ITSPA

IPv6 Opportunities and Challenges for the VoIP industry

About ITSPA

Founded in 2004, ITSPA is a membership-led organisation that represents predominantly network operators, service providers and other businesses involved with the supply of VoIP and unified communication services to business and residential consumers within the UK.

ITSPA helps act as the voice for the sector to key stakeholders; ensures that standards created by or imposed on industry are fair; leads on developments of best practice; campaigns on key issues that members face, promotes competition and self-regulation and serves as the leading networking forum for the UK VoIP industry with events throughout the year (including the annual industry awards – www.itspaawards.org.uk)

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Members also receive complimentary subscription to the dispute resolution scheme CISAS; summaries of Ofcom (and other) consultation papers; regulatory briefing documents; Government monitoring and intelligence reports; updates from legal professionals; anti-fraud information; and the opportunity to collaborate with peers to promote career development.

About IPv6

Internet Protocol version 6 (IPv6) is the new revision of the Internet Protocol (IP), the communications protocol that is used to carry traffic across the Internet. It is intended to obsolete and replace IPv4, which still carries more than 96% of Internet traffic worldwide as of May 2014. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with, among other things, the long-anticipated problem of IPv4 address exhaustion.

> SIP natively embraces IPv6 addressing, so assuming that SIP clients/servers are suitably provisioned, it should work with a minimum of fuss.

Background

Available IPv4 addresses are running out. On the 3rd February 2011 the Internet Assigned Numbers Authority (IANA) allocated the last remaining block of IPv4 addresses to Regional Internet Registries (RIRs). This means that once the allocated addresses are used by the respective RIRs, there will be no further IPv4 addresses to hand out to members. Current statistics (2014) show that RIPE (responsible for European IP allocation) has a remaining pool of around 15 million IPv4 addresses. Even with extensive efforts at conservation (such as the use of NAT and reclaiming allocated but unused addresses back into the pool), the march towards zero available IPv4 addresses continues.

The consequences of IPv4 address pool exhaustion are that no further IPv4 addresses will be available for customers. It is already getting difficult to obtain IPv4 addresses for customers.

IPv6 will solve the Internet address shortage problem by expanding the available address space from about 4.3 billion to an astronomical 3.2×10^{38} possible addresses (7.9×10^{28} times as many as IPv4).

A period of parallel running of the two protocols will be required during the global transition to IPv6 which means IPv6 will take time to fully resolve the problem of address shortage. The transition to IPv6 was meant to be gradual but requires the "network effect" to kick in, which is has not yet, in order for the required deployment work to be done. This is apparent from the fact there has been discussion and development on IPv6 for more than 20 years, yet IPv6 adoption is still patchy. However the depletion of available IPv4 addresses is now forcing the issue. Members that are not "IPv6 ready" need consider the potential risks around a rapid switch over to IPv6 caused by the exhaustion of available IPv4 addresses. As such, it is strongly recommended that members make sure they start initiating a plan to be IPv6 ready, if they haven't already done so.

The IPv6 support depends on:

- Capabilities of networks and devices at the ITSP
- Capabilities of the ITSP's access networks
- Capabilities of the customers' access networks; this includes public and private circuits to customer premises and public networks such as Wi-Fi hotspots, 3G and 4G data networks

Deployment Timescale

In October 2011, about 3% of domain names and 12% of the networks on the internet had IPv6 protocol support. There has been an improvement in take-up since 2012's World IPv6 Day, but still 96% of traffic on the internet is IPv4. Many of the world's most popular services, such as Google, YouTube and Facebook have shown that they can extend services to be available over IPv6, but the co-requisite enthusiasm from ISPs is lacking. Looking at the UK, none of the large ISPs are offering IPv6 for general residential connections. This is quite poor compared with IPv6 success stories like XS4ALL (in the Netherlands) and Free (in France).

None of the large UK ISPs sees IPv6 as a competitive advantage, and there is much foot-dragging in making an infrastructure investment in a technology that it is considered "not necessary". At the core of ISPs, IPv6 is now starting to be rolled out.

Meanwhile, looking at large scale network deployments in other fields, such as transport and energy, IPv6 endpoints are assumed as a starting point. The GSMA's *Connected Cities* proposals talk about IPv6-enabled endpoints for applications like remote data reporting / logging and information dissemination. Example applications would be communicating train/bus location information, or large scale reporting of domestic energy readings via wireless technology. For these types of M2M (machine-to-machine) and embedded applications, it is clear that millions of new IPv4 addresses are not going to be available.

The rapid adoption of wireless aids the adoption of IPv6 in more ways than by depleting the number pool: it increases the expectation of mobility, and also encourages rapid device turnover. Mobile IP, which allows users to stay connected to the services they depend on as they roam, is defined for IPv4 and yet almost unused; IPv6 addressing improvements greatly simplify Mobile IP deployment and has the potential to make this much more popular in the future. Rapid deployment of new services has encouraged short device life and rapid upgrades; this in turn allows devices to quickly adopt new protocols, and stay in step with changes at the service layer. Deployment of "Internet of Things" (IoT), which is expected to want to use IPv6, will put further pressure on Service Providers to adopt IPv6 and to increase investment in IPv6 in embedded technology such as CPE devices including VoIP phones, telephone adapters and compact PBXs.

