IGF 2016 - Best Practice Forum on IPv6

'Understanding the commercial and economic incentives beneath a successful IPv6 deployment'

Case studies

These case studies serve as input for the 2016 BPF on IPv6. They are collected via an online questionnaire or contributed directly via email and on the mailing list.

The Best Practice document of the 2016 IGF BPF on IPv6 can be found at: http://www.intgovforum.org/multilingual/content/bpf-ipv6

The below questionnaire was used to collect case studies via an online survey between August and December 2016.

Questionnaire:

1. General Information
   Name organisation and / or project
   Country
   Region
   Contact person (email not disclosed)
   - ★ What is the most accurate description of your activities and the network for which you deployed IPv6?
   - ❖ Please provide details on your activities and your IPv6 planning.
2. Motivation
   - ★ What was the motivation behind the decision to deploy IPv6?
   - ❖ Follow up questions: (A) Were there external parties involved (eg government project stimulating IPv6 deployment, request from clients, …) (B) Did you face any challenges ? If yes, what were the challenges and how did you overcome? (C) Do you see any remaining issues which need to be addressed?
3. Business case
   - ★ What are the economic and business factors that you have taken into consideration? (short, mid, long term)
   - ❖ Follow up questions: (A) How does the IPv6 deployment fit in your longer term strategy and business model? (B) Any financial and business assessments which you can share ? (eg cost vs benefits)
4. IPv6 deployment
   - ★ Who took the decision to deploy IPv6 and who else at the management level was involved? The who in this case could be a specific individual, committee, a department, etc.
   - ❖ Follow up questions: (A) When did you start the planning and how long did it take? - (B) When did you complete IPv6 deployment? - (C) What were your goals and what have you reached?
5. Experience and lessons learned

- ★ What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?
- ❖ Follow up questions: (A) Did your organisation experience any financial/business impact when and after it deployed IPv6, including benefit to customers? - (B) Is there anything that your company could have done different in the planning that might have saved money? - (C) Is there anything that your company could have done different in the planning that would improve the deployment?

6. Additional information

   Please share any other additional information. (Reference URL to your IPv6 service, videos, presentations about your service, and any other information that can serve as helpful reference)

List of case studies:
(case studies contributed to the BPF via the survey come first; case studies indicated with ** are case studies available online in presentations, videos etc.)

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1. The Netherlands - PC Extreme B.V. (Europe)

PCextreme B.V.
Netherlands
Europe

Activities:
- ★ b. Service Infrastructure
- ❖ We are a hosting provider (VM, Containers, webhosting) running our services over IPv6

Motivation: What was the motivation behind the decision to deploy IPv6?
- ★ Being ready for the future and the imminent shortage of IPv4
- ❖ No external parties, we wanted IPv6. We ran into multiple issues in the past 7 years, but we were able to resolve almost all of them. It just takes time and patience.

Business case: What are the economic and business factors that you have taken into consideration?
- ★ Long term: Shortage of IPv4. If you don't do IPv6 now you will run into a brick wall at some point. Short term: Being competitive, showing our customers we know what we do.
- ❖ Again, IPv4 shortage. We need IPv6 to grow our company.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?
- ★ I took the decision. I own the company and have the role as CTO.
- ❖ We started 7 years ago and gradually added IPv6. Everything we deploy now is dual stack or sometimes even single-stack IPv6

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?
- ★ Just do it! If you don't use it you never learn how to use it. Yes, you will make mistakes, but that's human.
- ❖ We have customers coming to use because we have IPv6. They like us for that.

Additional information

2. Greece - Forthnet (Europe)

Forthnet
Greece
Europe
Submitted by: Anastasios Chatzithomaoglou

Activities:
- ★ a. Corporate network infrastructure (web server, mail server, Internet connectivity to corporate network users)
  b. Service Infrastructure
  c. Customer base for service(s) you provide

- ❖ Our retail internet service is fully IPv6 enabled since 2013. Our corporate infrastructure is IPv6 enabled since 2011. Our business internet service will be fully IPv6 enabled in Q4 of 2016 (we are running a pilot now).

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Lack of IPv4 addresses and high cost of other solutions
- ❖ a) No external parties were involved. There were some requests from clients but they were not the main reason.
  b) Our major issue was the support of IPv6 on our TR-069 platform and the management of our CPEs. We had to create our own implementation on the CPE firmware, because there was limited documentation available publicly.
  c) Our OTT (WebTV) platform is still not IPv6 enabled.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ We compared the cost of "buying" IPv4 addresses VS enabling IPv6 and DS-Lite, and we found out that the former one was not going to help us support our customer growth according to our business plan. So we started migrating customers to DS-Lite, freeing IPv4 addresses for new customers.
- ❖ Every new project (that relates to our network) has to take IPv6 into account.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The decision was taken by the IP Engineering manager (Anastasios Chatzithomaoglou)
- ❖ Relevant information is provided in the following links:
  https://ripe65.ripe.net/presentations/171-Forthnet_IPv6_-_RIPE_65_-_26.09.2012.pdf
  https://ripe67.ripe.net/presentations/287-Tassos_Chatzithomaoglou_-_Moving_On..._IPv6,_DS-Lite_&_PCP_-_17.10.2013.pdf

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ -
- ❖ a) positive advertising (word of mouth)
  b) no
  c) provide better training to customer helpdesk

Additional information

https://ripe65.ripe.net/presentations/171-Forthnet_IPv6_-_RIPE_65_-_26.09.2012.pdf

https://ripe67.ripe.net/presentations/287-Tassos_Chatzithomaoglou_-_Moving_On..._IPv6,_DS-Lite_&_PCP_-_17.10.2013.pdf

3. Sweden - Tele2 (Europe)

Tele2
Sweden
Europe

Activities:

- ★ b. Service Infrastructure
- ❖ Mobile Operator; Live with dual-stack for over 1M subscriber planning to go live with NAT64/DNS64 in near future.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Running out of public IPv4-addresses, will be easier to manage a real e2e -network without middle-ware. New services like VoLTE, IoT/M2M will be extremely hard to deploy in full scale without IPv6. Lots of performance benefits for the end-user.
- ❖ A) None B) Technical issues with devices from multiple vendors. We overcame them by pushing for solution, if we should keep them. Internal issues with priority C) Yes indeed

Business case: What are the economic and business factors that you have taken into consideration?

