OPENSYNC INITIATIVE ENVISIONS CLOUD-MANAGED MODERN SERVICES

SOFTWARE ABSTRACTION OF DEVICES TO HELP DEVELOP NEW APPLICATIONS AND SERVICES FOR CONSUMERS' HOME NETWORKS

THE HOME NETWORK AND ISP INFRASTRUCTURE LANDSCAPE

The home network, the role of internet service providers (ISPs), and consumers themselves have evolved and changed enormously over the past 25 years. At the dawn of the Internet age, broadband access was typically hardwired to a single point in a home, near a desktop PC and cable modem. Other PCs or notebooks in the home could not access it.

During these early years, consumers with broadband access engaged in common activities: email, surfing the Internet, music downloads (often via dubious music distribution Web sites), work-related word processing, spreadsheet management, and presentation development.

ISPs quickly identified the thirst for wider broadband access in the home and began offering incremental services to increase broadband capacity. In the late 1990s and early 2000s, ISPs commonly offered consumers "triple play" broadband usage models that included data (Internet access), voice (IP-based telephony), and core video consumption (paid premium channels).

Concurrently, more affordable desktops and notebooks enabled consumers to acquire multiple PCs per home as the consumer broadband space evolved. PC penetration rates in the home (especially in the United States) rose dramatically. All the while, rudimentary wireless networking gained popularity, despite frequent ease-of-use challenges and generally poor Wi-Fi coverage throughout the typical home.

Home networking is now very different than it was in the past. For more than two decades, wireless chipsets in PCs and notebooks enabled more powerful wireless capabilities for faster broadband speeds. The rise of smartphones and tablets transformed the way users consume video in their home, utilizing broadband in ways that were almost unimaginable in 2000. The explosion of Internet of Things-based (IoT) devices over the last decade (for example, smart thermostats, cameras, smart digital assistants, home security products, etc.) created the *smart home* category. A Cisco

study projects that by 2021 the average home in North America with four members will have more than 13 or more devices competing for broadband access on a 24/7 basis,[1] often unsecured and unmanaged.[2]

Up until recently, it was difficult to achieve robust and reliable Wi-Fi coverage in the home. While powerful, consumer-based routers with multiple radios grew in popularity over the last 10 years, blanket Wi-Fi coverage remained a challenge due to the construction materials used in many homes. Mesh networking solutions, designed to blanket homes with strong, reliable Wi-Fi signals, emerged to solve this problem.

FIGURE 1: THE EVOLUTION OF THE SMART AND MANAGED HOME

	1995 – 2001	2002 – 2006	2007 - 2018	2019 and Beyond
Phases Consumer Drivers	▪ **Connectivity** (driven by the need to be productive at home)		▪ **Performance** (driven by the need for entertainment)	▪ **Personalization and Cross-Device Experiences** (driven by IoT)
Most Popular Consumer Devices	▪ Desktop PC	▪ Desktop PCs ▪ Notebook PCs	▪ Smartphones ▪ Tablets ▪ PCs ▪ Tablets ▪ IoT Devices	▪ IoT Devices ▪ Wearables ▪ Robotic solutions
Tethered/Wireless	▪ Tethered	▪ Tethered ▪ Appearance of wireless (WiFI)	▪ Mainly wireless (WiFi) ▪ Appearance of cellular for data	▪ Blossoming of cellular due to 5G
Most Popular Consumer Usage Models	▪ Basic Web surfing ▪ E-Mail ▪ Productivity apps	▪ More robust office-related productivity apps ▪ Emergence of online ecommerce (Amazon)	▪ Gaming ▪ Video consumption (streaming) ▪ Creative	▪ Emergence of mainstream AR and VR apps ▪ Portability of ISP-level services and learnngs transferability
Average Number of Internet-Accessible Devices	▪ 1-2	▪ 3-5 (multiple PC devices in the home)	▪ > 20 (PCs, smartphones, tablets, IoT devices)	▪ >50
ISP Growth Opportunity (Internet Pipe to Home)	▪ Nascent	▪ Ramping	▪ Accelerated transitioning to slowly flattening	▪ Flattening
ISP Growth Opportunity (Internet-Related Services)	▪ Non-existent	▪ Ramping (primarily voice and data)	▪ Stabilizing (due to ISP business model challenges)	▪ Accelerating

(Source: Moor Insights & Strategy)

During this evolutionary period, ISPs did not idly stand by as they recognize the number of homes and businesses in their respective geographic regions cap their growth. To combat this, ISPs attempt to drive incremental revenue per user with consumer-focused services like home security, home automation, and even popular streaming over-the-top

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[1] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/complete-white-paper-c11-481360.html

[2] Plume Design Incorporated's internal data, based on their installed base, shows an average of 17 devices in customer households with Plume mesh network solutions (Source: Plume Design, Inc.)

