

The emergence of Smart Wi-Fi

Based on interviews with HKT (PCCW), Liberty Global, Orange, Swisscom and Telenor

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INTRODUCTION AND BACKGROUND

When Wi-Fi stops working we all notice, we all get irritated and we all feel helpless. Whatever version of Wi-Fi you have, on one occasion or another there always appears to be a problem. Except when there isn't. Because Wi-Fi will go for long periods of time doing just what it's supposed to. Unfortunately for ISPs (Internet Service Providers), their customers rarely notice how well Wi-Fi has worked when it works, they just remember how frustrating it was when it didn't.

This is not because Wi-Fi is broken, but rather because it is a victim of its own extraordinary success. The more it offers, the more everyone wants from it, the more devices which are connected to it simultaneously, the more it has to evolve into something new, in order to stay in our good books. So far the desire for improvement has been coped with admirably by chip companies, by constant improvements to the PHY (physical layer), effectively the silicon of the Wi-Fi, and the MAC, (Media or Medium Access Control), the software which shares out the Wi-Fi resources between users. They have tried to improve the native underlying speed of connection, and how much data you can get through it.



SMART WI-FI

A little over a year ago, the temperature changed in the Wi-Fi market and fresh requirements, calling for bids to provide Smart Wi-Fi, began appearing more and more often. The driver of this change are those who believe that more than one Access Point (AP) is required to give coverage around a home, especially a large one or one that has concrete walls.

But as soon as you begin to think about a multi-AP Wi-Fi network in the home, where instead of a single Access Point trying to serve an entire household, you have connected Access Points that share the load between them, you start to see the problems this can immediately throw up. Many of those problems are in the existing MAC and PHY, those very improvements which came out of the development of better Wi-Fi chips.

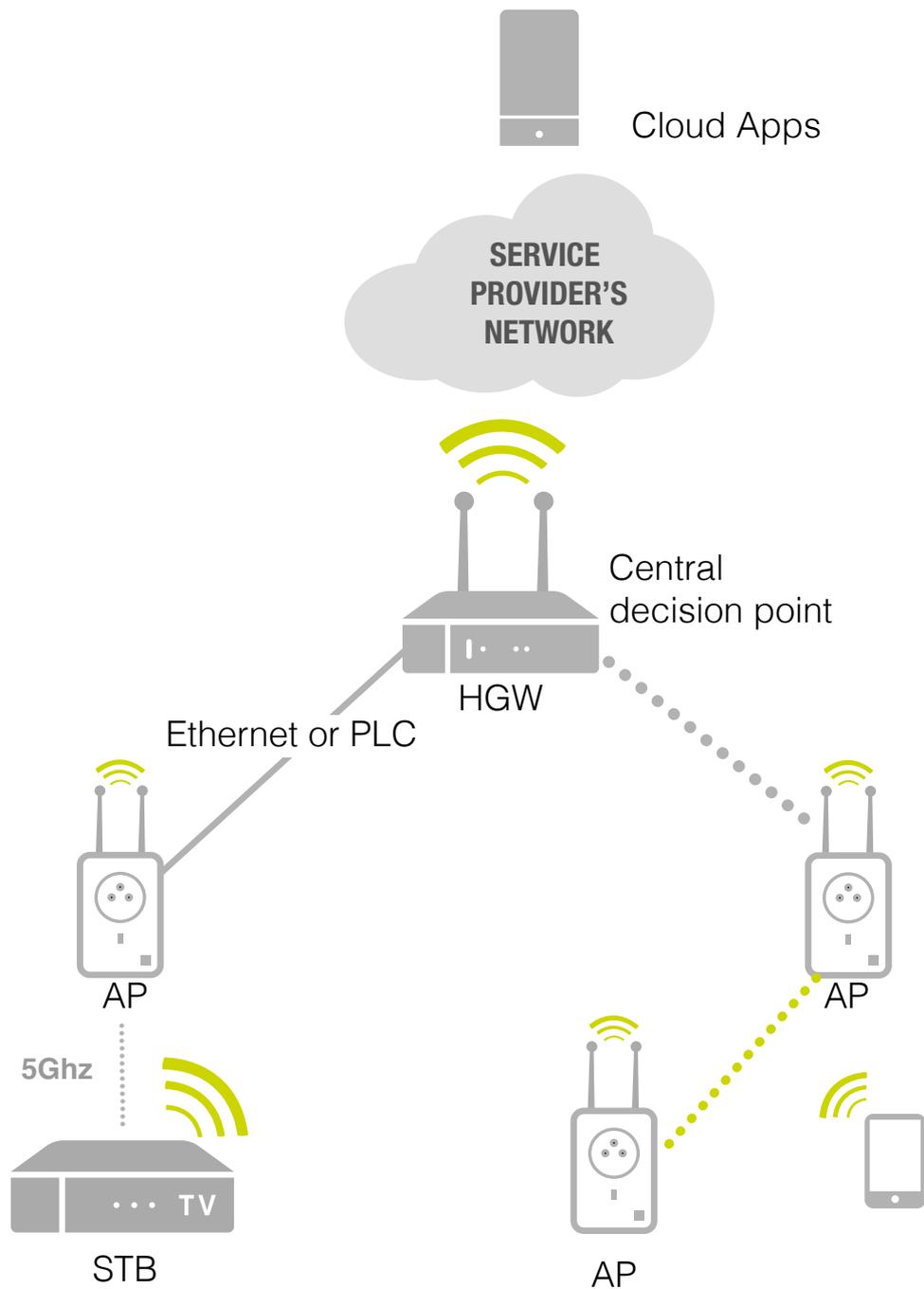
Take for instance beamforming. Lots of Wi-Fi chips these days use beamforming, which is a highly mathematical process used to combine signals from multiple antennas, so that they favor being received in a particular direction. A smartphone being moved around a home in that way, can be followed around by a beam.

