FRICTIONLESS SELF INSTALL

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Options and Developments toward a Frictionless Self-Installation

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Executive Summary: RF detection, frictionless gateways, new architectures, and more

This document captures in summary the findings, decisions, and choices made by the Frictionless Self-Install Working Group (FSI-WG) at CableLabs, exploring solutions to the key problems that cause friction in the self-installation process.

This Working Group (WG) brainstormed the major problems, and then the potential areas to explore for technology development, trialing, and research. As of the time this report is released, the group has explored many topics in three main areas: radio frequency (RF) detection, frictionless gateway, and avoiding RF. Each area is briefly explained, then the area is broken down into subtopics and specific solutions. Some additional areas were looked at too. Some solutions are under investigation still, some are tabled until the timing is more appropriate, and others are decided to not pursue further.

Participants in the group continue to work on incremental improvements within their operations, and share information to help each other progress.

On the technology improvement side, they wish to steer development of cable modem (CM) and gateway improvements that reduce install friction, including integrated DOCSIS® RF detection, and enable direct integration with a cell phone application.

They also want to steer technology toward a solution that assumes DOCSIS RF to one location at the home, with Wi-Fi providing the inside network solution to the largest extent possible.

RF Detection

The RF detection category of work encompasses low friction or no friction ways to detect a DOCSIS signal at one or more locations in a home, most not requiring a technician. With reliable, easy RF detection before equipment is shipped, operators will know whether to send a technician or install kit. With a fast way to detect RF, customers will have a better self-install experience. With reliable RF detection, there will be a smoother, faster install experience. But because the detection of RF is ambiguous, the group defined specific RF detection needs for a frictionless self-install experience:

- differentiation of the RF source, separating MoCA, DOCSIS, Satellite, and over the air (OTA);
- identify DOCSIS RF in seconds; and
- possible integration with the gateway, maybe the home wiring itself if it can be powered.

Next, we outline the identified methods for RF detection.

Passive

- Simple detection of RF energy, perhaps by RF harvesting to power an LED. This is too simple and open to false positives.
- Simple RF detection with thresholding. This is still too open to false positive RF detection.

RF Tuner

- Use an RF tuner repurposed for RF detection. As an example, take the Hitron DSS-01. There are also versions from VeEX Inc. which can scan DOCSIS and MoCA frequencies separately to differentiate them, or the solution offered by PPC which may be programmable in flexible ways. Some of these options can be made for a low cost but all must be powered in some way. These capabilities are promising and are being trialed with operators as tools to learn about the installation experience. However, it may just be a way to experiment with gateway enhancements in the long run, or be used to serve a small niche market.
- Place the repurposed RF tuner into a wall plate. In this application, the problem with powering still exists, but RF harvesting or solar cells for energy may be an option in the future. Depending on the findings of the trials, this design adjustment may be considered. But there is the issue of disengaging the RF tuner from the RF port so that the energy received is not reduced when in use.
- Place the repurposed RF tuner into the TV remote. This has an advantage of being easier to power and being available with the self-install kit (SIK), when a remote is involved. Also, there are remotes offered that maintain power using solar panels attached, further reducing the power problem. This may be a consideration that rivals a modified gateway, and could be explored in the future.
- Consider other potential modifications to the RF tuner detection methods, including more optimized algorithms in the RISC processor, Bluetooth to enable connection to a cell phone to relay information through SMS or an application, cable-dongle connection to power and provide data to the application or via SMS, and more. These can be explored with field trials and models that suggest benefits weighing more than cost.
- There may be ways to create markets that place RF tuners in the hands of others outside the service process including home inspectors, real estate agents, retail channels, electricians, handyman, home builders, etc. This was informally trialed and shows some promise. One home inspector said it works and added little time to the job. One TV repair man said it will come in handy to save time in a number of jobs. Airbnb has begun rating internet capabilities at their rentals, so there could soon be an emerging market for real estate agents and buyers and sellers to request the information ahead of the transaction. There remains a problem of data management however, so depending on what develops we may want to define data solutions for the industry to be ahead of the demand. This could be done through SCTE or CableLabs as industry standards or specifications.

Software Defined Radio (SDR)

Consider SDR-based solutions, with a dongle connection to a cell phone. This has been investigated as it avoids the powering issue, and provides more capabilities than a basic repurposed RF tuner, but is more expensive and has questionable benefit above the same functionality provided by extension of RF tuner solutions like the Hitron SSD-01.

Power Alternatives

There are advantages to considering alternate powering options like solar, RF harvesting, etc., added to RF detection to extend battery life, or eliminate the need for a battery. Solar was added to a remote and demonstrated at CES in 2021; this suggests adding RF detection to a TV remote may be a worthy consideration for some operators.

Head End Detection

In these methods, we reverse the path of the detection signal to be sent upstream and detected by the burst receiver.