(OTT) services like Netflix and Hulu. With declines in their traditional voice and premium (paid) video business, today's ISPs fear marginalization (though their broadband segments are still growing nicely). Failure to participate in new products and services could render them a "utility-like" entity, with all the negative growth and margin baggage associated with such a label.

THE PROBLEMS THAT ISPS FACE

Pursuing these incremental services is difficult. The historic business model of most ISPs is not conducive to offering new services or adding features to existing services. Lengthy, complex product development cycles and proprietary customer premise equipment (CPE) hardware and software make delivery of new services costly, slow, and inefficient. In addition, ISP business models typically amortize CPE hardware over lengthy periods of time for the most favorable impact to their balance sheets.

Many top tier ISPs, end up favoring capital expenditures (CapEx) over operating expenses (OpEx) in an attempt to maximize operating cash flows (OCF). This is an Achilles heel for ISPs. In the new era of "everything as a service," the key competitive advantage may be the ability to curate and deliver new services at a faster cadence and at scale. A CapEx-heavy financial model that encourages hardware investments over software-as-a-service (SaaS) and cloud is a problem for ISPs.

Because of this dynamic, ISPs generally lock into proprietary hardware vendors for lengthy periods of time. This makes it almost cost-prohibitive to mix CPE solutions in their installed bases. Applications that deliver new services are often tied to common chipsets in CPE to ease the burden on application development and customer support. This phenomenon makes it nearly impossible for ISPs to transition quickly to a more agile service delivery model.

These business model challenges make it difficult to extract and apply modern cloud-based business analytics and machine learning to CPE hardware and the billions of devices in consumers' homes. There is no easy, uniform way for ISPs to access aggregated consumer data, making it difficult to gain insight into how their consumers use their home network and the devices on it. In short, ISPs' legacy business model and operating conditions make it difficult to remain competitive and nimble.

OPENSYNC: A NEW FRAMEWORK WHOSE TIME HAS COME

In 2016, Plume caught the market's attention with its Adaptive Wi-Fi, one of the earliest implementations of "self-optimizing" wireless functionality in the home. Adaptive Wi-Fi claims to deliver robust and dependable Internet coverage throughout the home, regardless of size. More than a mesh backhaul solution, Adaptive Wi-Fi is implemented through the Plume Cloud—an approach that purportedly allows the network to dynamically acclimatize and respond to constantly changing loads and interference. Comcast, Liberty Global, Samsung, and Shaw Communications became strategic partners and investors in 2017.[3]

Plume spearheads an initiative called OpenSync to help cultivate, distribute, and manage emerging residential services and address the significant challenges that ISPs face. Buttressed by strategic relationships with large companies like Bell Canada, Comcast, Samsung Electronics, and Liberty Global, OpenSync seeks to create an open-source, agnostic software link between the cloud and in-home devices. It does so via a common software layer that operates across disparate hardware products, including residential gateways, routers, modems, access points, extenders, set-top boxes, IoT hubs, smart speakers, and other Wi-Fi-enabled CPEs.

This software layer creates a common cloud-to-hardware "abstraction" layer with open interfaces to cloud controllers. Ambitious in conception, the benefits of OpenSync for ISPs and consumer device manufacturers could be significant. Its implementation could deliver the benefits of cloud-based services to the consumer: curation, fast and scalable delivery, comprehensive back office management, and heightened support for emerging residential services.

