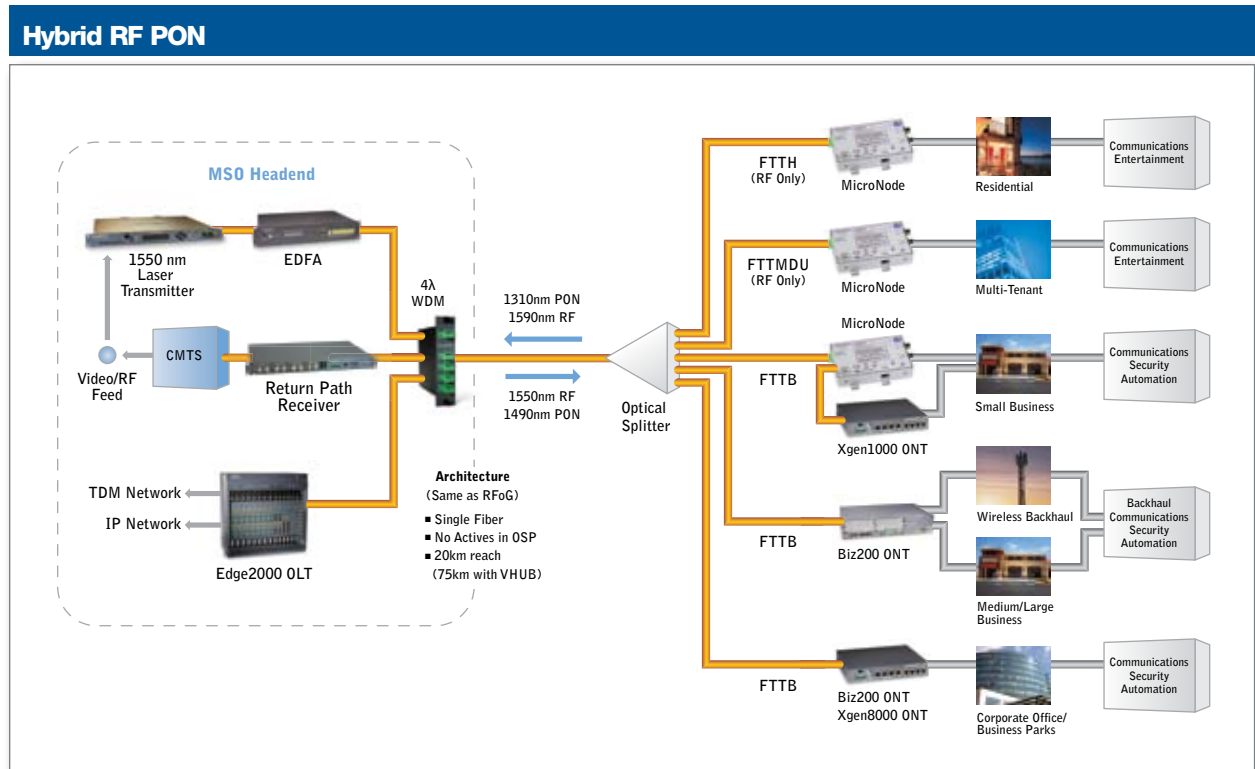
Migration to Hybrid RF PON is simple. The RFoG fiber network is overlaid with an Ethernet-based access platform such as CTDI's GEAPON system. The existing fiber is left intact, avoiding all the expenses of new fiber installation, new right-of-way concerns, and new plant engineering.

## Accelerated Deployment

More importantly, service turn-up is quick. By using the existing RFoG infrastructure, new subscribers can have service in less than one day. Customer

satisfaction is improved, new business is easier to close, and revenue is recognized immediately.

CTDI's MicroNode RFoG and Hybrid RF PON solutions are the next step in network evolution. They lower costs — both CapEx and OpEx — while enabling additional services to residential, SMB, backhaul, and large corporate markets. The elegance of these solutions is their practical application for today and tomorrow. They co-exist with current HFC networks, they leverage the HFC network equipment and practices, they make business services easy, and perhaps more importantly, they create the fiber infrastructure required for years to come.



**CTDI**  
PRODUCTS

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