But once a beam is formed, if its owner moves to another room, let's say right next to a less loaded Access Point, then it would make sense for it to connect to it. But instead of connecting to it, because of the strength of the beamforming, it will continue to be perfectly happy talking to the much more distant AP in another room, through a concrete wall.



This connection may be maintained, simply because of that beam, despite a big reduction in its ability to hear what the AP next door is saying. The miraculous new PHY maintains an unlikely connection, but data can potentially slow to a crawl. The way Wi-Fi deals with any difficulty is to deliver information more slowly by changing its modulation scheme to a more robust one. It's the equivalent of talking more slowly, carefully pronouncing each word.

But this also means it is using up Wi-Fi resources inefficiently, and it takes longer to deliver what it has to that client, while other devices in the home have to wait.



STICKY CLIENT

This type of “sticky client” problem is not going to be solved by making better radios, you would get much the same problem, but it would happen further away from the AP. It also won't be solved by addressing more spectrum with the device, or any of the other things which have made Wi-Fi what it is today. This problem is going to be solved, by adding intelligent software which turns Wi-Fi into something closer to a conventional network.

Wi-Fi, as it has been designed into a home router, is a bit of a loner. It's a good citizen, listening out for and avoiding any other nearby Wi-Fi devices. It has been designed to work in a congested and interference ridden environment, not to partner up and co-operate, with one or two other Access Points which are its friends. Instead it will try to self-sufficiently manage on its own the best it can. Essentially that's what new layers of software need to allow it to do in Smart Wi -Fi – cooperate, partner and share data – with other APs and the cloud.

Absolutely critical to this is the ability to share information between Access Points. It's not that this has never happened before, but when enterprise Wi-Fi systems are set up to cooperate with one another, there is usually some centralized additional intelligence organizing things, and in Hotspot configurations, data can be shared through a mesh protocol or an extender can be adapted to share the same SSID (service set identifier or WLAN ID) and share information across the same shared channels. These skills are not needed in a traditional Wi-Fi Home Gateway .

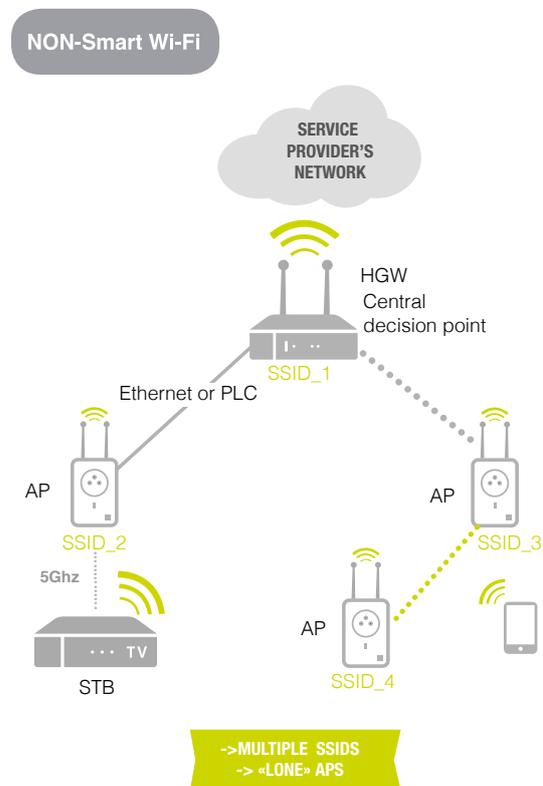
One particular situation which demands data sharing is when the home gateway is too far away to sense interference from a neighbor's Wi-Fi. As a result, it doesn't know it should avoid that channel. If it is not told by an extender that this interference is present, it has no mechanism to avoid it and stays firmly in the same channel and insists the extender sits in the same “interfered” channel. Once they share this information and any other information

about which channels are best suited for each clients' communication, then the Home Gateway will make the extenders move to another channel like good neighbors. The key ingredients then, to turn these “lone” APs into a coordinated network are a handful of simple shared tasks. They wish to collectively (and repeatedly) select channels with the least interference;

they wish to centrally agree which is the best spectrum band, 2.4 GHz (Gigahertz or billions of cycles per second) or 5.0 GHz for each conversation with each device, at each point in time, and similarly to agree which client devices should speak to which AP or which AP can offer the strongest signal to a particular device. This is not a set of “one off” tasks, but a repetitive series of “house-keeping” jobs, which have to be constantly running and adjusting.

So after a few years' of these Smart Wi-Fi systems being tested in secret by operators, and early products having been launched, the very first services are beginning to emerge into the daylight, from operators.

Each operator has to ask itself many questions about how such techniques best suit its business.



Will they be able to use less resources, saving money, or will they experience higher Net Promoter Scores (NPS) and gain market share? Can they make “Smart Wi-Fi” into a competitive feature set – with the claim “our Wi-Fi reaches further, faster,” which may help them win more customers ?

Even if an operator only gains an edge for a year or so, after which rivals catch up, the chances are that there will be a branding improvement among customers, which will be sufficient for the operators to retain that market share. Once a customer changes hands, he is yours to lose.