OpenSync uses what was originally Plume's Plume Middle Layer (PML) software developed for its Adaptive Wi-Fi functionality. Because of this, there could be pushback from ISPs who view OpenSync as proprietary and too tightly controlled. The OpenSync effort intends to minimize these ISP concerns by offering the software via a modified Berkley Software Distribution (BSD-3)[4] open source license, as well as opening the interface to third party cloud platforms beyond Plume. It also plans to ensure complete compatibility with other open source initiatives and industry alliances, including reference design kit (RDK), OpenWrt, and the prpl Foundation. Additionally, OpenSync's components are pre-integrated into the reference designs and software

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[3] https://www.businessinsider.com/wi-fi-startup-plume-gets-37-million-funding-from-comcast-others-2017-6

[4] https://opensource.org/licenses/BSD-3-Clause

development kits (SDKs) of industry silicon providers, including Qualcomm, Broadcom, and Quantenna. It's of note that in the mesh networking space Qualcomm is the dominant market share leader with 58 of the approximately 60 global stock keeping units (SKUs) shipping today.[5] Broadcom still has strong market share in the overall Wi-Fi space with 27 percent of the worldwide market as of late 2017.[6] ISPs are likely using legacy CPE devices with chipsets from these manufacturers, so this support positions the OpenSync endeavor well from a market coverage standpoint.

The OpenSync initiative uses traditional WLAN drivers and is mindful of the importance of the Wi-Fi Alliance's recently announced Wi-Fi EasyMesh certification program. Wi-Fi EasyMesh is designed to facilitate baseline interoperability between disparate mesh networking solutions from different vendors.[7] OpenSync forms a cloud-to-home link to Wi-Fi EasyMesh networks, augmenting the mesh networking functions with additional services such as access control, cybersecurity, and parental controls.

TR-369, also known as the Universal Services Platform (USP), is an even more recent standards development in the ISP area. TR-369 is an update to TR-069 that improves the efficiency of the messaging that was used by ISPs in TR-069 to communicate to gateways. It is important to note that TR-369 and OpenSync are quite different. Despite the name "Universal Services Platform" (USP), TR-369 is just a communications protocol and does not provide end consumer services. In contrast to USP, OpenSync includes all the capabilities required for new consumer services, such as cyber security, access control, parental controls, motion detection, and IoT onboarding.

WHAT PROBLEMS DOES OPENSYNC SOLVE?

OpenSync claims to be an all-inclusive, multi-vendor approach that is agnostic and open. This is an important aspect of the initiative. Regardless of OpenSync's benefits, ISPs would likely push back on anything that is remotely proprietary, out of fear of placing their destiny in the hands of a single company. While OpenSync heavily relies on Plume's PML software for its foundational Adaptive Wi-Fi capability, Plume is willing to hand the keys over to the developer community. This demonstrates Plume's understanding that large ISPs do not like to be handcuffed.
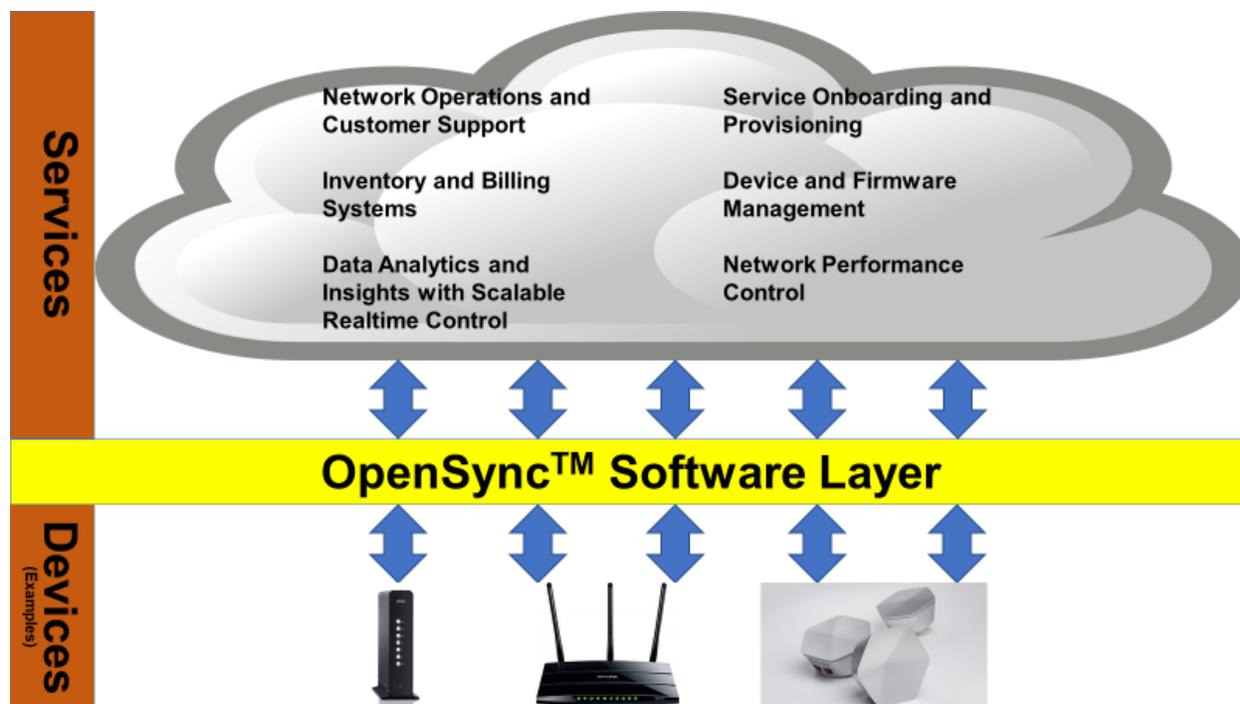
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[5] https://www.marketwatch.com/story/the-battle-for-next-gen-wi-fi-pits-qualcomm-against-broadcom-2018-09-10
[6] https://www.marketwatch.com/story/the-battle-for-next-gen-wi-fi-pits-qualcomm-against-broadcom-2018-09-10
[7] https://www.wi-fi.org/discover-wi-fi/wi-fi-easymesh

