

Virtual Segmentation™: Go fiber deep without fiber

White paper

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Abstract: Do you think it is possible to deploy Remote PHY (R-PHY) without fiber?

The innovative Virtual Segmentation™ solution by Technetix allows MSOs to create a virtual 10 GE pipe over the existing coax network. This high bandwidth connection can be used to deploy R-PHY without deploying fiber; providing MSOs with great savings in fiber deployment time and capex. Virtual Segmentation enables this high bandwidth by overlaying additional data on the high frequency bands of the coax medium and carrying it from the headend all the way down to the R-PHY location with two 10 GE SFP+ connections on each end.

Introduction and problem statement

The steady evolution of the DOCSIS system and Hybrid Fiber Coax (HFC) plant has enabled the delivery of DOCSIS 3.1 via Converged Cable Access Platform (CCAP). This evolution has provided an increase in density and scale, enabling operators to address the exponential year-on-year increase in demand for bandwidth.

The next step in the evolution of the cable access network is a shift to a Distributed Access Architecture (DAA). DAA enables access hardware to be moved from the headend to smaller hub sites or into the plant. This implementation is realized by separating the CCAP core and PHY functionalities. The PHY is moved as close as possible to the subscribers and only the core functions remain in the headend location. The R-PHY is connected to the core via a digital optical transmission link, which requires the operators to deploy fiber to each R-PHY location.

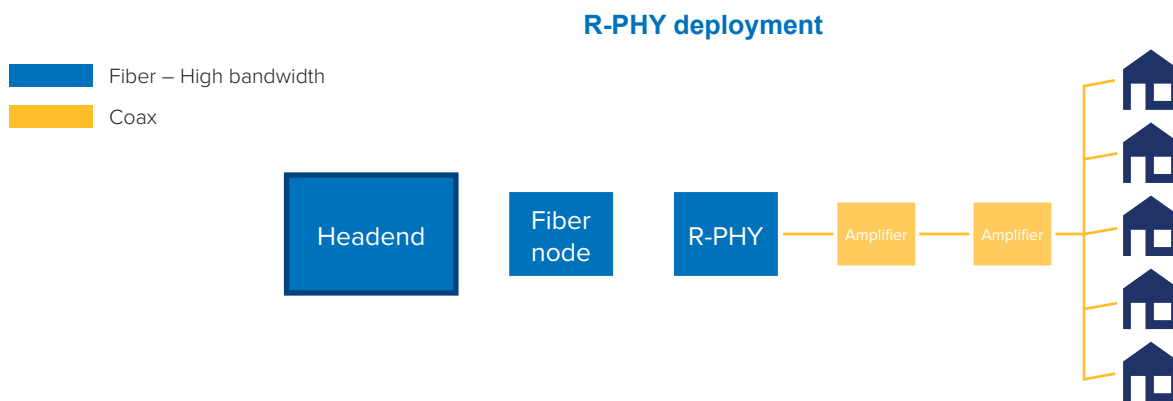


Figure-1: R-PHY deployment

Deploying fiber deep puts pressure on operators in terms of capex and time, particularly when the exponential bandwidth and data volume growth, and the limited time available to deliver are taken into consideration. In addition to the monetary costs, underground fiber deployment takes time; particularly with regard to obtaining construction and local government permits. Even if overhead fiber is used in some scenarios, it may not be practicable for an operator to deploy fiber to a location with a limited number of subscribers.

Solution: Virtual Segmentation

Technetix' Virtual Segmentation (VS) solution allows operators to deploy R-PHY without the need for fiber deployment. VS is an innovative technology which enables additional bandwidth over coax cable by allowing the deployment of R-PHY without deploying fiber. This additional bandwidth depends on the utilization of the RF spectrum and can go up to 10 Gbps symmetrical.

Virtual Segmentation is deployed as an add-on to the existing infrastructure while the existing DOCSIS spectrum is kept intact on the trunk line and VS utilizes the higher frequency up to 3 GHz. In this case, the VS solution provides 1.75 Gbps upstream and 8 Gbps downstream bandwidth. The frequency spectrum allocation where DOCSIS and VS signals coexist can be seen in Figure 2.