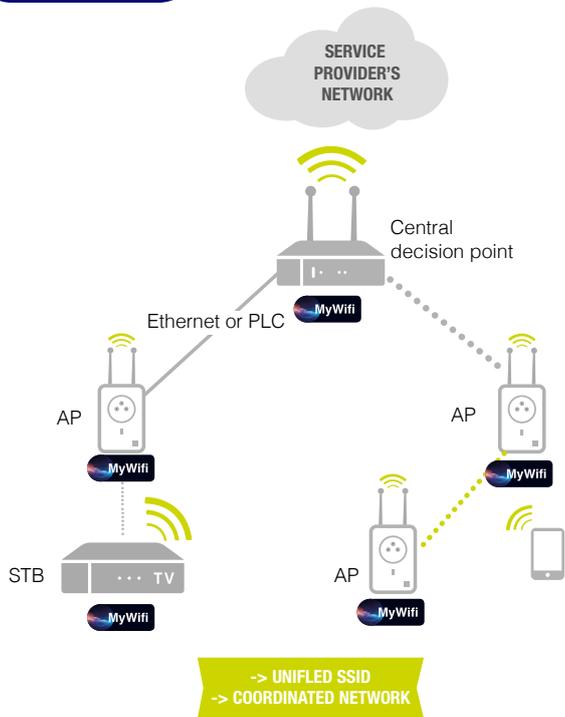
We decided to ask a handful of operators to compare and contrast how they plan to bring services to market and which of the features mean the most to them and how they may make money or take advantage with such systems.

We spoke to five tier one operators for this paper, about their specific Wi-Fi problems, how they have gone about differentiating their broadband and how they plan to monetize smart Wi-Fi. They have significantly different approaches, some which rely on the help center to support clients and use cloud tools to look directly into their

home Wi-Fi, and others which give the home user the power to better design their network.

We spoke to Yoann Vincent, who leads the Smart Wi-Fi anticipation projects at Orange at its French Technocentre; Peter Joyce, Director of Connectivity CPE Architecture at Liberty Global; Tore Løge, Telenor’s Product Manager CPE for Home Networks; and Dr. Allen Wong, Head of Product and Business Development at Hong Kong Telecom (HKT), part of PCCW and Marcel Burgherr, Head of Gateways, Phones and other Devices at Swisscom.

Smart Wi-Fi



WHAT ARE THE CORE PROBLEMS TO SOLVE?

So first, what problems have each of these operators found with their home gateway Wi-Fi?

Vincent at Orange said “About a year ago we began to see an evolution in the market and new devices began to appear. We began talking about how we might improve our Wi-Fi.

Vincent listed the problems for us, “Sometimes the device is not on a good channel, and sometimes the client device is attached in the wrong band. We wanted to improve the Wi-Fi in our home gateway, and we knew we would need to have an extender as well. Our first product LiveBox 4 was developed last year and has been very successful and now we plan to develop an even more advanced product. At the LiveBox 4 launch the Orange CEO Stephane Richard, said “This box literally tears down walls,» because he was so pleased with the performance of the SoftAtHome smart Wi-Fi compared to previous Orange Wi-Fi efforts.

The first priority Vincent talks about is ease of use. “The Wi-Fi needs to be configured by the consumer very simply, and Orange also felt that all Access Points must use the same SSID and the same security.” He is keen to use



all the features including client steering, but says that first Orange must prove all the use cases. “We will start by putting an extender between the gateway and the set top and grow from there,” he says. It is a timely conversation. Vincent has a 1,000 home commercial trial starting this month on a software evolution of the Livebox 4, using SoftAtHome Smart Wi-Fi.

Joyce at Liberty Global agrees with much of what Vincent said, but Liberty Global seems to be taking things more slowly. His company has no “big bang” style introduction planned and instead he advocates taking many small steps along the way.

“Do you actually need any more throughput per device right now than 30 to 40 Mbps (Megabits or millions of bits per second)? You can get 1 Gbps (Gigabits or billions of bits per second) to the home and that amount of throughput will deliver most services. We are supposed to be getting ready for VR (virtual reality), or 4K, but even a 4K stream requires a finite amount of throughput.”

“For the most part it is the devices which are not fast enough for the network, and not the other way around,” Joyce reminds us, referring of course to 1 x 1 and 2 x 2 antenna smartphone Wi-Fi, which cannot keep up with a 4 x 4 MIMO home router.

I ask him about Smart Wi-Fi “We have some activity rolling out called, funnily enough, Smart Wi-Fi. It involves channel optimization, band steering, airtime management – all in a multi-AP environment.”

“We want to drive optimum capacity, as do most ISPs, especially through existing, installed equipment. CPE is one of the largest capex drains on our business. So if we can get more capacity with the simple addition of software, that’s great.

“We also need to add an additional Access Point into the home, either an extender or repeater or whatever. And that gets us better coverage, and that’s our current primary aim. Even if you have a single AP, band steering is useful. In a multi AP environment, it’s essential. MIMO (Multiple input, multiple output) devices which are 3 x 3 (3 radios and 3 antennas) work fairly well, and 4 x 4 (4 radios and 4 antennas) gives you a little more antenna diversity.

But we have to look at the network as a whole and ask where is the right place to connect a client?”

Now we head to Norway, which is one of the most networked countries in the world, and regularly tops European broadband league tables, and asked Tore Løge at Telenor about his experiences in Smart Wi-Fi.

Telenor is just coming off one trial with a prototype and planning the company’s first strategic move into Smart Wi-Fi.

“We have piloted a Smart Wi-Fi project with 50 employees at their homes. We know our previous home gateway had some issues with Wi-Fi’s performance and coverage, and so far the results of this trial are extremely positive,” said Løge. He now plans to introduce the ideas into Telenor’s next generation router.

“We have taken a first intermediate step by offering that trial system, through a third party, so that consumers who have urgent problems can buy it now,” says Løge.

He has since gone through an RFQ process and has chosen to work with software from SoftAtHome for his future strategy. “We chose to work with a pure software supplier because we want our future systems to be software based, so we can avoid a lock-in to a single hardware provider.”

