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Wi-Fi Is Ubiquitous and Should Get Smarter

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Executive summary

Wi-Fi will remain the dominant mode of connectivity in the home environment, but the current device-centric networks have much to improve on. By adopting open standards, such as IEEE 1905.1 and EasyMesh, vendors and ISPs can help improve consumer experience. However, for them to go beyond the role of mere connectivity provision and create values for both customers and themselves, broadband operators and ISPs should embrace the full suite or selected elements of smart Wi-Fi solutions, the choices of which will depend on the positioning of their business, partner strategy, customer demands, and access to the latest technologies.

Wi-Fi rules the home

According to data from Omdia, a research firm, on average between 70% and 80% of media consumption takes place indoor. This means, regardless of the technologies used to connect the house to the internet, be it fibre, hybrid broadband technologies over copper wire (e.g. G.fast), cable, or fixed wireless access (FWA), most of the indoor connectivity to consumer devices is over Wi-Fi.

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In most cases mobile devices, such as smartphones and tablets are also routing traffic over Wi-Fi when they are used indoor. Cisco has projected that nearly 60% of global mobile data traffic will be off-loaded to Wi-Fi by 2022.

As Wi-Fi reigns in the indoor environment, there is much to improve in the home networks when it comes to setup, maintenance and ongoing performance management. Customers expect their Wi-Fi to work wherever they are in their home, as well as when they move around, which does not always happen in many houses now.

Such expectations require that internet service providers (ISPs) need to offer smarter services. Internet access provision alone is not enough. ISPs need to offer customisable solutions that best fit

About devolo:

devolo is a full-range supplier of hardware and software in carrier-grade quality and offers a scalable ecosystem that forms the basis for high-performing home networks. Hybrid solutions from devolo use the latest PLC generation G.hn as a strong backbone for seamless mesh Wi-Fi. The company enables ISPs to further improve the customer experience and generate additional revenues with OTT and other value-added services. devolo was founded in Aachen, Germany, in 2002 is today represented by its own subsidiaries and by partners in 19 countries.

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Figure 1:
Powerline Communications (PLC) bring high-speed data connections and perfect Wi-Fi to every room

the individual customer's housing situation and is adjustable to their changing needs.

Securing reliable coverage throughout the house

One of the biggest problems for home networks nowadays is still weak coverage or even dead spots away from the router. This gets worse when the house or apartment has more than one floor, as the radio signal beamed from the router antennas face similar problem as cellular signals do: it is hard to penetrate building materials.

The most common solution used by consumers is adding Wi-Fi repeaters in different parts of the house. However, there are major issues with repeaters. One is signal degradation. The wireless signal will be weaker by 50% by one additional repeater, made worse if the repeater is not of the best quality.

Another issue is complexity. A repeater added to the home network can take on basic information from the router, i.e. credentials like the SSID. But unless it is part of a mesh network (see more details in the following sections of this whitepaper), it creates a new basic service set. This means, when moving a connected device from one basic service set to another, the handover will not work smoothly, not to mention performance management.

These issues will render sub-optimal Wi-Fi user experience, and in turn, harm the reputation and business of the ISPs that provide the connection. So, it is of high importance that ISPs should embrace new solutions to guarantee customer experience and to safeguard and improve their own business performance.

A set of new and existing technologies, industry standards, and business model innovations have been termed collectively as "smart Wi-Fi" for marketing purpose, which has become one of the broadband industry's buzzwords. Though in itself the term does not refer to any specific technology, put together these solutions can help ISPs restructure their internet access offerings.