- In a first approach, a cell phone sends the signal that could be detected by the burst receiver and time-aligned through an application to verify connectivity. This was explored by Comcast and found to have potential, but iOS issues limit the penetration of this solution. Exploration continues within Comcast to search for a method or time in which the constraint is relieved.
- One could create a number of small battery-powered devices that emit a pilot signal coordinated with an application for location detection. Maybe one could create a device that encodes GIS coordinates and sends them over the coax connection to a receiver intended to receive these signals. This has not been explored. Perhaps an SDR could be explored to do this. However, this can conceivably be done with a CM too, if enabled to do so.

Leakage

Leakage methods have been studied to potentially detect RF. But the existing tools have been found to be insufficient, unreliable, and leakage should be very rare and not made more common as would be needed to be useful for RF detection. Therefore, this technology was deemed not viable, though if allowed to send a pilot for leak testing there may be an option to explore in the future.

Frictionless Gateway

The FSI-WG envisioned the concept of a gateway that was capable of fast, reliable relay of accurate information about the service (DOCSIS RF, Wi-Fi quality, and potentially more) without reliance on the DOCSIS connection (over coax), and potentially providing basic service in addition to management data through a second method when RF is not reliably connecting to the gateway. This concept could be extended to relay information for set top boxes and secondary equipment. By detecting RF quickly, the install process has less friction. By sharing information back to assistance seamlessly, customers can be rescued in the install process. With a backup capacity plan, service can be put in place quickly and then improved later, thus improving the experience further.

Potential options for realizing this capability include exposing the boot process results, putting RF earlier into the boot process, adding separate RF detection to the gateway and exposing it, and potentially adding power to the RF detection so that it does not need AC power to function.

Based on prioritization work done by the working group (WG), the WG set out to define the information needed from the gateway or CM during installation that will make the install process frictionless with a reliable outcome, and then pursue methods to obtain these data elements, either through Wi-Fi Alliance (WFA), Broad Band Forum (BBF), or CableLabs WGs such as User Services Platform (USP) and Operations Support Systems Interface (OSSI). However, as the WG concluded before completing this work, it will be considered for a future effort if enough evidence is gathered to support it.

The group operators will continue to trial expansion of the business gateway in the meantime, as that concept is closely aligned to the frictionless gateway idea, though less focused on installation and less capable overall.

Figure 1 shows the ranking process that the WG conducted to prioritize the five envisioned solutions (version 1 through 5, or V1 through V5) for a frictionless gateway. Each of these options is explained further in text next.

Idea Version	Criteria								Results		
Frictionless Gateway	Dev Cost	Deploy Cost	Dev effort	Deploy effort	Dev time	Cust. Exp.	Impact	Testable or Started	Total	Rank	Notes
V1 - GW-Cell-BackOffice	4	2	3	2	4	1	1	4	21	2	Tie for Second
V2 - GW-Cell-Display	1	1	1	1	1	2	2	3	12	1	Best
V3 - GW-Display	3	3	2	3	2	4	3	1	21	2	Tie for Second
V4 - GW-BackChannel-BackOffice	5	5	5	4	5	3	5	5	37	5	Worst
V5 - BusinessGW expansion	2	4	4	5	3	5	4	2	29	4	Middle

Figure 1: FSI-WG ranking of the five idea areas for a frictionless gateway (lower is best in rankings).

- V1 – GW-Cell-BackOffice – Relay management information from the gateway through a cell phone application to a back-office application. Comcast is exploring this idea with the goal to reduce install time (friction). The FSI-WG considered writing specifications for a frictionless gateway, or through a separate WG. This idea relates to the Wonder Twin Power project at CableLabs. The next version however is a shorter step to take first.
- V2 – GW-Cell-Display – Relay management information from the gateway to a cell phone application that can display information and guide a user to take appropriate action without reliance on the cable plant. Again, the FSI-WG considered writing use cases for a frictionless gateway, to provide input to a separate WG (considering the USP-WG). This idea space was identified by the FSI-WG as having the most promise, and is the starting position for the first idea listed here.
- V3 – GW-Display – Enhance the display on the gateway, either by adding more complex LED patterns, code readouts on low-cost LCDs, detailed messages on low-cost LCDs, or forms of audio (human understandable, codes, or tones for a phone application to interpret or send to a back-office application). A WG could be formed to define the information desired, and how to standardize on the translation that the customer sees. But perhaps it is enough to expose the data through the USP-WG and let CM manufacturers innovate. This idea is viewed as a stop gap measure for when an application is not viable. Still, even with a simplified interface, say a single LED, there may be ways to display blink sequences that can be read in other ways. But as many operators are getting away from displays completely, this idea is rated lower than some others.
- V4 – GW-Back Channel-Back Office – Create a gateway direct back channel, using options including LTE, Wi-Fi (mesh or shared SSID, etc.), tethered cell phone, etc., to perform functions without a cell phone application needed. This idea also relates to the Wonder Twin Power project at CableLabs. Deemed expensive and having questionable utility, the group decided to give this low priority, though this idea space continues to be examined at Comcast as an LTE dongle attached to the gateway. V2 may be a good staring place to explore the utility of this V4 idea space.
- V5 – Business GW Expansion – Expand the use of a business gateway in residential applications, with a backup channel established either directly (Say LTE), or via a shared peer to peer (hub to spoke or mesh) network connection. The WG considered modeling the conditions under which this approach may apply to assess the utility of the overall solution space. While being explored at some companies, this approach is deemed lower priority for the group. But as operators push the application space of their business gateways, we will gain knowledge which may inform this and other considered approaches.