Løge found that SoftAtHome sees many things the same way he does, “It’s important that we end up with a single seamless SSID across both 5.0 GHz and 2.4 GHz. We are believers in steering devices to the correct band and steering them to the right Access Point,” he added. “And we need control of Airtime allocation, but one key issue for us is low latency. Some systems we have looked at have some latency issues, and this is because the design chases throughput too aggressively,” he said.

Talking to Dr. Wong at HKT in Hong Kong the situation there is very different. Some 60% of HKT broadband customers have gone out and purchased a new router from Netgear, Linksys, D-Link or TP-Link. These retail routers are well known for having easy to remember default passwords built into their security, so PCCW customers worry that they are insecure.



When we spoke to him HKT was in its first few days of a geographical exclusive deal with Google over Google Wi-Fi, which is secured using a customer's existing Google account password. So unlike European operators, which have captured the vast majority of their home gateway customers with their own Wi-Fi, HKT is in the process of trying to win them over to its own Wi-Fi.

Most operators are not keen to take solutions from companies like Google Apple, Facebook or Amazon, often known collectively as GAFA – because of their agenda to drive further use of their other services – for instance Google likes operators to favor its search and Android devices, while Apple devices tend to only work with other Apple devices. Obviously in HKT's case, with low penetration of its broadband base with in-house routers, this has not been a consideration.

HKT in the past has used home gateways from two existing set top suppliers, and initially it approached these two for a Smart Wi-Fi gateway, but they are not yet ready with a product. "So we went for the Google Wi-Fi deal. Our old suppliers are good at DSL (digital subscriber line), VDSL (Very high bit rate DSL), Fiber and PON (Passive Optical Network) technologies, but not good enough yet at Wi-Fi," he said. The issues are dead spots in many homes and slow speeds, but also the concern that the customer can blame HKT for poor throughput performance, when it is caused by Wi-Fi which HKT didn't supply.

"Before the deal was struck, there was a test of Google Wi-Fi in just half a dozen homes, all in apartments of

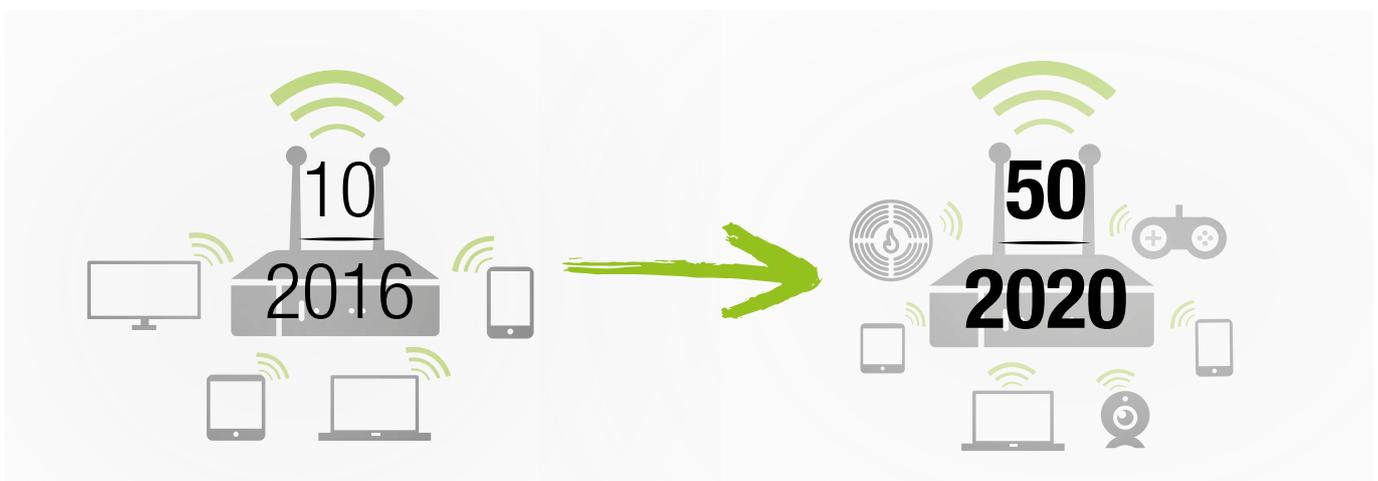
different sizes. In Hong Kong around 75% of our customers live in MDUs (Multi-Dwelling Units). We gave each home 3 Access Points. In Hong Kong most apartments are constructed of steel and reinforced concrete, making them difficult for Wi-Fi. In the trial there were virtually zero dead spots and the coverage was much better," said Dr. Wong. On the other hand the Google Wi-Fi comes with some cost because at present the installation requires an engineering visit.

Dr. Wong also felt that the outward design of the Google device would help uptake, suggesting that some customers find it difficult to find room for a big old Linksys Wi-Fi box, with four antennas sticking out, when they live in what is often a small apartment space – so they will prefer a sleek design and Google Wi-Fi has this.

Marcel Burgherr, from Swisscom explains, "We have just announced a new system using Broadcom chips and software from SoftAtHome and will deliver the first ones to customers in December 2017.

"There has been a trend towards Multi-AP, and some people want to install retail products for this, but there is a drawback in that each customer has to buy at least 2 devices."

"Swisscom already has one device in the home at the Home gateway and we just want to add one more in the living room, instead of adding two. We can attach the main TV's set top to the home gateway using the Wi-Fi in the gateway and one of our new WLAN-Box with Smart Wi-Fi from SoftAtHome."



HOW WILL SMART WI-FI HELP DIFFERENTIATE BROADBAND?

