# Cable Industry Signals Move to FTTH

## Vendors are rushing to roll out RFOG – RF Over Glass – technology; it's essentially DOCSIS without the multi-home DOCSIS node, and might accommodate a decade of bandwidth growth.

By Steven S. Ross ■ *Editor-in-Chief*

The American cable industry stands ready to embrace fiber to the home, but not by using conventional Ethernet protocols. The industry is leaning toward technology that allows delivery of a DOCSIS signal directly from a cable company's backbone network, through a passive splitter to the equivalent of an ONT on the customer's premises. In fact, some vendors already build it in to ONTs. Bypassing the DOCSIS node, which splits available bandwidth among up to 500 premises, allows a substantial increase in bandwidth for customers who need it. Nothing else changes at the headend or in the customer's home – the same cable modem and set-top boxes work with it. Only the transmission wavelengths are different.

The technology is not yet standardized, but it has one catchy name, courtesy of ARRIS – RF Over Glass, or RFOG. Motorola has been pushing CablePON. Cisco's Service Provider Video Technology Group, formerly Scientific Atlanta, has been calling it DOCSIS PON, or D-PON for short. The Society of Cable Telecommunications Engineers calls it Advanced Fiber Access and has started work on standards for it.

We've been reporting on it in passing for about a year as franchise cable operators have experimented with it, mainly in greenfield single-family developments and with a few business customers. The MSOs, generally short of cash, have been nervous about the technology and about spooking investors over the cost of matching Verizon's FiOS buildout and the buildouts of more than 600 smaller entities including ILECs, CLECs and municipalities. But at all the major industry meetings this spring – our own Broadband Summit, NAB, NXTcomm and SCTE – cable executives and technical personnel finally say they recognize the threat posed by fiber to the home, especially in the hands of a giant player like Verizon.

*RFOG has a place in greenfield builds and in MDUs that want a single distribution system. It will also be used to serve commercial customers, to provide cellular backhaul and to replace aging HFC plant -- especially in low-density neighborhoods.*

Those customers targeted for RFOG are still limited in number:

- Greenfield builds, where a DOCSIS-based hybrid fiber coax (HFC) system would cost about the same to construct as RFOG – and in some cases even more – while having higher operating costs and lower reliability. In general, dense neighborhoods are cheaper to wire with HFC. But costs mount as density decreases, because coax loops from the DOCSIS node to the subscriber need amplification every 1,000 feet or so. Also, the cable industry is beginning to get substantial pushback from greenfield developers demanding FTTH.
- MDUs where property owners want one broadband distribution system, not a mix of fiber and bulkier coax.
- Commercial customers, who want more bandwidth (especially upstream) than DOCSIS delivers through a shared node, or the physical security and reliability of fiber.
- Cellular backhaul, allowing the MSOs to compete more easily in lucrative mobile markets.
- Brownfield situations where the existing HFC plant has to be replaced anyway, especially in low-density neighborhoods.

But in most situations, vendors expect that full PON would be about 50 percent more expensive than HFC. Ethernet-based GPON or EPON would probably be less expensive than RFOG for the physical build, because component costs have been driven down over

time. But cable companies would then have to run the GPON or EPON in parallel with HFC, raising operating costs.

## LOOKING DOWN THE ROAD

The bandwidth potential of RFOG is substantial, but depends on how the RF is modulated. The signal to be delivered over RFOG would generally be at 1 GHz. Using the current norm for non-satellite DTV, 8-VSB (8-bit vestigal sideband), a 6-MHz TV channel can handle about 19.3 Mbps. Using the full 1 GHz stream for data provides over 3 Gbps. Presumably, a cable company would simply use its current modulation technology over RFOG, to maintain compatibility with what it sends through a DOCSIS node – and would upgrade an entire section of its network with better modulation schemes as needed. But it could also use a specific modulation scheme for the lasers feeding fiber routes meant specifically for RFOG.

RFOG also uses bandwidth more efficiently than existing cable technologies because the reduction in outside-plant electronics and coax loops cuts noise. So the bandwidth reserved for entering and exiting a signal could be used to carry data, especially upstream data.

At present, of course, DOCSIS bandwidth is shared by as many as 500 households on a single DOCSIS node, and few networks are running at frequencies as high as 1 GHz. But moving to RFOG as needed, and upgrading network electronics, obviously costs less up front than rebuilding entire networks from scratch. The downside is that both the ITU flavor of telco-style Ethernet-based PON (GPON) and the IEEE flavor (EPON/GePON) aren't standing still – and their upgrade paths look cheaper and more reliable.

Many cable providers are already using more advanced modulation to boost bandwidth. For instance, 64-QAM (quadrature amplitude modulation), particularly common in new MDU networks fed by satellite headends, allows 27 Mbps in a 6 MHz bandwidth slice (4.5 Gbps for 1 GHz, although most MDU installations run at lower frequencies; 870 MHz is being phased in). The latest 256-QAM, in limited use now, provides 38.8 Mbps per channel or about 6.5 Gbps total. There are other modulation schemes as well.