RF Avoidance (passive)

This area of exploration includes methods for reducing the RF problem in the install experience, including Wi-Fi only solutions, or minimizing the reliance on coax in the dwelling. The group met with Wi-Fi experts from CableLabs to develop plans for timing around home coax reduction, and explore joint pursuit of installation experience improvement.

- Ubiquitous Wi-Fi, and partnerships with multi-dwelling units (MDUs) for service ready at move-in, with Wi-Fi retrofit and other means – Operators are trialing and expanding on their university, campus, MDU, and community solutions. The FSI-WG participants could expand trials across other operators to compare notes, design tests, etc. The FSI-WG shared knowledge from operators who studied these approaches, and they work well. As operators expand on these approaches, there may be critical mass created so that installation is simplified much more broadly.
- Single RF port at side of home – This was an idea under evaluation at CableLabs. The FSI-WG exchanged information with the Perfecting Wi-Fi groups pursuing similar ideas. CableLabs could expand this work area to lab testing if requested by the WGs. Note that this is very close to the assumptions made for DOCSIS 4.0 deployments.

Additional Areas Explored

Home Data

This area of research includes methods to assure that details such as RF appearance at locations are captured so that the information is reliable (or has known reliability), accessible, and secure. Many operators have existing activities pursuing incremental improvements here. Now that Airbnb has begun publishing Wi-Fi speeds on their listings, we may see real estate markets pushing for similar information soon. Getting ahead of this trend may allow us to monetize the information too. Consider a mix of approaches to get a good foundation:

- Collect data when technicians are in the home, keep records, tag plates.
- Expand to home inspectors and other technical resources in the home before and after installation.
- Create a customer incentive structure to entice customers to collect and provide data, leave the gateway when moving, or attempt a self-installation even after a tech install is scheduled.

Simple Continuity

There may be some utility in having knowledge of continuity in the coax, even if RF does not appear at the wall plate. However, this was deemed as low priority so not pursued by the WG. Some variations of this approach are outlined next.

- Detect via return loss – low detection level, low probability of detecting, low reliability.
- Continuous wave (CW) send, CW catch – relating to methods on RF detection. Unreliable and difficult to implement in a cell phone.
- Cable Clothespin and other methods – many simple methods explored early in evolution that were not pursued for various reasons as covered by Tom William's presentation, and some of his approaches.

Topics and Work for the Future

Topics Yet to Be Explored

- Drop disconnection not matching billing records; how to fix this as drops are a significant reason for install failure?
- How to reduce unnecessary equipment swaps, which impact customer experience poorly, and how to track it?
- Proactive swap programs, how to make those 100% successful as they should be?
- What methods are available for finding house amps and splitters before sending out an SIK?

Explored Topics that Need More Work

- Explore embedding Augmented Reality into self-Install workflows or other support-based workflows.
- Wi-Fi 6 and backward compatibility.
- Preparation for a single plate in the home, and Wi-Fi for everything else.
- What can we do with improving the boot process or other solutions to help with wired STBs and their install success?
- Detecting MoCA vs DOCSIS RF with vendor prototypes and determining what is possible.

Frictionless Gateway

- Define use cases and data needs to support FSI and provide that as requirements to the USP-WG.
- Continue to share findings as operators explore and test this area.

RF Avoidance

- Ubiquitous Wi-Fi, partnerships with MDUs for service ready at move-in, with Wi-Fi retrofit and other means. Comcast is trialing. A WG could expand trials across other operators to compare notes, design tests, etc.
- Single RF port at side of home – Work with Perfecting Wi-Fi groups pursuing. Could expand to lab testing if requested by the WGs.

Conclusions

A rich set of CMs and gateways for various use cases may be required to provide better installation experiences. A better integration with helpful installation applications on edge devices, which can best guide the customer reliably, would be far better than blinking LEDs. Developing these solutions for the industry would allow cable providers to compete with other internet service providers, and the same tools can be used to facilitate and automate troubleshooting as well, thus improving the overall experience provided by cable-based services. More research and development are needed, by vendors, operators, and CableLabs. Fortunately, operators plan to continue to share their findings and work to help the entire industry, even after this WG concludes.

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