- ★ None more than mid term, that we will need to build a more complicated solution without IPv6.
- ❖ A) Long term to be able to have a business, that is not an obstacle for innovation like IPv4 will become.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The Network Engineers and their management. It would be great if this would be business driven but in our case it was not initially.
- ❖ A) 2010 B) Still ongoing C) Goals: First to do dual-stack and then do NAT64/DNS64 , when all other dependencies were taken care of.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ That the business case for end-customer is almost non existent today but will be there for IoT/M2M and new services.
- ❖ A) No negative impact, positive impact is the potential network performance. B) No C) -

Additional information
http://computersweden.idg.se/2.2683/1.594180/tele2-redo-for-340-sextiljoner-adresser?queryText=Tele2%20IPv6

4. Vietnam - FPT Telecom (Asia Pacific)

FPT Telecom
Vietnam
Asia Pacific
Submitted by: Tam Phan Hong

Activities:

- ★ -
- ❖ - At this moment, FPT Telecom provide Internet services to Customer with IPv6 added on. Now we have more than 100k subscribers.
  - FPT Telecom NOC team worked closely with other team to bring all websites, contents that belong to FPT Telecom to run on IPv6. I show you some website supported IPv6:
    - · fpt.vn
    - · ipv6.fpt.vn
    - · fshare.vn
    - · fptplay.vn

- fptplay.tv
- nhacso.net
- mix166.com
- startalk.vn
- abcplay.net
- giahan.fpt.vn

- All service for customer now can support IPv6 include: Broadband Services, VPN Service, Internet leased-line services, Hosting services.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ -
- ❖ -

Business case: What are the economic and business factors that you have taken into consideration?

- ★ There are 2 main reasons that FPT Telecom decide to deploy IPv6 faster than other:
  - FPT Telecom has only 1.4M IPv4 and at this moment we have more than 2M subscribers, so IPv6 is long term solution to keep FPT Telecom going rate, short term is using CGNAT.
  - FPT Telecom converted almost subscribers from xDSL using copper line to optical line, so that mean we have change to convert all CPE to new model that support IPv6, save lots money for new revolution to IPv6.
- ❖ -

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ FPT Telecom has built an organization to be responsible for the development of issues related to IPv6 as below: (image missing)
- ❖ We plan to deploy IPv6 since 2013. Over the testing in the lab system during 2014, starting in 2015 we decided to carry out testing on real network infrastructure gradually increasing subscriber numbers . By mid-2015, the number of subscriber largest recorded about 100,000 subscribers, with a total bandwidth capacity of 30Gbps IPv6 measurement range in which most of the traffic mainly Google and Facebook.
  During the period between 2015 and 2016, we focused on adjusting the parameters and handle the problems arising in the process of customers using IPv6. Almost issues focus on CPE compatible with IPv4 and IPv6, and progress to convert network from IPv4 network to Dual-stack IPv4 and IPv6 running.
  From May 7/2016, we are confident that fixed almost issues and start offering IPv6 services official to users.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Actually, the IPv6 deployment plan has started from 2013, when it then we do not feel the need for IPv6 because IPv4 is still pretty redundant . However, with the vision of executives about the need for the development of IPv6 , we have to take steps more quickly than the other competitors. And the facts have demonstrated , the current FPT Telecom is a pioneer in the progress to provide IPv6 services to subscribers.
- ❖ -

Additional information

5. Switzerland - Swisscom (Europe)

Swisscom
Switzerland
Europe

Activities:

- ★ b) Swisscom is a full-service telecom operator: Service include wireless and wireline services (voice, TV, internet, networking) for residential, business and wholesale customers
- ❖

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ IPv6 is the long term solution to the shortage of IPv4 addresses. By deploying early, we wanted to create momentum for others to deploy and use as well.
- ❖ a) No government, little customer demand. IP addressing is not seen as a problem by end customers, hence IPv6 as a solution is of little interest to them
  b) Lots:
  - Financial: incremental deployment as part of lifecycle to avoid having to have large budgets for IPv6
  - Technical: basically at every element involved. It needed time for the products to mature. Basically, it seemed like we were always the first to actually use IPv6 on any given product.
  - People: Lack of technical expertise internally. This is getting better. Now the problem has shifted to “power users”, those who like to fiddle with their equipment without thorough understanding. Their current best practice is to switch off IPv6 whenever there is any kind of problem (which are commonly not related to IPv6)

Business case: What are the economic and business factors that you have taken into consideration?

- ★ IPv6 is a strategic technical decision to keep the services running in the future that we’re offering today. It is not a business per se. It helps us to relieve the shortage of IPv4, especially when deployed as IPv6-only networks. This is possible in wireless networks: We’ve deployed VoLTE on an IPv6-only APN, and are planning to migrate the APN for internet-access to IPv6-only.
  A success factor to our deployment was the incremental approach. We started early and took small steps at a time, so that no big “program” was necessary.
- ❖ a) As stated above, IPv6 is seen as a future technical necessity for our services. We wanted to prepare early.
  b) We have no such assessments. But the lack of IPv4 addresses requires usage of CG-NAT devices, which are expensive (at least 4 times the cost per bit when compared to a normal, stateless forwarding device). Moving traffic to IPv6 helps to limit investment in CG-NAT -- but this alone will not finance the cost of deploying IPv6.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ Initially, it was me (technical cluster lead at IP network development), my boss who’s head of IP network development and his boss who’s head ot network development and who approved the initial funding. Since then, many more initiates and projects were started. I either was leading these initiatives or had a consulting role. The budget usually came from the development units, following the ordinary budgetary processes. (We always got the funding that we asked for J.)