Cox started moving to 1 GHz on its network last year and should have most of its network converted by now, but has kept details of its plans secret – and as a privately held company, it can do so. It has said it is using 3 GHz for some business customers. That technology comes from Vyyo, which says several MSOs are doing the same thing. But using 3 GHz for some customers while keeping the rest of the network at 1 GHz or at the older 700 MHz and 870 MHz standards requires dedicated equipment at the headend and dedicated fiber in the field. Some MSOs just string GPON or EPON to those customers instead. (See this month's deployment roundup for news of cable companies deploying GPON to commercial customers.)

GPON downstream bandwidth, by comparison, is 2.4 Gbps, and 9.6 Gbps is being tested. RFOG advocates envision a 1:32 split for residential customers, just like Ethernet-based GPON and GePON, so current downstream bandwidth delivered to customers is in the same ballpark now. But Verizon has made no secret of its upgrade plans for FiOS – eventually getting to 40 Gbps downstream, 10 Gbps upstream to the splitter on a single GPON wavelength, or more than 1 Gbps to the typical customer. Adding wave-division multiplexing would increase the potential greatly – certainly as much as 256-fold. RFOG uses two wavelengths down to the customer and one back.

RFOG still lags in bandwidth symmetry. DOCSIS supports 27 MHz upstream and RFOG gets an extra 10 MHz because it can use the band that now buffers noise between upstream and downstream. That means about 120 Mbps shared – and twice that with advanced modulation. Upstream bandwidth for EPON is the same as downstream, and for GPON it is half as much – 1.2 Gbps today, typically shared by 32 customers. So total upstream bandwidth would still lag GPON or EPON in a typical private-dwelling allocation. But commercial customers' configurations could be tweaked to get more upstream bandwidth where (and when) needed.

RFOG may also lag in operating costs. Alloptic documented a 68 percent reduction, compared to HFC. That's good, but still about twice the operating cost of GPON. Savings come in electricity and need for calibration sweeps (no amplifiers needed on the coax loops) and in reliability (fewer components overall). Alloptic also predicts, logically, that there will be fewer outages over time, leading to higher customer satisfaction.

## VENDORS MARKETING CABLE-ORIENTED PON PRODUCTS

| | |
|---|---|
| Alcatel-Lucent | www.alcatel-lucent.com |
| Alloptic | www.alloptic.com |
| Arris | www.arrisi.com |
| Aurora Networks | www.aurora.com |
| Calix | www.calix.com |
| Cisco Systems | www.cisco.com |
| CommScope | www.commscope.com |
| Corning Cable Systems | www.corningcablesystems.com |
| Enablence | www.enablence.com |
| Harmonic | www.harmonicinc.com |
| Hitachi Telecom | www.hitel.com |
| Motorola | www.motorola.com |
| Tellabs | www.tellabs.com |
| TXP | www.txpcorporation.com |

*Alloptic was the first PON vendor to make a major commitment to RFOG; it has now been joined by most of the other companies serving the US PON market. However, Wall Street analysts haven't rewarded them for their foresight.*

## KEY PLAYERS

RFOG is particularly important for vendors that concentrated on EPON, and that either didn't make the move to GPON or didn't want to compete at the low price points dictated by Verizon in purchases for its FiOS build. Alloptic was one such vendor. Last year it came up with a single-node circuit for the customer premises that could handle the same signals that cable companies usually send to a DOCSIS node. Other vendors that announced cable-oriented PON last year included ARRIS, Aurora Networks, CommScope, Motorola, and Wave7 Optics. Calix announced in January 2008. Now, the major players with RFOG components announced or shipping include Alcatel-Lucent, Cisco (through its Service Provider Video Technology Group), Enablence (which absorbed Wave7), Hitachi Telecom, Tellabs and TXP.

Among the major MSOs, Time Warner Cable seems to be most interested in RFOG. Smaller MSOs such as Armstrong Cable, BendBroadband, Bresnan Communications LLC and CableOne all have announced trials, mainly with CommScope. The CommScope BrightPath system uses its outside plant equipment with Aurora Networks' optical nodes and headend equipment. BrightPath can also be integrated with Harmonic's forward path transmitters and return path receivers.

Many others at this point are actually using the Alloptic circuitry. Alloptic did not announce the next step – new receivers and transmitters for the return path, for seamless uploading – until May. Wall Street analysts, not seeing much immediate market share gain, certainly did not bid up Alloptic stock. And that's despite the fact that Alloptic is close to releasing its Ethernet-standard 10 GigE equipment as well. But, then again, Wall Street, impressed by Verizon's performance, has only recently begun warming to fiber in any form.

Likewise, Wall Street has not been friendly to Motorola, which announced field trials this spring and expects that the technology will eventually lead MSOs to GPON. Motorola is playing to both its GPON and its cable modem strength, but has also announced development of back-office management software that would allow MSOs to bridge the gap to GPON more easily.

Calix has another twist. Its 725 ONT, which shipped in January, supports RFOG along with all of the current cable RF return path standards, including DOCSIS HFC and set-top boxes and cable modems, and SCTE 55-1 and 55-2.

Corning Cable Systems has a new OptiSnap connector, billed as a "field-installable, no-epoxy, no-polish" connector that enables quick and cost-effective termination of fiber-optic cables in CATV deployments.

The bottom line: No matter what the technology and what they are calling it, the cable industry now sees FTTH as inevitable. It's about time. **BBP**



**About the Author**
*Contact Steve at Steve@broadbandproperties.com.*