ADVANCING THE INTERNET OF THINGS WITH IPV6

HOW THE NEXT INTERNET PROTOCOL SUPPORTS THE NEXT INTERNET

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For the Internet of Things to advance and reach its full potential it must be built upon a broad and robust foundation.

This whitepaper is part of the gogo6 special report on IPv6 & The Internet of Things. See the report for original infographics, podcasts, videos, presentations and other useful resources.

OVERVIEW

For the Internet of Things to advance and reach its full potential it must be built upon a broad and robust foundation. This foundation is the network – the network that transforms physical "things" into an information system that can be read, changed and interpreted to provide value. Today's foundation, consisting of spindly silos of proprietary networking tech, is wobbling under our expectations.

This document describes an evolution to the next generation Internet Protocol, IPv6, and how that will enable the Internet of Things to reach its full potential.

INTRODUCTION

Even before the Internet of Things had a name it was evolving separately in different industries solving different problems. Each use-case was driven by the functionality of the "thing" and goals of the system. Each network's technology followed its own evolutionary path. Most were kept propriety and some were standardized through the IETF, IEEE or ITU, but they all stood separately.

Whether it was a SCADA (Supervisory Control and Data Acquisition) system for business or a home automation system for consumers, specific networking technology supported specific tasks. From this sprouted the infamous IoT (Internet of Things) silos – independent ecosystems that stunt growth and hinder innovation.

Connecting a proprietary network requires the use of a “translator”. This has given rise to the internet of gateways and the Internet of cloud middleware. And whenever translation is involved, trouble isn’t far behind.

Requirements for the networking layer can be described in infinite ways but can be boiled down to information and device complexity. A low-cost battery powered temperature sensor communicating a single reading once a day wirelessly has very different networking needs than an expensive and complex bridge sensor communicating a deep set of complex data in real time over Ethernet.

Given this wide range of use-cases, is it practical to use a single networking technology?

PROBLEM

For any technology to get off the ground and reach escape velocity, the economics must work, and the Internet of Things is no different. Looking across all business and consumer industries we see the result of IoT’s Darwinian history - a litany of custom deployments within restraining silos.

Launching a new IoT deployment or expanding an existing system today is relatively expensive. Sensors and actuators that only operate within a single vendor’s IoT silo are naturally more expensive and the deployment’s functionality is constrained by the inventory of components available.

Even more expensive than custom components is custom integration. If an instance of IoT requires a specialized team of system integrators to connect the dots to make things work, or worst, are needed to maintain the system, the business model won’t work for most organizations.

Proprietary networks cannot exist in isolation. To derive any value they must interface with internal and external applications, services and people. Connecting a proprietary network requires the use of a “translator”. This has given rise to the internet of gateways and the Internet of cloud middleware. And whenever translation is involved, trouble isn’t too far behind. Practically speaking, translators require a lot of special care and attention (labor cost) to make them work as designed and even then, they break things. Not only do they add an unwelcomed layer of complexity and unreliability to the system, they don’t scale – whether as a local device or service in the cloud.

SOLUTION

Most would agree [1] that the same proprietary networking technology that independently followed its own path will eventually find its way back to a networking tech that has been around for over 20 years – the Internet Protocol. Standardizing on IPv4 and IPv6 will nourish a new market of standardized components. Selection will be greater, inspiring ideas, and costs will be lower, by riding the economics of scale.

There's a nickname for IP in some IoT circles - the "Integration Protocol". A well-known entity like IP makes for simple integration. It slashes costs by relying on common knowledge and by drastically reducing the need for network-bloating gateways and trendy cloud middleware that break the end-to-end connectivity benefits of IP.

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In addition to knocking down cost, the biggest hurdle limiting IoT expansion, the Internet Protocol also carries along a few other important advantages.

According to the U.S. government, attacks on critical infrastructure like electricity and water has increased some 700% since 2011 [2]. A breach of something as simple as a temperature controller can have wide reaching effects. IP network security isn't perfect but it's a better place start than reinventing the wheel atop another networking protocol.

We can be confident that IP's proven architecture and $514 billion IT ecosystem [3] that supports 2.4 billion users today [4] will scale to connect an estimated 50 billion devices by 2020 [5].

And the same characteristics that make IP the "Integration Protocol" also make it the "Interoperability Protocol". Already interoperable with layer 2 (Data link layer) and indirectly, layer 1 (Physical layer), IP runs seamlessly over any wireless or wired connection – perfect for supporting the wide variety of links and transmission mechanisms required for diverse IoT applications.

WHAT ABOUT IPV6?

IPv4 is the predominant Internet Protocol and will continue to be for years but it can't last. Addresses have already run out at two the three largest Internet Registries (APNIC and RIPE) and the third, ARIN, is estimated to run out in 2014. Economics will drive the migration to IPv6 at its own pace.

While the IPv6 characteristics of a larger addressable space and auto configuration add value to IoT, it will simply be the unavailability of IPv4 addresses that will rise the IPv6 tide for every networking application, including the Internet of Things. IPv6, like its predecessor, will be with us for decades to come - future-proofing any IPv6-based IoT deployment.

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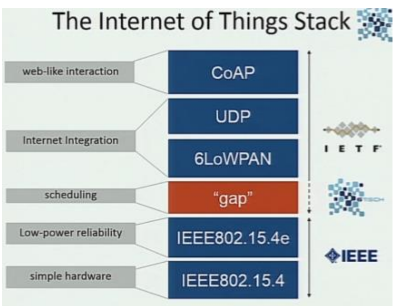
NOT ALL ROSY

But not all is rosy with IP. Conspiring against it is its power requirements, memory size and resilience in unreliable networks. IP has proven itself on high-powered, fast networks, but many IoT deployments are built upon low-power, lossy networks. We know IP can scale up, but can it scale down?

IP today can seem like overkill; as can Wi-Fi for IoT at layer 2, but that's not stopping its growth in popularity. The ubiquity of Wi-Fi and IP are undeniable forces. A force, in the case of IPv6, that is enabling it to work in tiny, low-cost, low-energy, low-processing devices on lossy networks.

In a similar way that DSL was created to make telephone lines better accommodate IP, 6LoWPAN and more recently 6TiSCH were created to make IEE 802.15.4 radios (widely used in wireless IoT) better accommodate IPv6. Also supporting the rise of IPv6 in the Internet of Things is RPL, a routing protocol for constrained node networks and CoAP, a constrained application layer protocol that enables web services for even the most constrained devices and networks.



From Xavier Vilajosana presentation at gogoNET LIVE! 4 on 6TiSCH filling the gap.

CONCLUSION

IPv4 is the networking protocol of the current Internet of people and IPv6 will be the networking protocol of the next Internet of things. There are too many forces helping and too much shear brain power working on the challenges, to reach any other conclusion. It may take time for current, proprietary IoT deployments to refresh and transition to IPv6 but when they do, and we have one common networking protocol, the benefits derived from the Internet of things will be historic.

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REFERENCES

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