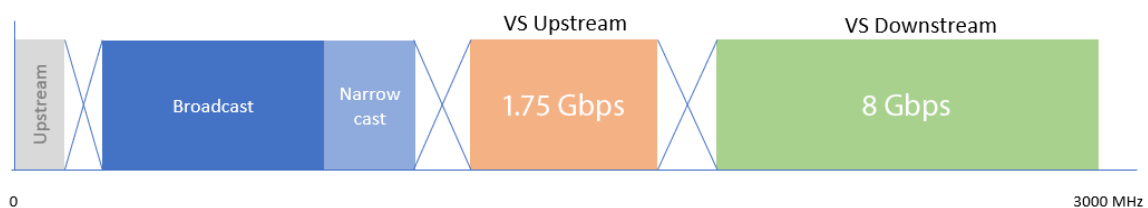


Figure 2: Spectrum allocation for Virtual Segmentation and DOCSIS

In this scenario, the existing DOCSIS signals and the VS overlay data coexist using the same coax cable. This allows the operator to keep the analog TV service intact and deploy a R-PHY at the same time over coax. In order to keep the analog TV service in a fiber based R-PHY deployment, an additional fiber is required to carry the analog TV signal.

If the operator is ready to remove the analog TV service and can reserve the whole trunk line spectrum just for the VS overlay data, then it is possible to get a higher bandwidth over coax.

In this setup, the whole RF spectrum is used for Virtual Segmentation; i.e. removing the DOCSIS RF signals from the trunk lines and generating the DOCSIS RF only from the R-PHYs. In this case the Virtual Segmentation utilizes the frequency range from 5 MHz to 3 GHz and provides a 10 Gbps symmetrical bandwidth over coax. Figure 3 shows the corresponding RF spectrum allocation.

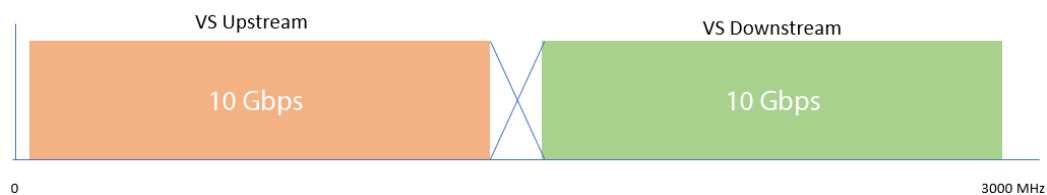


Figure 3: Full spectrum allocation for Virtual Segmentation and DOCSIS

VS is a very low latency and low power solution which provides the operator with a virtual Ethernet pipe over coax. This virtual pipe starts and ends with a 10 GE SFP+ connection that can be used to link the core in the headend with the R-PHY in the field. The high bandwidth (10 Gbps) and low latency (IEEE 1588v2) of VS ensures the smooth operation of the R-PHY.

Virtual Segmentation link

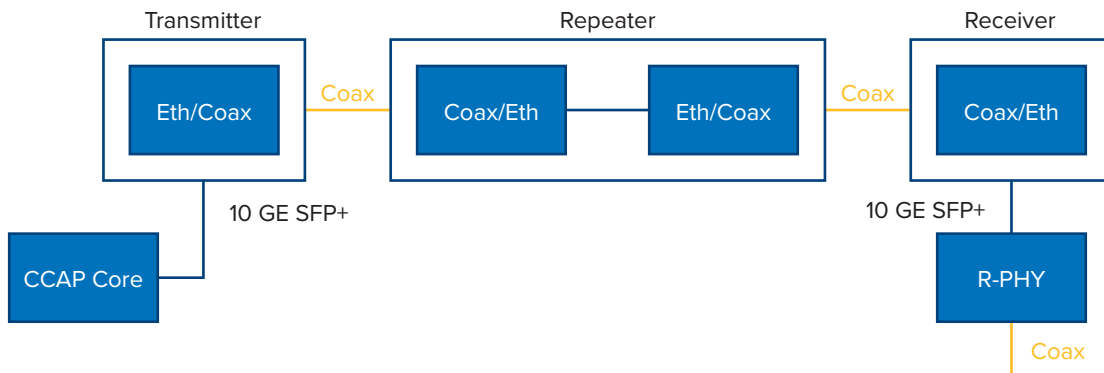


Figure 4: Overview of the Virtual Segmentation link

VS enables operators to make great savings in capex compared with deploying R-PHY via fiber. Operators can deploy R-PHY in little time at a very low cost, while replacing existing amplifiers on the trunk line with low power consumption VS nodes, which will also reduce energy consumption.