SIP and IPv6

On paper, SIP has had a relationship with IPv6 for a long time. Although probably more attuned to seeing IPv4 "dotted quads" as part of a SIP address, the use of IPv6 with SIP has been well-defined for many years. Likewise "RTP (for media transport) using IPv6" is an established and working solution.

In the wireless sector, the 3GPP "next generation" services based around the Evolved Packet Core (EPC) are defined for use on IPv4 and IPv6 equally. This architecture underpins services like Voice over LTE (VoLTE), currently changing mobile phone technology from circuit-based to a fully packet-based service.

Mobility is an intrinsic part of SIP, and the ability to register from multiple locations, while retaining the same telephone number and services is already user expectation. This dovetails with improved mobility at the infrastructure level in next generation services and makes VoIP a natural application of IPv6.

Challenges for SIP

Implementing SIP over IPv6 is a particular challenge because SIP messages include embedded IP addresses. Running SIP natively on an IPv6 network requires that the SIP stacks on all devices are capable of correctly parsing and processing IPv6 addresses.

There are several available methods for implementing IPv6 connectivity but the most preferred one by far is "native dual-stack" and this is what UK ISPs will use. In this approach all systems support both IPv4 and IPv6 network stacks natively and use the appropriate stack for communicating with each remote device. This avoids using the IPv6 via tunnelling solution which comes with complexity, latency and other issues of implementing or the IPv6 only network solution with its lack of legacy IPv4 support.

Implementing dual-stacks at the IP level is relatively straightforward, however, unlike most other higher level protocols, the SIP stack sees and has to deal with IP address and so must also support both IPv4 and IPv6 address format and also be capable of SIP header mapping to convert between the two formats.

> Some ITSPs' are already taking advantage of the benefits afforded by IPv6 and deploying Dual Stack handsets which are readily available from many leading handsets manufacturers to overcome the constraints of NAT.

The exhaustion of IPv4 addresses might force ISPs into implement "Carrier Grade NAT" (CGN), which is a giant centralised NAT at the ISP that runs thousands of sessions. This is problematic for VoIP especially when combined with CPE doing NAT to give "double NAT".

Benefits for VoIP

The use of NAT on a customer's network is a huge headache for VoIP and NAT is often implemented because of lack of public addresses. The NAT on IPv4 issue will get worse if ISPs put customers behind CGN so that customers experience "double NAT". IPv6 has the potential to solve this issue, allowing VoIP equipment to easily have public IP addresses and so not have NAT.

Summary

Routine provision of IPv6 to the UK end-user is still far from the norm. The level of preparation in the UK seems behind the curve; however rather than being complacent, members should ensure that their VoIP infrastructure is ready for the change, since the adoption of IPv6, when it comes, is likely to happen quickly. Those members that have not prepared may find themselves fairly quickly at a disadvantage while they spend time and money implementing IPv6.

New services, like utility metering and wireless deployments are likely to move rapidly to IPv6, and there is a danger that wired and broadband-based services will be further behind. IoT devices and software will likely create spin-off benefits for low-cost VoIP devices.

Strategies for SIP over IPv6 deployment are dependent on the architectural choices by ISPs. The chosen architecture will decide customer-side CPE, and the rapidity of change-over from IPv4 to IPv6-based services. Dual-stacked clients will offer a seamless transition to IPv6.

SIP natively embraces IPv6 addressing, so assuming that SIP clients/servers are suitably provisioned (and software/firmware-updated) for IPv6, this should work with a minimum of fuss. CGN will be a real challenge for SIP over IPv4 and the question of who controls remaining pools of IPv4 addresses can affect customers directly.

Recommendations

- Ensure that core services, including business processes, are IPv6-compatible and test with IPv6-aware CPE.
- Consider changes and compatibility issues of IPv6 to business processes including databases and provisioning.
- Adopt IPv6 sooner rather than later, as some ITSPs have already.
- Request native IPv6 support and connectivity from ISPs, interconnects, partners and suppliers.

Further Information

- www.ipv6actnow.org
- www.worldipv6launch.org
- GSMA
- Nominet
- RIPE
- Mobile IP (rfc5944, rfc6725)

Notes

This paper was prepared for ITSPA by ITSPA Operations Working Group and the ITSPA Secretariat. This guide has been prepared by the authors (who hereby assert their moral rights) on an 'as is' basis and is not intended to constitute advice on regulatory or any other matters, whether general or specific, and accordingly the authors disclaim all liability, however arising, from any reliance placed on this guide.
Copies of ITSPA's two responses to the two Ofcom consultation phase can be found on the ITSPA website "Policy Papers" page or via the ITSPA Secretariat.