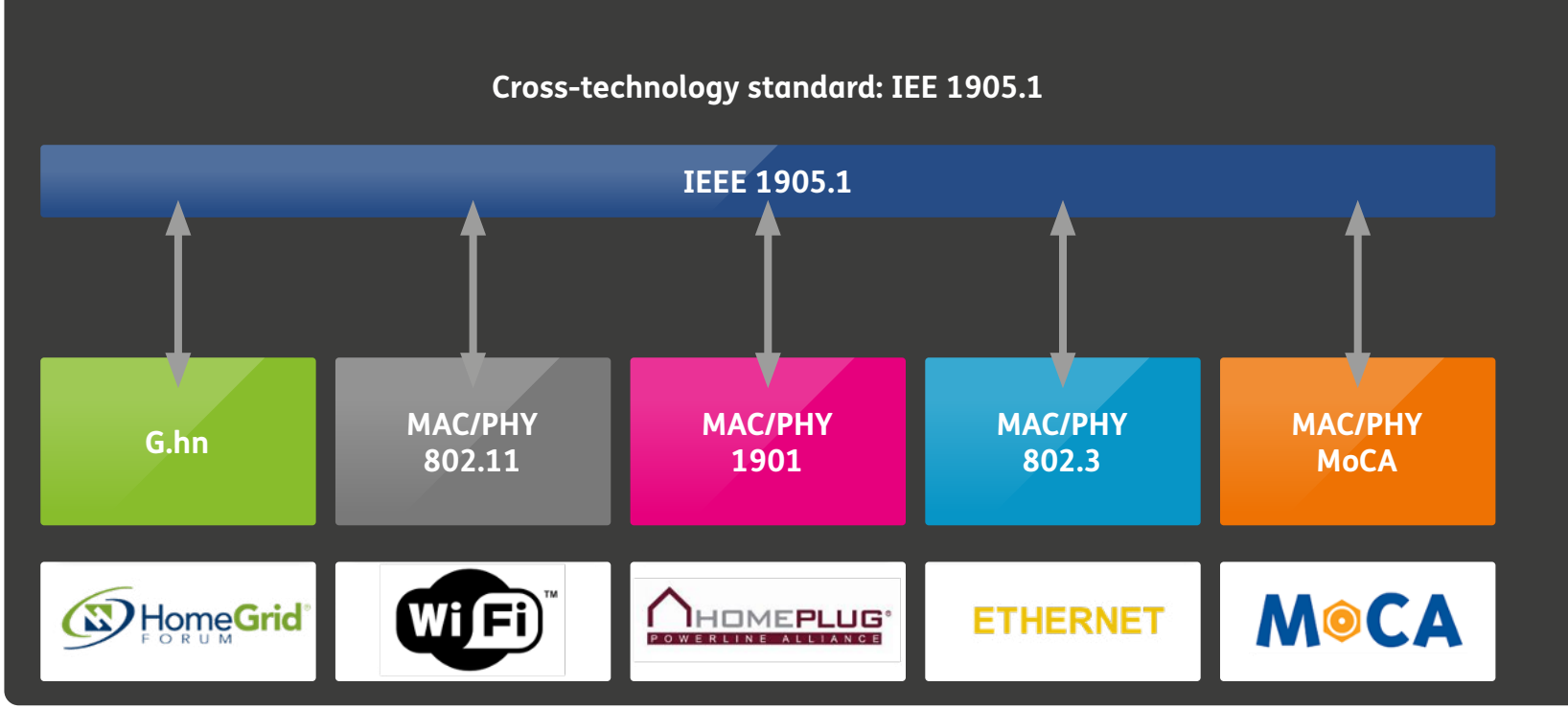
What to be smart about?

The starting point for ISPs to improve in-house Wi-Fi experience, and the most obvious improvement consumers can feel, is to address the issues of weak coverage and fragmented SSID.

An existing but effective technology to solve the problems of weak coverage or dead spots in the house is delivering network signal through the powerline that already extends to all parts of the house, using powerline communications (PLC). The technology has been around for many years and, with millions of adapters shipped, it is a proven concept in households across the globe.