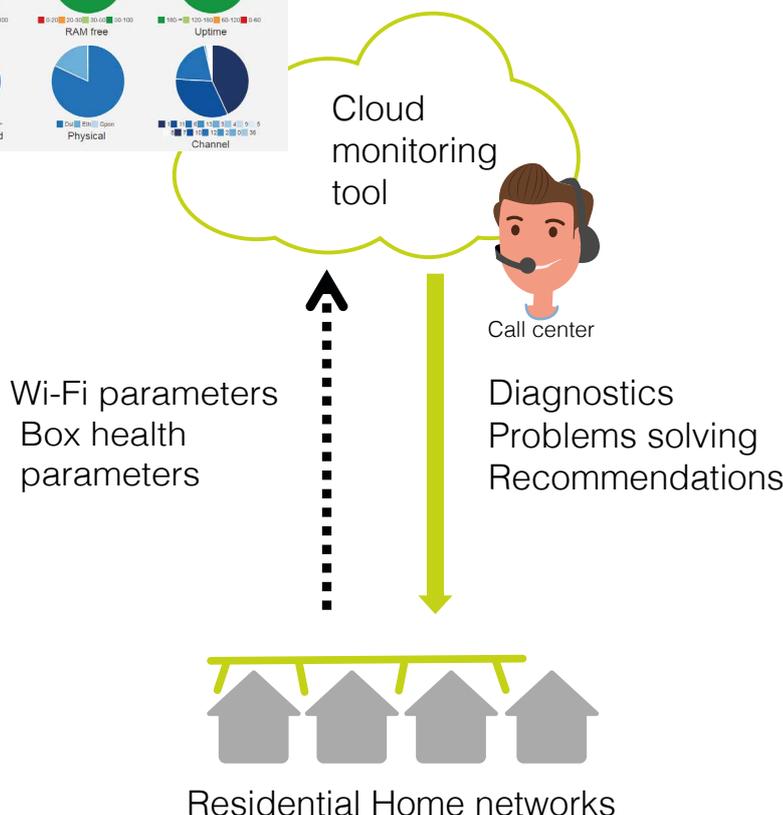
The new Orange home gateway uses a Quantenna 4 x 4 MIMO chip, running at 5.0 GHz and a Broadcom 3 x 3 chip in 2.4 GHz and Vincent told us, “We need to put smarts into it. We have already had lots of feedback from our Help Desk on the features that are needed.”

“The older system uses powerline as backhaul between the Access Points, but in our next product we want to remove powerline and just use wireless, because powerline will no longer be fast enough.” Orange is providing fiber customer speeds from 500 Mbps to 1 Gbps.

“Of course some portable devices do not yet support 5 GHz,” Vincent reminds us. “Most tablets now have 5.0 GHz, but Smart Wi-Fi is needed, and it must support both 2.4 and 5.0 GHz.”

“We don’t think it is all about monitoring the raw throughput, as much as trying to improve the stability of the Wi-Fi,” points out Vincent. “The thing is that when the customer has a problem, at any point in time there may be either of two separate things going wrong – the Wi-Fi may have a problem, but it is also possible that the broadband line is saturated – we need to know which problem is happening. Both are important, which is why we talk about 1 Gbps minimum. We want to be sure it is not the line.”

Peter Joyce at Liberty sees differentiation coming from lots of application awareness being applied as the cloud management as Smart Wi-Fi develops further. He sees systems emerging which can prioritize on the back of how individual consumers actually use Wi-Fi.



Some people want to put more smarts into Wi-Fi



He feels that many of the minor technological changes which are being made available within Smart Wi-Fi software will have little or no effect on the customer proposition. A client device can often do a perfectly good job on 10% of its maximum connection capacity, he points out.

So the Liberty Global approach is to put “more smarts” into the entire system, not just the Wi-Fi router and the company has its eye on potential advances in AI and machine learning. The idea is to be preemptive about device usage. So that if someone plays a virtual reality (VR) game on a console at 8pm most Thursday nights, it might be that at this time the video network doesn’t need so much capacity – so priorities can be changed. Perhaps this might be because the person playing the VR game is the person who watches all the 4K video. So the company sees a kind of intelligent load balancing for each of the different APs in the network, with prediction slowly being built in.

Joyce agreed about Powerline coming to the end of its useful life when used as Wi-Fi or video backhaul, topping out at around 200 Mbps. But he also insists that while 1 Gbps may be delivered to the home, it is not essential to get that amount of bandwidth around the home, perhaps something closer to half that amount of bandwidth will do the job.

Telenor wants to move to a new architecture simply because of the pace of change in customer expectation and Tore Løge said, “Customers use Wi-Fi in more devices and increasingly with video. The average number of devices per home in Norway is approaching 10 for each home, but we see some homes with 40 to 60 Wi-Fi clients, and we have to be able to offer them a service which works well.” This is a testament to how richly competitive Norway is as the leading European broadband market.

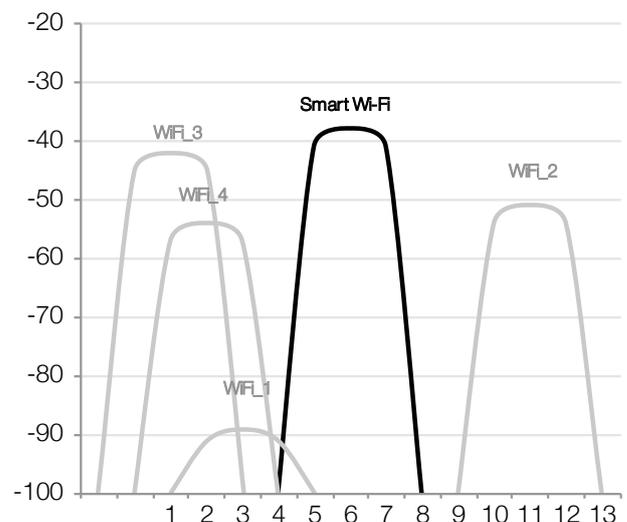
Løge worries less about fixing a particular offering in Wi-Fi and instead he knows from Net Promoter Scores that a lot of customers who do not complain, still feel that with Wi-Fi you just have to put up with some things going wrong and he wants to attack that attitude.