One notable exception was the project to develop the IPv6 product for small and medium businesses: This project was funded entirely by the respective business unit. There was noticeable demand for IPv6 in this market segment.

- ❖ a) Start in 2009. First mass-market service (IPv6 wireline internet access for residential customers) in 2013, rollout finished 2015. Other products and services followed with overlapping time frames. IPv6 for mobile services are targeted for 2018. I expect the transition to IPv6 to continue at least until 2020 (large businesses are laggards).

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Two key success factors
  1. Convince the right people that IPv6 must be deployed and that deployment better start early than late
  2. Develop and deploy in small increments that fit normal project budgets.

  Using 6rd (RFC 5969) helped immensely to start an IPv6 service early that scales to carry all traffic. At the time this architectural decision was taken, the alternative approach was DS-lite – which failed for many (most?) carriers.

  So far, IPv6 is not yet an enabler for new business for Swisscom. Customers can still do with just IPv4. However, it is clearly a factor to set us apart from competition. Being seen as a technical leader justifies higher prices.

- ❖ a) Not noticeable.
  b) & c) Internal processes in large companies always lead to inefficiencies. However, that applies to all kinds of projects and does definitely not relate to IPv6.

Additional information

http://www.swinog.ch/meetings/swinog27/p/01_Martin_Gysi.pdf
http://www.ipv6conference.ch/wp-content/uploads/2015/06/B10-Swisscom-Status_Roadmap_and_Outlook_IPv6.pdf

6. Brazil - UOL Diveo (Latin America and the Caribbeans)

UOL Diveo
Brazil
Latin America and the Caribbeans

Activities:

- ★ b. Service Infrastructure
- ❖ We already provided ipv6 in UOL Infrastructure and all Cloud services. The next step is to refactor legacy infrastructure to provide ipv6 for old customers. We are also expanding our peering and transit links with ipv6 because we are observing the traffic rising.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ to attend the end user traffic to UOL website which increased when the telecommunication companies started to delivery ipv6 to their customers.

- ❖ a) No external parties involved.
  b) Yes we did. The first one was budget. We had to develop ipv6 projects in our infrastructure even with lots others projects related to new products. The second one was technical. We had to change equipment configurations, change physical structures, update microcodes and software versions to make everything works. The third challenge was the knowledge. We had to train the support staff and the development team to work well with ipv6. The fourth was security. We had to adapt our securities systems to work with ipv6.
  c) We still need to adapt back office systems and increase capacity.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ Short term: to continue to receive traffic migrating from ipv4 to ipv6. UOL has many end users using ipv6. They need to continue to access the products and the advertisement traffic was not permitted to be affected too.
  Mid term: The end of availability of ipv4 .
  Long term: Customers started to ask for ipv6 as a new requirement.
- ❖ A) We planned to have all the infrastructure supporting ipv6 natively. To finish that we need to replace equipments in our large network infrastructure. This was planned to be done in several months.
  B) We can not share that information.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ CTO, CIO and Head of Products.
- ❖ We started to plan the ipv6 deploy in 2010. We are still doing some work, but he first phase finished in 2011. The second phase in 2014. Our goals was provide access to UOL content in 2011 and to Cloud Services in 2014. We achieved all our goals.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ The main lesson was: the market had that demand. So it was necessary to deploy ipv6 in our infrastructure. Without that we would had loosen money in the last 4 years.
- ❖ a) keep the business in a healthy status.
  b) No, There isn´t .
  c) Yes, We could adapt the edge routers first.

Additional information

http://www3.uol.com.br/ipv6
http://ipv6.br/media/arquivo/ipv6/file/12/08-UOL-Rodrigo.pdf
http://www.uoldiveo.com.br/noticias-e-eventos/2014/11/21/uoldiveo-participa-de-painel-do-forum-brasileiro-de-implementadores-de-ipv6.html#rmcl
http://ipv6.br/forum/slides/6forumv6-GustavoRodrigues04.pdf

7. Brazil - Globo (Latin America and the Caribbeans)

Globo
Brazil
Latin America and the Caribbeans

Activities:

- ★ b. Service Infrastructure
  c. Customer base for service(s) you provide
- ❖ Content provider for the Brazilian largest media group

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Ensure that the quality of our service for our users is not affected by CGNAT and other techniques that will be used to deal with the IPv4 exhaustion
- ❖ A - The stimulus came from NIC.BR
  B - Most of the IPv6 implementations on our equipments had bugs and all kind of problems. This happened with all suppliers that we work. The IPv6 didn't seem to be well tested.
  C - At this point we don't have issues to address. IPv6 is working well with the networks that already deployed it.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ The big business factor was to assure that all users can access our content from any kind of device and network
- ❖ A - IPv6 will assure that we can reach all of our users without limitations that we have in IPv4

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The IT top level management with the network team. All the managers from IT were involved, as they had to address all the services and applications compatibility with IPv6. In some cases, we had to reimplement some apps to solve compatibility issues.
- ❖ A - We started in 2012 and it took 3 years to complete
  B - We finish in 2015
  C - Our goal was to have the our web and video services available in IPv6 for the Internet users

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ The main lesson is that we needed the commitment from the board to implement IPv6 and they need to understand the importance of the solution.
- ❖ -

Additional information

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8. Malaysia - Telekom Malaysia (Asia Pacific)

Telekom Malaysia
Malaysia
Asia Pacific

Activities:

- ★ -
- ❖ IPv6 services have been offered since 2010, and now cover corporate and retail customer base for leased line & broadband type of services.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ 1) Government & regulatory mandatory standard for ISPs to adopt IPv6 by a certain timeline
  2) To Ensure business continuity in view of global IPv4 address exhaustion.
- ❖ a. Regulatory imposed mandatory standards for ISPs to offer IPv6 services by a certain deadline.
  b. Challenge - Lack of business case to justify the amount of investment required – required top-down awareness and communication as well as company-wide communication.
  c. Remaining issue – How to increase IPv6 adoption by subscribers as IPv6 traffic is still low. Only leading content providers have adopted IPv6 but that is still not enough.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ 1) Ability to offer IPv6 services give competitive edge amongst local ISP
  2) Graceful migration of unmanaged customer devices / CPE (no force migration).
  3) Minimize capex through natural progression of hardware refresh (no drastic network equipment upgrades)
- ❖ While IPv6 used to be something on the network strategy map years ago, IPv6 deployment is considered as something done and is now a pre-requisite / enabler of other potentials. Thus, it is no longer in the roadmap.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ A steering committee was formed which consists of all stakeholders.
- ❖ 1. Early adoption of IPv6 began as early as 2004 at very small scale and very few customers.
  2. In 2010 (6 years later), we offered our first commercial services with IPv6 connectivity
  3. IPv6 deployment in the core network infrastructure is completed.. but in terms of services portfolio, it remains as an on-going de-facto effort.
  4. Main goals primarily were to enable IPv6 in the network and start giving IPv6 to our mass consumers, which we have accomplished. Other goals are to have IPv6 as a default requirement for any new network/service implementation & to drive IPv6 traffic up.
  5. The end goal would be to have an all IPv6 traffic-network some day.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ 1. Top-down support & company-wide communication is key to the success of any initiative.
  2. Spread the deployment cost – try to slot in during typical network tech refresh
  3. IPv6 by default for any new network/service implementation

  Short / mid term financial incentives may not be difficult to achieve. Think long term benefits of being early adopters of IPv6 – platform for content providers , advancement of IoT etc
- ❖ Maybe if we started our commercial services years earlier.

Additional information

blog.apnic.net/2015/12/01/championing-ipnt-in-malaysia/

9. USA - T-Mobile (North America)

T-Mobile USA
USA

North America

Activities:
- ★ b. Service Infrastructure
- ❖ Deployed 464xlat

Motivation: What was the motivation behind the decision to deploy IPv6?
- ★ Growing business
- ❖ No

Business case: What are the economic and business factors that you have taken into consideration?
- ★ Cost of complicated IPv4 extension solutions
- ❖ No

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?
- ★ Specific individuals championed solution
- ❖ Started 2009. Deployed 2013.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?
- ★ Just do it.
- ❖ No

Additional information
https://www.youtube.com/watch?v=Xl-hIyZSAmA

10. Japan - IPv6 Promotion Council Japan, and WIDE Project (Asia Pacific)

IPv6 Promotion Council Japan, and WIDE Project
Japan
Asia Pacific
Submitted by: Hiroshi Esaki

Activities:
- ★ b. Service Infrastructure
- ❖ 1. Smart meter system for residential houses in Japan, deployed by major electric utility companies. Especially, TEPCO (http://www.tepco.co.jp/en/index-e.html), that is the largest company in Japan accommodating more than 30 Million residential houses, and Kyushu Electric Power Company (http://www.kyuden.co.jp/en_index.html), that accommodates more than 8 million residential house, has been developing IPv6 single stack smart meter access network. TEPCO mainly uses multi-hop wireless network with 6LOWPAN and Kyushu Electric Power Company mainly uses 4G LTE IPv6 service for the access network. Both companies's system deployment is progressing with the provision of the interface (called as "B" route), that provides the capability so that residential costumer can get smart meter data by themselves for their purposes. These access networks has carrier-grade authentication functions (CHAP with RADIUS) and full-scale cyber security consideration.

2. The largest fiber-to-home infrastructure, deployed by NTT group (http://www.ntt.co.jp/index_e.html), has been deploying the default IPv6 service capability since around 2012. IPv6 promotion council and Task force on IPv4 address exhaustion Japan (http://www.kokatsu.jp/blog/ipv4/en/) has worked with NTT to monitor the progress of this deployment activities. As in summer of 2016, about 20% of fiber-to-home residential customer houses of NTT group are IPv6 capable without any notification nor configuration by their customers, as shown at http://v6pc.jp/jp/spread/ipv6spread_03.phtml . This site provides other ISP's (i.e., KDDI and CTC) IPv6 service status, as well.

3. Japan has three major MNO (Mobile Network Operator), which is NTT DoComo, KDDI and SoftBank. In the discussion at MIC (Minister of Information and Communication) in 2015, Japan will progress "IPv6 Mobile Launch" in 2017 (next year), which means all three mobile carriers in Japan will start the full-scale IPv6 service deployment in their commercial mobile networks. Page 8 in http://www.soumu.go.jp/main_content/000388371.pdf

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ 1. Large number of customer for their networks, 2. discussion among related stake-holders including Japanese government.
- ❖ (A) Government was one of important party for the discussions, but the final decision was made by private companies with technical discussion with IPv6 and Internet experts in academia.
  (B) Huge number of challenges related with technological and operational issues, since these networks are very large scale (i.e., nation-wide networks). The technical and operational experiences by industry-academic collaboration in the past helps a lot for their decision.
  (C) Especially for IPv6 Mobile Launch, we are now discussion technical and operation detail for real deployment.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ Long term operation of their networks and the "current status" of technical stability for the professional and commercial operation are the key factor for these decision.
- ❖ (A) IPv4 can not provide enough address space. When NAT is adopted, there are large operational overhead and security concerning.
  (B) Especially for mobile networks and fiber-to-home networks, it require huge cost for enabling/introducing IPv6 into their existing networks. But, it is based on the discussion among stake-holders including Japanese government. As for smart meter networks, since it is green field development, it is mainly a matter of technical stability of IPv6.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ All are company decision, with including the discussion at the government committee including all of stakeholder for these business.
- ❖ (A) fiber-to-home is since around 2012. Smart meter is since around 2011. Mobile networks is since in 2015.
  (B) fiber-to-home is on-going. Smart meter is also on-going. Mobile networks is under discussion for full-scale deployment.
  (C) fiber-to-home is about 20% and will be complete around in two years. Smart meter is about 10% and will plan to be complete in about 7 years. Mobile networks will start from 2017.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Technical stability and operational experiences. Also, the discussion by multi-stakeholders and the technical expert is important.
- ❖ (A) each company considers financial impact.
  (B) saving money is long term point, but the short term is usually not beneficial
  (C) previous and existing networks are based on IPv4 with NAT. As for the smart meter, there is not existing network, therefore it is a matter of technical stability of IPv6 compared to IPv4.