A VS link is deployed between the core and the R-PHY, this consists of a transmitter, repeater(s) and a receiver. It is also possible to make cascades by using the second SFP+ port on the R-PHY device by connecting it to a VS transmitter and then carrying overlay data all the way down to another R-PHY device. The VS link includes a control module which enables the operator to integrate it into the network monitoring systems.

Virtual Segmentation: Fiber level bandwidth on coax

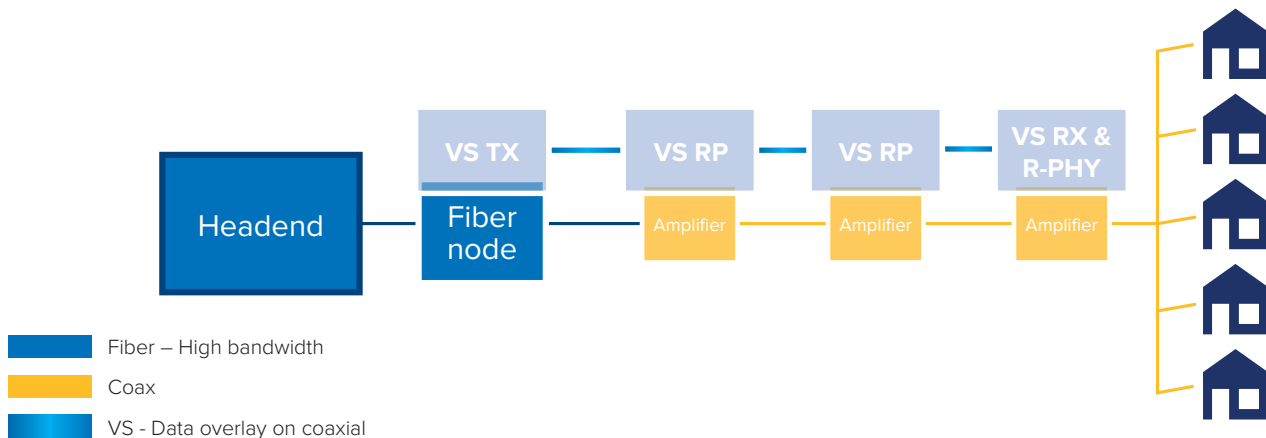


Figure 5: Virtual Segmentation over the existing network infrastructure

The VS solution consists of three main components and a control module:

- **Transmitter:** is deployed on the fiber node and is connected to the core via a 10 G SFP+ connection. It receives Ethernet traffic from the core and converts it to RF which is then sent through the coax cable (or vice versa).
- **Repeater:** Repeater(s) are placed on the coax network at certain distances to compensate for the loss of data over the coax medium. A repeater receives the RF data degraded over the coax and converts it to Ethernet to regenerate the RF data. This means that in every repeater location the RF signal is regenerated from Ethernet data, eliminating any noise/interference that occurs.
- **Receiver:** The receiver is deployed at the R-PHY location which provides a 10 G SFP+ connection to the R-PHY. It receives RF and converts it to Ethernet to feed the R-PHY (and vice versa).
- **Control Module:** Each VS Link is controlled/monitored with a single control module which can be deployed at the transmitter or receiver location. It enables the operators to remotely monitor and maintain (upgrade/configure) the VS link via SNMP and/or web GUI. The control module runs on Linux and supports the latest security protocols with a security based design.

Conclusion

The R-PHY, introduced with DOCSIS 3.1, allows MSOs to answer the high bandwidth demands of their subscribers, however this requires the deployment of fiber to many locations where an amplifier node will become a R-PHY node. Deployment of fiber takes a lot of time and has a high cost.

The Virtual Segmentation solution by Technetix, provides MSOs with a 10 GE SFP+ connection from the fiber node/CMTS all the way down to the R-PHY location via their existing coax network. Depending on the deployment scenario, VS provides from 1.75 Gbps US – 8 Gbps DS up to 10 Gbps symmetrical bandwidth. Virtual Segmentation allows R-PHY deployment for less time and less cost. Table 1 shows the comparison of the VS and fiber deployment in terms of cost and time.

		Cost (m)	Time to deploy
Fiber	Overhead	++++	3-6 days
	Underground	+++++	6-12 days
Virtual Segmentation		+	1-2 days

Table 1

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