The senior management at Telenor believes very much in Net Promoter Scores (NPS) and staying on top of them, and are constantly looking for ways to have a higher NPS than national rivals.

One of the key things that Løge points out is that when Wi-Fi doesn’t work properly it is hard for customers to know that the problems are really down to the Wi-Fi. Sometimes they just think it is because the broadband connection is slow. “We don’t want our customers to confuse the broadband access speed with the performance of the Wi-Fi.”

But Løge is convinced after recent Telenor trials that a roll out of Smart Wi-Fi will solve all these problems. The new service will roll out in Q2 or Q3 of 2018.

There is an issue in Norway with broadband customers not sticking with the Telenor supplied router, but buying their own. “There are a lot of retail routers in the market in Norway,” says Løge, “and some people will always buy these. We all know about retail router security problems, and it’s a worry for any of customers which go down that route. Sometimes those retail routers also create problems on our network. There have been instances where we have had to blacklist devices, because they brought down our DNS servers.”



SMART WI-FI IS ALWAYS POLITE AND FINDS THE BEST CHANNEL TO OPERATE WITHIN

All this brings more urgency to Løge's aims to roll out Smart Wi-Fi, and to chase a bigger broadband market share on the back of being first to market in Norway.

Dr. Wong at HKT sees the geographical exclusive deal with Google as an easy way to differentiate HKT broadband. "The pre-orders are encouraging. Google Wi-Fi is a good weapon to convert people to our broadband service," Dr. Wong said. "If they want Google Wi-Fi in Hong Kong they must buy HKT Netvigator broadband."

HKT is the dominant broadband provider in Hong Kong, with around 2.5 million broadband homes, with some 700,000 of them as fiber customers and the rest are fiber to a distribution point just outside the building. Wong is clear, "ISPs cannot just stop services at the wall plate. About 70% of the calls we have telling us the broadband is not working, are Wi-Fi related."

Interestingly Swisscom took its Smart Wi-Fi move as much for video delivery as for general improvement of its Wi-Fi offering, replacing a previous video bridge it had on offer, supplied by AirTies. Now its new WLAN Box uses the Smart Wi-Fi software from SoftAtHome and a 4 x 4 Broadcom chip, and it began with a field trial with 1,000 employees and then carried out a survey. "We received a Net Promoter Score (NPS) of over 50, which is very good. Both coverage and speed was better, with 24% of homes saying the coverage was slightly better and 54% saying it was much better." There were similar numbers when customers were asked about speed, with 23% saying they thought it was slightly faster, and 38% saying it was much faster.

HOW WILL THEY MONETIZE SMART WI-FI?

Vincent is not yet clear on this, but Orange has always taken the view of bundling most features, and using that to attract more customers. "Orange still has not yet decided how this will be offered to clients, maybe for sale or as a rental?"

The current thinking at Liberty Global is that this should all be part of the cost of broadband delivery, the company sees this more as a form of churn protection and revenue protection, than as a direct revenue generator in its own right.

Liberty Global plans to bring all these features in gradually, one feature at a time, so unlike some operators we interviewed, it won't have a service launch date, after which all the benefits of Smart Wi-Fi will have been delivered. Its approach is consistent with Joyce's caution and over time as the demands on Wi-Fi gradually change, its systems will change so that the customer just feels that the system works well, but without really having to know anything much about the detail.

We ask about Net Promoter Scores, and Joyce nods enthusiastically, like it's a given. "We are already doing some multi-AP, and we will do more. But we have to do this in a standardized way so that we can continue to have vendor commercial tension."

How will Telenor go about turning the creation of Smart Wi-Fi into cash?