Additional information

http://hiroshi1.hongo.wide.ad.jp/hiroshi/downloads/IPv6_SmartMeter_Esaki2016.pdf
http://v6pc.jp/jp/spread/ipv6spread_03.phtml

11. Germany - Continental, Automotive Industry (Europe)

Continental AG; IPV6 for external connect
Germany and sites in APAC, EU, NA, LA
Region

Activities:

- ★ Other:
- ❖ **Overall Target is to enable IPV6 protocol/dual-stack on the network infrastructure of Continental to the public internet**
  › Public DMZs (of Conti is IPv6 enabled incl. lines. (ext. IPv6 clients can connect to IPv6 web service in DMZ)
  › Continental public websites are accessible from IPv6-only consumer
  › Public-websites-content provided over IPv6 is accessible via Continental Internet-proxies (dual-stack enabled including lines).
  › Employees using IPv6 can connect via Conti-Remote Access; Remote Access Gateways are IPv6 enabled incl. Lines.
  › Ext. Continental DNS-root is IPv6
  › IP-Address-Management tool of Continental is functional to register IPv6
  › IPv6-adresses used for public internet access are registered in Continental IP-Address-Management tool
  › IPv6 address/subnet routing concept for Corporate Services is documented
  › Proxy.pac supports dual-stack

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Connectivity to external partner via Internet must run also on IPv6, the network of Continental needs to be prepared for this situation.
- ❖ a) No external parties involved, so far there was no request from external business partner to use IPv6.
  b) Challenge in Firewall-DMZ environment more complex than expected due to missing supplier informations

Business case: What are the economic and business factors that you have taken into consideration?

- ★ There is no business case with a financial benefit.
  Major driver was to avoid any risks in connectivity for B2B and B2C, in case that a business partner or consumer might notice issues in connectivity, if he can only access via IPv6 or IPv4CGN.
- ❖ a) External Connect was defined as a first step before introducing IPv6 in the internal networks

Evaluation for IPv6 in Continental products/services or IoT/smart factory is ongoing
b) N.a.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ Decision was prepared by IT-Strategy department and Contis Network Management Council. Decision taken by Corporate Infrastructure Management and CIO.
  a) Planning six months for project preparation
  b) Implementation from Q1/2016 until Q2/2017
  c) Overall Target is to enable IPV6 protocol/dual-stack on the network infrastructure of Continental to the public internet – project is on track (e.g. ~ we see more than 25% IPv6 traffic on our internet-proxies.)

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ High effort in training, planning and testing for IT-staff.
  No major invest in hardware, licenses or services for IPv6.
- ❖ n.a

Additional information

-

12. Peru – Telefonica del Peru (Latin America)

Telefónica del Peru
Perú
Latin America / Hispam

Activities:

- ★
- ❖ Telefónica del Perú has deployed IPv6 native connecitivity to more tan 2.5 million broadband residential customers (mainly ADSL lines). Thanks to this, Peru has been the leading country in the región until Apr 2016 (later on surpassed only by Ecuador) with around 16% of accesses to Google over IPv6.
  (https://www.vyncke.org/ipv6status/compare.php?metric=p&countries=pe,ec,br,bo)

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Telefónica is a leading provider within Hispam region and therefore the first significant IPv6 deployment was decided to happen there. Telefónica del Perú modern infrastructures and experienced engineers positioned this country as the best option to roll out this technology.
- ❖ A. Government has been pretty active by promoting with events the leading role of Peru in IPv6 to local corporations and the local administration.
  B. The main challenge has been to deal with legacy customer equipment not supporting or providing a buggy support of IPv6. The natural renovation of customer equipment has mitigated this over the time showing the advantage of considering IPv6 deployment years ago.
  C. We expect to face new challenges on the forthcoming mobile deployments and delivering IPv6 to corporations.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ IPv6 is a matter of business continuation and simplifying comms for new business paradigms such as IoT, Smartcities, SmartIndustry, etc. Only those playing with the technology at first hand will be able to identify the business and differentiation opportunities.
- ❖ A. New businesses such as IoT, Smartcities, etc. are all developed with IPv6 in mind.
  B. IPv6 means costs today that might be lowered by correctly phasing network deployments/updates. Benefits will be more experimented as long as the majority of the traffic becomes IPv6 (as it is already happening in some other countries) or new businesses take benefit of that. For the latter, we expect IoT to play this business role as long as we start to see large IoT deployments, not just reduced testing pilots.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The decision was taken at the technical level with the agreement of the Services Development department and the company committee.
- ❖ A. We started our deployment as soon as Feb 2015 and it took us a year and a half to achieve a significant mass (5%). 15% was reached only one year later, so our speed is getting higher due to the precious experience and the maturity of the solutions.
  B. We do not consider our deployment complete, but we consider our strategy to be sufficiently mature to keep on growing since Aug 2014, when we reached the 5%.
  C. The main goal was to proof the technology is deployable and can reach a significant mass of users. We consider this validation challenge has been fulfilled.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Planning ahead and correctly phasing deployment saves complexity and extraordinary costs.
- ❖ -

Additional information

Press release:
https://www.telefonica.com/en/web/press-office?contenido=/jsp/notasdeprensa/notadetalle.jsp&id=0&origen=portada&idm=eng&pais=1&elem=19926