PLC is seen in a new light by consumers and ISPs recently. A generation change from the previously dominant standard HPAV 2 to G.hn is taking place. Devices based on the latest version of the standard, called G.hn Wave 2, offer a significantly higher performance and greater range as they use a more efficient multiplexing method and are optimised for forward error correction.

PLC has the obvious advantage over Wi-Fi that the signal on its way from the router through the house is not weakened by massive ceilings and thick walls. The latest generation of the technology makes PLC even more reliable to be deployed as backbone for home Wi-Fi.



▲ **Figure 2:** **IEEE 1905.1**

While it is important to eliminate dead zones, it is equally critical, if not more, for ISPs to build a seamless network whose status and performance is transparent. Only with strong visibility into the network can ISPs defend their reputation and grow their customer base by minimising errors and fast taking remedial actions when needed. Network visibility is also the starting point for ISPs to offer more value add to their customers than providing connection.

But there are obvious challenges. Home networks consist of a growing number of devices, e.g. gateway, repeaters, PLC adapters, Wi-Fi access points etc. More and more clients in very different locations are connected. To ensure the best possible customer experience, it is therefore essential for the ISP to know how the network is structured, how it is performing or which of its elements may have a problem. This is a key area where home networks need to become smarter.

Established standard at basic level

There are smart solutions on different layers of the networks. At the basic level is IEEE 1905.1. The standard family includes standards for connectivity technologies including PLC, IEEE 802.11 (i.e. Wi-Fi), Ethernet, and communication over coaxial cable (or MoCA). Without modifying the underlying backbone technologies, the 1905.1 abstraction layer enables "advanced network management features including discovery, path selection, autoconfiguration, and quality of service (QoS) negotiation", as IEEE said when the standards were approved.

An IEEE 1905.1-based home network can provide ISPs with visibility to its topology, showing which station connected to which interface and which 1905.1-enabled device connected to which interface. Devices can then be remotely accessed using Technical Report 069 (TR-069). ISPs can also view the network's link metrics, including packet errors, transmitted packets, MAC throughput capacity (Mbps), link availability (% of idle time), as well as the physical layer (PHY) rate. Devices compliant with IEEE 1905.1 are easy to DIY-install and to add to a network by customers, therefore reducing the operational cost to ISPs.

Despite 1905.1's benefits to ISPs and to customers, not much management can be done through 1905.1 alone. ISPs can claim to have managing capability of home Wi-Fi networks if they keep control of the network based on information provided by e.g. 1905.01 and if they can upgrade the firmware of consumers' home gateway remotely, using TR-069. But to create value to both consumers and to themselves through managed Wi-Fi, ISPs should aim higher.

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One level up: EasyMesh

Elevated from the underlying technology, on top of IEEE 1905.1, mesh networks are effective interaction and communication tools ISPs should actively embrace. Mesh Wi-Fi, as the name suggests, is a way to distribute Wi-Fi access throughout the house without creating multiple "sub-networks" with new access points added. However, most of the mesh solutions on offer now are based on proprietary technology, which means that all access points need to come from

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a single vendor for the network mesh to work together smoothly.

EasyMesh, promoted by Wi-Fi Alliance and supported by companies including devolo, is based on IEEE 1905.1. It sets out to address the vendor lock-in problem created by proprietary mesh networks. An open standard, EasyMesh allows compliant Wi-Fi access points and home gateways from different vendors to communicate with each other to form a mesh. On top of enhancing network performance and reducing the complexity of combining hardware from different vendors in one network, EasyMesh can also help improve network intelligence and self-organisation.

Moving up to “Sophisticated” managed Wi-Fi

“Managed Wi-Fi” has become another buzz word lately, though the meaning can vary depending on who is speaking.

In a managed environment ISPs and operators would be able to use the home Wi-Fi network as the platform to offer its own intelligent services, for example smart home or security. However, this kind of managed services do not only rely on ISP visibility into the home network, but also the capability to implement end-to-end network management remotely, which the current hard-ware centric home Wi-Fi networks do not support.