FIGURE 2: OPENSYNC CORE CAPABILITIES

Services

Network Operations and Customer Support

Inventory and Billing Systems

Data Analytics and Insights with Scalable Realtime Control

Service Onboarding and Provisioning

Device and Firmware Management

Network Performance Control

OpenSync™ Software Layer

Devices (Examples)

(Source: OpenSync Ecosystem[8])

The initial release of OpenSync focuses on complete-home Wi-Fi networking, management, and control, and the collection of data and statistics using standard protocols such as Message Queuing Telemetry Transport (MQTT). It also includes interfaces for IoT device security, secure guest and device access management, and advanced parental controls. Additionally, OpenSync features robust, enterprise-like security capabilities, such as device and user-revocation support. For an extra level of security, OpenSync-supported devices only embrace certificates after they have been validated with credentials in the cloud. Devices are white-listed and authenticated to avoid improper and nefarious network intrusion.

OpenSync's cloud element offers other advantages that deserve attention. The cloud attribute of OpenSync could provide ISPs with the ability to optimize channel groupings across multiple homes or even an apartment complex. The initiative's embedded ability to centralize and aggregate all of this data—in a secure, anonymous manner—should make it easy for ISPs to derive insights from consumers' behaviors and patterns. As a result, this capability may allow carriers to roll out new services and features that drive

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[8] https://www.opensync.io/documentation/

higher customer satisfaction. For example, inconsistent device-level firmware updates create customer havoc (and unwanted customer calls) at ISP call centers. OpenSync could go a long way to reduce support calls and mitigate this situation.

Though their individual motivations may vary, it is significant that companies like Comcast, Bell Canada, Liberty Global, and Samsung signed on as initial participants in the OpenSync initiative and have already adopted and deployed elements of OpenSync. These organizations, along with endorsements from Broadcom, Qualcomm, and Quantenna, bring immediate gravitas and credibility to the effort. To further understand the OpenSync initiative, it is worthwhile to explore the various motivations and capabilities of these early adopters and industry innovators.

OPENSYNC'S TECHNICAL UNDERPINNINGS

This white paper does not purport to be a technical document, but OpenSync's key technical attributes deserve brief explanation and insight.

OpenSync's software foundation is comprised of three core elements: telemetry, control, and networking. The telemetry attribute is based on Message Queuing Telemetry Transport (MQTT), an ISO standard that provides messaging protocol support for connections of small sensors and mobile devices with remote locations. It is ideal for these types of devices because it has a small code footprint and can operate in a limited network bandwidth environment. Protobuf is supported as well. These protocols are ideal for OpenSync because they efficiently handle frequent reports from millions of sensors. Protobuf is particularly useful because it provides a flexible, simplistic format that can be parsed easily.