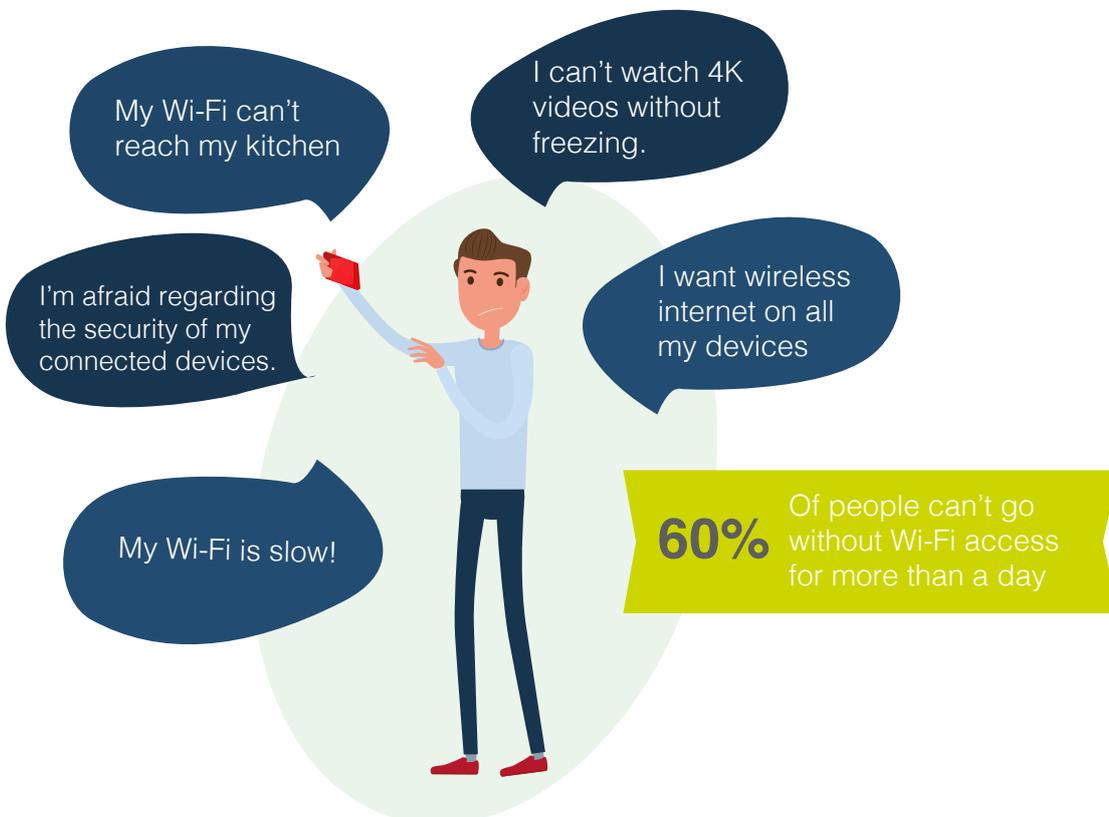


“At present,” says Løge, “we plan to market Smart Wi-Fi heavily and just go after more of the ISP market. There is no set number of APs that we will push, we think that the first step is putting just one extra AP into each home, and in some which are larger, they might need two extra APs. In very large homes with concrete walls and underfloor, water carried heating, this may go as high as 2 APs for each floor.”

The business plan right now is to simply to rent the extra Access Points out and they would all be self-backhauled using 5.0 GHz wireless. “It’s not possible to use powerline for communication in Norway,” said Løge, “So these must all be backhauled over wireless.”

In Hong Kong Dr. Wong is clear that Smart Wi-Fi is only for those who stump up the money to pay for the fastest broadband lines. “We plan to bundle Google Wi-Fi with the broadband line, but existing customers must agree to upgrade their broadband to 1 Gbps, and then they will get a pair of APs, and these operate as a mesh,” said Dr. Wong.

Google Wi-Fi integrates a Qualcomm dual mode wave 2, 802.11ac MU-MIMO (multi-user MIMO) chip, which uses not one, but two 5 GHz radios, with one dedicated for backhaul, plus a 2.4 GHz channel, to communicate with phones. In an MDU environment, it is likely that as these saturate, using two 5 GHz bands for each apartment may end up making 5.0 GHz even more congested than 2.4 GHz and create a potential future interference problem.



But for now HKT is first to market with a Smart Wi-Fi product, and plans to use it to capture even greater market share.

Marcel Burgherr at Swisscom says, “We will sell this one additional box close to cost price, because we do not need to make a profit on the device itself. New Swisscom broadband customers can also profit from a free gateway.” The single extra WLAN Box costs just 79 Swiss Francs, while other systems available retail are priced close to the 150 Swiss Francs level and customers will need at least two to achieve anything similar. So Swisscom is likely to keep most customers on its own routers.

Swisscom will also promote the service to existing customers and one way will be through the helpdesk and by being data driven. “We have data from every router and if a device is at the edge of its range then we promote this new WLAN Box from the helpdesk.

SELF HELP VERSUS CALL CENTER

One of the key ingredients to Smart Wi-Fi is that a lot more data on real time Wi-Fi performance can be made available and this can be routed securely to cloud held applications, so that either Apps or Help Desk personnel can discover why Wi-Fi is stalled or look for configuration issues. How will each operator use this ability to peek into the machinations of wireless to help keep down complaints or poor experiences?

Liberty Global says it is working on systems which can take a look at the traffic in each of its Wi-Fi installations, and take a snapshot of how the system is working. But the company’s approach to what it does with that data will be evolved over time.

For instance he doesn’t want someone in customer care killing off a connection or steering a client to a particular

AP, because that has the potential to upset someone else in the household. He prefers a world where it just happens. Algorithms should be in charge, some kind of policy manager, but this has to evolve very slowly because operators are right at the beginning of working with such algorithms. Customer care may have a role, but it may be as small as checking that the right algorithms are switched on.

Joyce makes the point that the learning curve needs to start as soon as customers have these systems in place, but that learning must occur in the real world and it can’t be “theorized” in advance. He worries that there are many types of clients and some will just hate having their Wi-Fi messed around with remotely by anybody else.

But Joyce also worries equally about the idea of giving each customer his own configuration tools for Wi-Fi, and sees this too as a bit of a danger. This is because he feels it is hard for anyone to say that any one application should be prioritized, because they don’t always realize that they will have inadvertently de-prioritized something else.

To Joyce it’s about algorithms which can manage capacity dynamically between different devices in the home, once it learns how that particular home uses the Wi-Fi resource.

“We don’t think you can afford to have customers talk to customer care, ask them questions and then get them to prioritize their bandwidth directly. It should just work,” says Joyce.

And remember that requirements change, customers may have a 5 year old and a 7 year old in a particular house, but then 5 years later you have a 10 year old and a 12 year old who will have very different uses for Wi-Fi. Joyce concludes that we must build business models around the evolution of Wi-Fi demand. Maybe one extra AP is the right thing tomorrow, but 2 years later customers



may need a few more APs added to their home. So this will involve constant evolution. Telenor's Løge said "It's too complicated an issue to explain how Wi-Fi works to the call centers and then have them explain that to the customer, so we just want our Wi-Fi to work, and for our customers to be happier.