13. South Korea - SK Telecom (Asia Pacific)

SK Telecom
Republic of Korea
Asia Pacific

Activities:

- ★ c. Customer base for service(s) you provide
- ❖ Mobile Service

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ - To solve the problem of IPv4 exhaustion
  - To take technology leadership in the market
- ❖ a. IPv6 government project with KISA.
  * tax reduction for corporate

b. It was painful to explain the justifiability of IPv6 adoption because of an alternative technology such as NAT. However, we managed to persuade the management level to adopt IPv6 because we have to deal with numerous IoT devices in long term basis.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ - From short / mid-term point of view,
  - To solve the problem of IPv4 exhaustion and IoT device increase
  - To build up infrastructure for the services which require device to device communications
- ❖ a. To deal with the problem of IP needs for exploding devices in IoT environment

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ - The decision was made by an investment department of N/W (Engineering HQ)
  - And managed by an operational department (N/W operation HQ)
- ❖ a. We carried out as a 3G government project in 2010 and a LTE government project in 2012.
  b. We started to commercialize IPv6 service in Mar. 2013 and completed in Sept. 2014.
  c. We have launched IPv6 default devices to deal with IP shortage problem for new services

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ - It was relatively easier to deploy IPv6 on the new networks than the existing networks. As such, we decided to deploy IPv6 mainly on the networks for mobile services.
  - And also, a driver for commercial and economical incentive is needed to adopt IPv6.
- ❖ a. SKT (ISP) secured potential sales increase and a cooperative business relationship with Kakao (CSP) in the process of IPv6 commercialization.
  b. SKT reduced IPv6 adoption cost by conducting a government project in cooperation with KISA.
  c. IPv6 traffic was increased through cooperation with Google

Additional information

n/a

14. South Korea - Kakao (Asia Pacific)

Kakao
Republic of Korea
Asia Pacific

Activities:

- ★ c. Customer base for service(s) you provide
- ❖ Service type:
  - Similar Messenger service to WhatsApp
  - Similar Portal Web service for news, mail and web surfing to Yahoo.com

  IPv6 deployment plan
  - through cooperation with Kisa and ISPs
  - phasing in IPv6 stage by stage
  - Full IPv6 deployment on the whole services

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ - To provide Mobile centered services

- End user's IPv6 only devices are getting increased
- To give the best support for Native IPv6 environment

❖ a. - Government project for IPv6 deployment in cooperation with KISA
b. - Most Network equipments are ready for IPv6 deployment, but there are minor bugs in some of Application and OS.
- We are trying to debug through testing with program developers and deploy IPv6 step by step.

Business case: What are the economic and business factors that you have taken into consideration?

★ - Additional purchase of equipments for IPv6 deployment
- Cost for development of human resources for IPv6 operation
- Service quality improvement by providing Native IPv6 environment

❖ a. - Service quality improvement by providing Native IPv6 environment
b. - Considering cost, it is reasonable to keep IPv4

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

★ - Technical reviews are conducted at each working level
- Approval for Investment is required from the infrastructure management level
- After appraisal of investment, things are panned out according to the decision at the working level from a technical view point

❖ a. - We started to review IPv6 deployment about 1 year ago.
b. - Currently, IPv6 are being supported in some of services.
c. - Our goal is provide all the services through Dual Stack, and we have completed IPv6 deployment in about 10% of our services.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

★ - There is no benefit in early IPv6 deployment without additional supports.
- Changes in users' environment
- Or, forcing IPv6 deployment on the Apps such as Apple, Google will be efficient.

❖ a. - N/A
b. - IPv6 deployment will cause additional cost anyway.
c. - We deployed IPv6 stage by stage solving the difficult cases of IPv6 deployment on Application and OS with NAT64 and Proxy.

Additional information

http://m.daum.net
http://t1.daumcdn.net
http://img.daumcdn.net

15. Belgium - Proximus (Europe)

Proximus
Belgium
Europe
Submitted by : Marc Neuckens

Activities:

- ★ b. Service Infrastructure
- ❖ -

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Be ready for IPv4 exhaustion impact
- ❖ -

Business case: What are the economic and business factors that you have taken into consideration?

- ★ CPE replacement cost
- ❖ no financial info to be shared

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ Program board with representatives from different departments
- ❖ Started >10 years ago. Not yet finished and will take minimum another 5-10 years to have it completed for all services

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ It is a must do, for sure business case is negative.
- ❖ -

Additional information

16. USA - 6 connect (North America)

6connect
USA
North America
Submitted by : Aaron Hughes

Activities:

- ★ b. Service Infrastructure
- ❖ All services are dual stacked. SaaS model. Anycast distributed hosts serving the globe. IPv6 is not planning for us, it's a required part of all deployments. All engineering employees and dev staff talk about it everyday. Most internal resources in the company are v6 only. Staff is expected to get v6 at home as most supporting services are not accessible over v4. We made the decision a few years ago to treat v4 as legacy and not to turn back. This means in many cases, not only are we single stacked over v6, but even dual stacked hosts have heavy dependency on v6 only services. As a simply example, there are no v4 addresses in resolv.conf files.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ First, v6 has a sexy factor. It gave us the ability to deploy more infrastructure at a lower cost and a repeatable architecture done once and only once without ever having to look back and size of pop or resource utilization. Our costs are now easily calculated for new deployments and have no unknown cost factors. Our vendor selection and partner selection has become far easier with v6 intelligence at the top of the requirements list. This means with only a few questions about IPv6, we can determine how intelligent and how easy a partner or vendor is going to be to work

with going forward. This actually eliminates a great deal of the 'getting to know you phase' of relationships. Second, we could completely eliminate NAT. There is zero NAT in any of our infrastructure. We are now able to have a single security policy which applies globally simplifying security policy. Lastly, part of our company mission requires continuously evaluating current technology and embracing it and IPv6 turns out to be low hanging fruit. We have far greater challenges in the orchestration automation technology space, so v6 is one of many easy things to tick off the list and keep the company on its toes.