Admittedly, the IEEE 1905.1 standard can already enable some network visibility, including information about network topology and link metrics, which will help assess the status of the network, its performance and possible issues, but not much management can be done “over the air”.

Even with EasyMesh, although a mesh can be formed by combining devices from different vendors compliant with the open standard, the software agents and mesh controllers operating on top of the mesh are often proprietary. This means functionality and rich features cannot work across meshes, making it impossible for ISPs to apply optimal management.

In an ideal world, the solution for a more sophisticated idea of Managed WiFi could lie in “the cloud”. By moving towards the cloud, we mean a vendor using a software stack to deploy applications and to shift device management, monitoring and performance management to the cloud. However, on top of the fact that cloud-based managed network is a complex that needs sophisticated technology support, without end-to-end open source implantation of open standards, ISPs will face an even bigger risk of full-stack vendor lock-in. Devices from different manufacturers cannot simply be integrated into the network, and the sophisticated, partly AI-supported network intelligence only works if all elements in the network are equipped with the vendor's corresponding software agent, which in turn raises the question of license costs for using the agents on third-party devices.

Therefore, ISPs should calculate the pros and cons of the different solutions that give them transparency of the network or enable the total virtualisation of network management as well as the creation of an intelligent, self-managing home network.

Some ISPs including telecom operators with their own broadband services may be happy to

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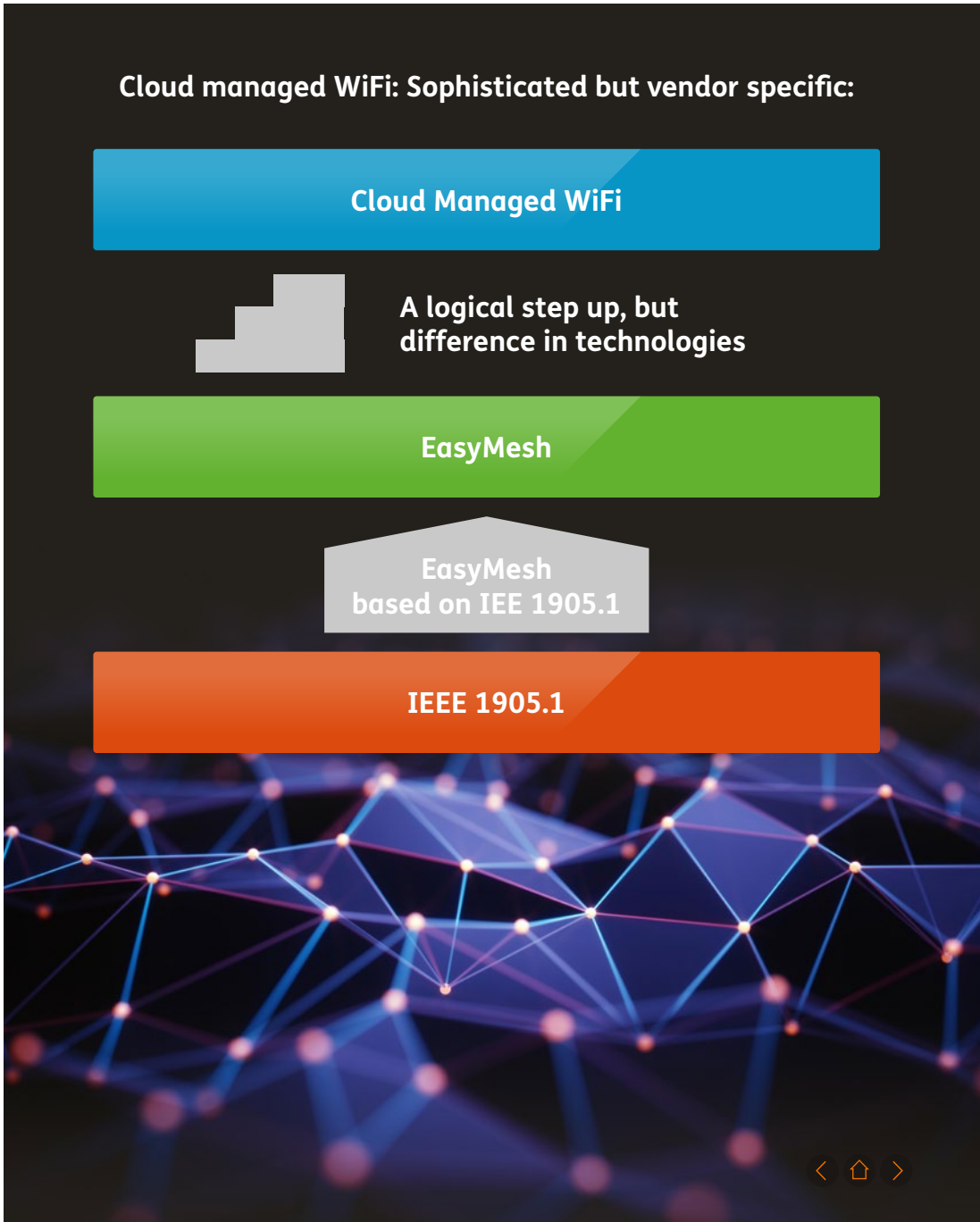
go for an “all-in-one” cloud-based managed Wi-Fi solution in partnership with their preferred vendors. They could position end-to-end managed service either as a premium offer or as a differentiator for their premium customers. Some may even want to explore the so-called “Wi-Fi as a Service” (WaaS) subscription model, by which customers would get the benefit of not having to invest upfront for access points, not worrying about broken hardware, keeping firmware up to date, or hardware becoming obsolete.