The control portion of OpenSync is based on Open vSwitch Database Management Protocol (OVSDB) which is highly reliable and industry tested. Consistent with the open nature of OpenSync, OVSDB provides a synchronized distributed database with transaction callback capability. The protocol is well-supported by software that is mutually appropriate for the cloud and device, significantly aiding with development.

Finally, the networking element of OpenSync leverages Open Virtual Switch (OVS) and works jointly with OVSDB and OpenFlow. OVS has a good reputation in data center applications and OpenWrt-based home routers. It provides OpenSync with open source, high-performance implementation support (including hardware acceleration and programmable capabilities) on a wide range of chipsets.

In all of this, the key technical takeaway is that OpenSync leverages existing industry software stacks like OpenWrt, Reference Design Kit (RDK), and prpl Foundation. This eliminates the need for software developers to "reinvent the wheel" and allows them to utilize the software code they've already invested in.

More technical detail can be found in the documentation section of [OpenSync's web site](#).[9]

FOUNDING OPENSYNC PARTNERS

PLUME

Plume is the key infrastructure development entity behind OpenSync, having developed the PML software that is at the initiative's heart. Plume's Adaptive Wi-Fi capability is evidence of the company's significant cloud knowledge, Wi-Fi, and firmware expertise, given the breadth and intricacies of the CPE hardware that ISPs use. Additionally, Comcast's selection of Plume as its official mesh networking provider in 2017 speaks volumes to Plume's expertise and vision in the Wi-Fi and cloud space.

Plume entered the market only two years ago, which gives it the advantage of code currency—there are no legacy "spaghetti" code issues. This is a tremendous advantage for OpenSync from an efficiency and time-to-market standpoint. Plume sees itself as a neutral, non-hardware company in the middle of the home network delivery chain. This allows it to position OpenSync as agnostic, open, and not partial to any particular carrier or hardware company.

COMCAST, BELL CANADA, AND LIBERTY GLOBAL

Comcast is the second-largest broadcasting and cable television company in the world from a revenue perspective and the largest cable TV company and largest ISP in the U.S..[10] Over the past several years, the company has been particularly proactive in enhancing its Xfinity service (its brand name for cable TV, Internet, telephone, and wireless services) in consumer homes with upgraded set top box solutions that offer DVR, voice recognition, and a much-improved guide.

Earlier in the year, Comcast formally launched its Wi-Fi mesh system, Plume-designed xFi Pods, that utilizes Plume's Adaptive Wi-Fi capability and works in conjunction with Comcast's xFi Wireless Gateway. Because of this prior relationship with Comcast, Plume's PML software is already integrated into the advanced gateways of Comcast's

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[9] https://www.opensync.io/documentation/
[10] https://en.wikipedia.org/wiki/Comcast

software stack. OpenSync is especially attractive to Comcast for this reason coupled with the fact that it has more than 40 million RDK devices already deployed around the world.[11]

Bell is Canada's largest communications company, providing advanced broadband wireless, TV, Internet, and business communications services throughout the country. At the end of 2017, Bell had nearly 10 million wireless and Internet customers.[12] Liberty Global is the world's largest international TV and broadband company, with operations in 10 European countries under the consumer brands Virgin Media, Unitymedia, Telenet and UPC.[13] These organizations, with their large subscriber bases, endow the initiative with scale and trustworthiness.

Over the past several years, ISPs like Bell Canada and Liberty Global have been expanding their residential services beyond the core "quad play" offerings of voice, video, data, and mobile. OpenSync's ability to curate cloud-enabled services likely appeals to these ISPs and its ability to enable the deployment, management, and support of these services in a scalable manner. In many cases, new services can be deployed using OpenSync without having to change firmware on the devices in the home. OpenSync also has the potential of improving time to market with new (or incremental) services in a cost-friendly and user-friendly manner. In this way, ISPs may view OpenSync as a new infrastructure offering with the potential to improve their competitive position.

With its wide European footprint, Liberty Global may see value in OpenSync's ability to create an amalgamated, elastic, cloud-based network with open interfaces out of the assorted, multi-silicon mixture of legacy CPE hardware that currently exists. Put simply, the ISPs want to have the best of both worlds: the agility to easily offer new services without being dependent on another entity they can't control.