- ❖ A) No. The internal champion was/is the CEO of the company. B) We face challenges everyday and v6 like everything else continues to have them, however, far fewer than v4+NAT. For us, v6 was just like any other technology we embrace. It's always going to challenge your staff to learn and at times v6 was hard to fully embrace due to so many incorrect implementations, however, this is no different than any other new technology. C) The biggest issue is having to educate partners, vendors and customers. The technology itself will always have some issues just like every other protocol or network service out there. If all technologies were perfect, we would not need an IETF, or for that matter, Silicon Valley. Scaling is a part of functioning on the internet and v6 is a requirement to continue to conduct business.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ Just like all technologies, hardware, software, services, etc., v6 is just another required update to the architecture. While this technology had an economic impact, it was relatively small. In contrast, a few years ago when virtualization became the replacement for bare metal the economic impact was massive and had impact trailing off to the norm over the course of 5 years. IPv6 implementation had an economic impact equivalent to 1 round of CAPEX upgrades. (We have approx a 3-5 year life-cycle on supporting gear)
- ❖ A) it's now just another requirement in a long list for all technology decisions. B) IPv6 implementation was a drop in the bucket which is nearly nonexistent on the books in contrast to many other investments. The only clear financial realization we had early on was to single stack v6 where possible as dual stack would cost us more money in the long run. While there are some performance and policy benefits, the true benefit is staying in business. e.g. We are not running our production services on Windows 3.1, OS/2 Warp, IPX/SPX, Token Ring. We don't send faxes. We don't call Pony express. v6 is a _requirement_ to continue to conduct business on the Internet.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ In this rare case, the CEO is heavily involved in the operational and policy community and therefore is a critical part of the company culture.
- ❖ A) 2005 and ten years. B) Ongoing. Our standard architecture is evaluated each year and in most years we have updates. While we had a standard that included v6 in 2007 for all architecture, every year we have updates for v6. This year, as an example, we shut off v4 for all internal services. I expect by 2018 we will only have IPv4 on public facing services where absolutely required. C) To always have the most appropriate architecture for the organization and its supporting services and we do our best to deliver that.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ IPv6 will be only as hard as you make it. Your staff and community will challenge the need due to a lack of education. It, like all changes to underlying supporting technology, will scare some people. You will likely find your entire organization will run better if you embrace the technology update. Much like moving from the rotary phone using pulse to touch tone phones, looking back,

you will wonder why you ever used v4 as soon as get past the fear of change. The economic incentive is the same as any other cost of doing business.

- ❖ A) Yes. Many inefficiencies were removed related to Out Of Band networks and NAT. We are now able to operate with lower network cost and no longer need to check on IP resource utilization per pop. All pop sizes are now the same IP architecture despite serving small, medium or large service areas. B) Removing dual stack earlier would have saved time and money. IPv4 support turned out to be the larger cost than just moving to single stack IPv6 where possible. C) Plan larger. It took some time to get comfortable with thinking about a 10-20 year architecture plan rather than utilizing to the next 80%. We would have had fewer design updates had we started looking at a 10-20 year architecture early in the process.

Additional information

https://www.6connect.com/blog/

17. Mexico - University of Guadalajara (Latin America and the Caribbean)

IPv6 deployment at the University of Guadalajara
Mexico
Latin America and the Caribbean
Submitted by: Jaime Olmos

Activities:

- ★ Other: Academic network infrastructure (web server, mail server, Internet connectivity to academic network users)
- ❖ The implementation of Internet Protocol version 6 (IPv6) in the data network of the University of Guadalajara, has been a great effort from 2001, by which has promoted its use within the university and on different national community. This initiative is reflected today in network traffic of the institution considerably, having presence in various university departments throughout the metropolitan area of Guadalajara; in the university campus, high school and university buildings and throughout the state of Jalisco, through the regional university network, reaching 9 regional campuses and some high schools located in the regions of Jalisco. This deployment allows 90% of the institutional network to have the IPv6 addressing in production, since 100% of the network is ready to support this IPv6 address scheme.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ In recent years, a change has occurred in the technological paradigm that enables on-demand provisioning, almost in real time, IT resources through virtualization infrastructure of data centers; however, the rigorousness of the networks has become an obstacle to its flexibility and operation. Besides the above, we add depletion Internet addressing, IPv4, as another major limitation in scalability.
  The needs of the University of Guadalajara regarding the implementation of Information and Communications Technologies (ICTs) represent a major challenge because of the size of its academic community and territorial dispersion. In this sense, the solutions implemented make a number of features that have led us to search the available ICT innovations. The data network of the University of Guadalajara, in the main distribution and dorsal, is not exempt from this situation because it is required to be dynamic and have growth in devices and access points to cover the academic demands.
- ❖ Currently, in the data network of the University of Guadalajara, traffic on IPv6 is main part of the network architecture and routing control for the institution, since it takes advantage for service delivery to the community coexisting with the IPv4 addressing. This service consumes an average of 600 Mbps (with peaks of up to 1 Gbps) to the Internet daily and it represents just over 40% of total traffic at the University of Guadalajara regularly. One of the

most important data is showing us the website of World IPv6 Launch where the University of Guadalajara ranks 96 globally with 31.59%.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ -
- ❖ -

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ Since 2001 began as a university thesis work, creating IPv6 islands to the 6Bone network with pTLA IPv6 address block 3FFE: 82F0 :: / 28
- ❖ Global Address Block 2001: 1210 :: / 32 delegated by LACNIC, 2004.
  Participation in the pilot IPv6 World Day, 2011 test.
  Participation in the World IPv6 Launch 2012, starting widespread deployment in university network.
  Dual-stack, in all universities campus.
  First IPv6 native connection through a national Internet service provider, 2014.
  IPv6 development projects with Software-Defined Networking (SDN).
  Project VoIPv6, 2016.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ -
- ❖ -