However, in the foreseeable future cloud-based managed Wi-Fi and WaaS will remain a niche. The majority of ISPs will find the intelligence and management capability enabled by the combined deployment of IEEE 1905.1 with EasyMesh or similar open source initiatives sufficient to support their business strategies. In such scenarios, while ISPs are aiming to move away from the device-centric network model, collaboration with leading vendors will remain critical. This is not only to do with the quality and reliability of their products, on which customer experience will rely on, but also largely determines ISPs’ access to the latest technologies and business model innovations.

In summary, Wi-Fi will continue to be the dominant mode of connectivity in the home environment, but the current device centric networks have much to improve on. By e.g. adopting IEEE 1905.1 compliant technologies, for example PLC as backbone to reach all corners of the house, and open standard interconnectivity technologies like EasyMesh, vendors and ISPs can help improve consumer experience.

However, for them to go beyond the role of connectivity provision and create values for both customers and themselves, broadband operators and ISPs should embrace the full suite or some elements of smart Wi-Fi solutions, depending on the positioning of their business, partner strategy, customer demands, and access to the latest technologies.

Figure 3: Road to Cloud Managed Wi-Fi?



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An increasingly hot topic in telecoms is Managed Networks, and for good reason. ISPs that seek to provide end-to-end home networking need to have an overview of the individual devices within the network in order to stay informed about network performance and to be able to optimize it. Network management however can be implemented at various levels of complexity. To decide which level is suitable for them, network operators need the right partner.

devolo has been partnering with international ISPs for many years. Our advantage is that we combine the know-how of a technology pioneer in home networking with experience of the retail sector and comprehensive expertise in logistics and fulfilment.

On this basis, we provide independent consulting and develop what the customer needs: solutions that provide basic information about topology and link metrics, as well as products with integrated third-party agents that can become part of a cloud-based Wi-Fi service.

Moreover, as a hardware specialist with millions of products shipped, we know the potential of two specific technology worlds better than almost any other vendor: powerline communication and mesh Wi-Fi. This is an important advantage for our partners, because by cooperating with devolo, they receive the best combination of hardware and software on the one hand, while at the same time avoiding having to commit to one technical approach.

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