"Customer care is a high cost for us, and this is a difficult issue for them, so what we are thinking is that we must collect and store Wi-Fi usage data, and instead of asking customer care to interpret a particular customer problem, we can instead create a set of self service options for consumers. This would aim to help them configure Wi-Fi for their particular usage and will offer advice on where to place new Access Points."

CONCLUSIONS AND TAKEAWAYS

Operators are clearly plagued by the consequences of only having a single Wi-Fi Access Point in the home, but as Wi-Fi gets smarter, each operator will have different priorities and want to harness it in different ways.

Some will want to grab market share, others will want to simply reduce churn or improve video delivery, while some operators will want to be able to take control of their Wi-Fi, so that when they get complaints, they have the opportunity to fix them permanently by re-configuring, rather than working alongside retail products.

Each operator is therefore likely to favor different aspects of Smart Wi-Fi in the first instance – maybe they want improved throughput, lower latency, or achieve greater in-home coverage. Some operators may even want to focus on mobile offload, supporting other customers passing the home.

One of the most important aspects is that Smart Wi-Fi gives operators access to data about connections, the amount of airtime each device and application are using, the signal strength and data throughput. Further analytics within set tops and apps may also provide operators with buffer times and QoE, which can help them further tune any of their video delivery services.

The use of the data will be dependent upon which problems are perceived as urgent by each operator, and operators will in many instances need help planning the deployment of each feature, and writing cloud apps which show in detail which aspects of Wi-Fi are the most problematic and give the operators opportunities to fix it. But we also know that the first movers in any given market to install multi-AP Wi-Fi systems, are likely to mount a challenge on market share, save costs, reduce churn and drive new revenues. The most likely outcome is an improvement in customer satisfaction and a rise in net promoter scores, which should drive overall operator brand lift, which is always acknowledged as making business flow more easily.

GLOSSARY

AP – Access Point

PHY – Physical Layer or hardware layer

MAC – Media or Medium Access Control

Beamforming – Multiple Antennas combining to create a stronger signal in one direction

Bad Apple – A Wi-Fi client device which is using too much resource

Sticky Client – A Wi-Fi client device which continues to use the wrong AP

Extender – A second Access Point which shares the same identity as a Home Gateway and communicates back to it

Mesh – A way of delivering data in multiple routes across a network

SSID – Service Set Identifier which identifies the source of your Wi-Fi and ensures the right packets are sent to each Wi-Fi client device

NPS - Net Promoter Score, a method where customers rank services

Mbps – Megabits per second (Millions of bits per second)

Gbps – Gigabits per second (Billions of bits per second)

MIMO - Multiple-input multiple-output, using multiple radio links at once to send or receive more data from more multiple antennas

MU-MIMO – Multi-User MIMO, this is when more than one client has data sent to it simultaneously

DSL – Digital subscriber line, uses Discrete Multi-tone encoding scheme to deliver broadband on a twisted pair phone line

VDSL – A family of high density DSL broadband which uses up to 35 MHz of spectrum

PON – Passive Optical Network, a point to multipoint optical fiber standard

Dead Spots – Places where no Wi-Fi signal can reach in a home due to interference or attenuation.

MDUs – Multi-Dwelling Unit, a building where more than more family lives

3 x 3 – A Wi-Fi term for 3 radios and 3 antennas sending at once

4 x 4 - A Wi-Fi term for 4 radios and 4 antennas sending at once

Powerline – Using electrical cable to also carry a broadband signal

VR – Virtual reality, where an immersive world is created for a single user and viewed through a headset

ISP – Internet Service Provider, a broadband operator



ABOUT RETHINK TECHNOLOGY RESEARCH

Rethink is a thought leader in quadruple play and emerging wireless technologies. It offers consulting, advisory services, research papers, plus two weekly research services; Wireless Watch which has become a major influence among leading wireless operators and equipment makers, and has recently introduced RAN Research, a parallel research stream forecasting all aspects of cellular RAN Equipment shipments; and Faultline, which tracks disruption in the video eco-system, which has become required reading for anyone operating in and around quad and triple play services and digital media. Rethink TV is Rethink TV a modular service which allows you to explore the recent roadmap of OTT technology at any operator in the world, one at a time, a country at a time or a continent at a time. We also have RiOT, an IoT weekly service as well as RiOT research, which produces key forecasts in IoT technologies.



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ABOUT OUR SPONSOR SOFTATHOME

SoftAtHome's software can run on all operator devices such as Home Gateways, set-top box, Wi-Fi repeaters or extenders. It is independent from chipsets or manufacturers,



so operators benefit from the best ecosystem. SoftAtHome Smart Wi-Fi delivers the best in-home Wi-Fi experience thanks to Intelligent Channel Selection and Instant Steering. A unique SSID is propagated

on all Access Points creating a Smart Home network supporting any network topology including mesh.

Self-learning algorithms adapt to user device behaviour to constantly optimize performances and user experience. SoftAtHome's Smart Wi-Fi prioritizes time-critical traffic like multicast IPTV so that dedicated video bridges are no longer necessary.

SoftAtHome's cloud-based tools provide AI class analytics to feed both marketing teams and help solve home network problems before they occur.

SoftAtHome is a fast growing software company delivering leading connectivity, pay TV and digital services for Operator devices in the home. SoftAtHome empowers operators to compete against local and global players alike by leveraging the ecosystem to deliver outstanding services. SoftAtHome delivers a standard based cost-effective solutions, which are simple and long lasting. Its solutions are deployed in 30 million devices across 18 countries.

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The emergence of Smart Wi-Fi

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