SAMSUNG ELECTRONICS

Samsung is one of the more intriguing partners supporting the OpenSync initiative considering it is not a traditional ISP. The electronics giant recognizes that its long-term prospects in the smart home, home automation, and consumer home network areas demand a solution that will help it scale its SmartThings WiFi platform. SmartThings is

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[11] https://www.prnewswire.com/news-releases/plume-and-samsung-launch-opensync-open-source-initiative-810403548.html
[12] https://en.wikipedia.org/wiki/Bell_Canada
[13] https://www.libertyglobal.com/about/who-we-are/

Samsung's platform for managing smart home and home security solutions on a wide range of Samsung third-party connected devices. Samsung understands customers will demand "best of breed" services that are either offered from the ISP via the broadband pipe or in an OTT type manner[14] over the next decade.

Samsung already has SmartThings-enabled devices at retail that leverage OpenSync. Because of this, Samsung's retail "aftermarket" devices that are cloud-connected and managed will have an easier path to upgraded services from Samsung in the future. Samsung's partnership with Plume on SmartThings WiFi (which essentially provides mesh networking capability) and its support of the OpenSync framework should allow it to provide plug-and-play compatibility with the hundreds of non-Samsung IoT devices that ISPs offer. This will provide consumers with the highest degree of flexibility and choice.

CONCLUSIONS

The connected landscape has changed dramatically over the past 25 years from a device, consumer usage model, operator/ISP, and customer expectations standpoint. Moor Insights & Strategy (MI&S) believes OpenSync is a logical and pragmatic initiative that addresses the long-term business model challenges operators face.

OpenSync creates a frictionless way for ISPs to provide new and incremental services without being burdened by the disparate silicon ingredients of legacy CPE hardware. OpenSync could enable ISPs to use their finite engineering resources in a more efficient and ROI-oriented manner by reducing the services and applications development burden. Additionally, OpenSync can be seen by ISPs as an opportunity to offer services and pursue customers outside of their identified geographies. The competition would ultimately be good for consumers, fostering best of breed services that in theory could even become "portable" (for example, a user could take a preferred security service from one ISP to another).

OpenSync's go-to-market approach is also important. The open source model should allow OpenSync to maximize its potential as the DNA of most (if not all) ISPs is to resist attaching themselves to proprietary solutions that make them dependent or reliant on others. The "open nature" of OpenSync is one of the key reasons why the initiative has attracted such an impressive roster of participants at the onset. From a pure business

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[14] https://www.prnewswire.com/news-releases/plume-and-samsung-launch-opensync-open-source-initiative-810403548.html

model standpoint, this is forward-thinking that will break down the barriers OpenSync would inevitably encounter with a non-open source approach. Fahri Diner, Plume's co-founder and CEO, has stated OpenSync could create a competitor to Plume in the long-term and he's not troubled by that possibility. As Diner explains, "We have complete confidence in Plume's own cloud capability, scalability, learning, and analysis competencies. We also believe our ability to enable preemptive support separate us from the rest of the pack."[15]

It's possible some ISPs may choose to forego the expanded services and applications opportunities presented by OpenSync out of fear of the initiative's disruptive power, but this seems unlikely given the challenging business environment in which ISPs operate. Still, some ISPs will embrace OpenSync more aggressively than others.

Consumer needs no longer center around pure productivity and baseline Internet connectivity like they did 25 years ago. Today, users require higher performance for continuous entertainment and engagement, available on all devices in the home. Personalization and customization are "must have" requirements. As connectivity to the home and services in the home decouple from each other, OpenSync provides ISPs with the potential for rapid and scalable modern services development and deployment. With increasingly capable smart speaker solutions, giants like Google, Amazon, and Apple continue to challenge ISPs for in-home services. ISPs may find OpenSync to be a timely offering that could help them defend their turf and avoid being relegated to the status of a basic utility.

The scale of smart devices will transition from millions to billions of units over the next few years and the injection of centrally-managed unlicensed spectrum into the equation will only accelerate growth. The timing of the OpenSync initiative is optimal and ISPs should take notice.

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[15] MI&S interview with Fahri Diner (October 3, 2018)