Additional information

Main URL with dual-stack: http://www.udg.mx , http://www.ipv6.udg.mx/ , Mexico TOP10 http://stats.labs.apnic.net/ipv6/MX , Ranking 177 IPv6 adoption: https://www.akamai.com/es/es/our-thinking/state-of-the-internet-report/state-of-the-internet-ipv6-adoption-visualization.jsp , Ranking 92 measurements: http://www.worldipv6launch.org/measurements/ ASN 2549

18. Mongolia - Communications Regulatory Commission (Asia Pacific)

Communications Regulatory Commission -Regulatory Authority
Mongolia
Asia Pacific

Activities:

- ★ Other: Regulatory Authority
- ❖ To formulate regulatory framework and to make technical requirements for implementation of IPv6 Transition Strategy

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ Technology development trends and new applications
- ❖ Government and Communications Regulatory Commission of Mongolia is making IPv6 Transition strategy and Regulatory frameworks. Main challenges are capacity building, economic aspects and investment for IPv6 Deployments

Business case: What are the economic and business factors that you have taken into consideration?

- ★ In short term, most ISPs are deploying technical and network renovation comply with IPv6.
- ❖ Not yet.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ Not yet formulated the specific strategy for transition to IPv6.
- ❖ In company level, planning is started.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Feasibility study needed.
- ❖ We have small survey. If you need more info regarding the situation of IPv6 transition in Mongolia, contact: Dr.Naranmandakh.T (naran@crc.gov.mn)

Additional information

more detailed info contact to: Dr.Naranmandakh.T

19. Brasil - AMERICA MOVIL BRASIL (Latin America)

America Movil Brazil
Brazil
Latin Amercica
Submitted by: RONEY MEDEIROS

Activities:

- ★ b. Service Infrastructure
- ❖ Our responsibility was IP Architecture and project leader, including design, test, homologation, scope definition, budget, training, implementation and rollout. The scope was to provide Dual Stack to our Internet Customers in HFC/Cable network.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ The exhaustion of the free IPv4 addresses was the main motivation for the IPv6 project. That could force us to suspend new sales, because we do not have IPv4 Public Address available in our network.
- ❖ (A) There was a great government incentive covering the creation of standards and deadlines for CPE manufacturers' adequacy. The rules were adapted to avoid new products "IPv4 only" under the sentence of sales blocking. That decision helped us to have IPv6 equipments available on the market.

  (B) The biggest challenge was the lack of content and Dual Stack and unavailability of CPE compatible with IPv6, Which forced us to:
  1. use CGNAT in many locations
  2. The creation of an automated process to provide fallback for customers who have applications only IPV4 that do not work with CGNAT (IP cameras for example) and a audit process to identify unjustified public address requests were also necessary to prevent any IPv4 public address waste

  C) Other devices like as IP Cameras, Residencial WiFi Routers, Connected Home devices and

SmartTVs without support IPv6 generate a real financial impacts in CGNAT and Legal ID Platform.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ After the strategy and solution definitions, a program was created inside the Corporate PMO (Project Managing Office) involving several projects and company's areas in 4 fronts:
  a) IT Front: New legal identification system / big data; adequation of provisioning systems, CRM, BSS and Field Services; new BI reports.
  b) Engineering Front: IPv6 implementation along the whole network; CGNAT implementation on the main cities; log collector systems; team training; adequation of Management, Provisioning and OSS platforms.
  c) Customers Front: internal and external communication, training of the call center and field technicians; revision of the customer service processes; monitoring of customer experience KPIs (churn, visits, contact rate, etc).
  d) Regulatory and legal Front: coworking with NIC.br, government areas, customer defense entities; revision of contracts and services delivered to the clients.
- ❖ The project implementation was managed inside the company as a survival strategy and technological evolution. There was no business gains up to now.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The recommendation was made by the Engineering Team and they were submitted to a executive committee, formed by the CEO, COO, CTO, CIO and other vice-presidents. The project was also submitted for the America Movil's headquarter in Mexico.
- ❖ (A) We've started in the 2011. It took three years only in tests, PoCs, customers scenarios simulating, homologation of CPE, Core and Access Networking equipments, and Field Pilots During in this process we detected many problems with scalability, performance or errors with Dual Stack, more solved with software or hardware updates.
  (B) The deployment was finished in late-2015 (1 year of rollout process)
  (C) The goal was to deploy IPv6 along all operations in Brazil. Fortunately this goal was reached.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ There is no financial gain in the IPv6 deployment.
  The costs were increased with CGNAT, but deliver only IPv6 is not an option for our customers and the reasons are a great resistence coming from the industry (IoT, IP Cameras, WiFi routers, SmartTV, etc) about IPv6 compatibility of their products, making it difficult the protocol adoption. Several cloud systems, APPs, eCommerce and eGov still don't support IPv6, what forces the ISPs to use CGNAT solutions and pay the bill alone.
- ❖ The key success factor was spend most part of the time in tests, homologation and planning. In addition, the simulation of the client's environment, the small pilots and the accompaniment of the project's engineers / IP architects in the field visits were very important.

  The executive's sponsorship on maintaining the original guidelines of the project were also mandatory for the success.

Additional information

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20. USA - QuadraNet, Inc (North America)

QuadraNet, Inc
USA
North America
Submitted by: Kate Gerry

Activities:

- ★ a. Corporate network infrastructure (web server, mail server, Internet connectivity to corporate network users)
  b. Service Infrastructure
  c. Customer base for service(s) you provide
- ❖ We are a datacenter that provides Dedicated servers, Colocation, and transit services. We provide IPv6 connectivity so that our customers (primarily businesses) can communicate with customers running the IPv6 protocol.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ We had intense customer demand to roll out IPv6. We now release all services with an IPv6 /56 by default.
- ❖ No, the transition to IPv6 was smooth.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ IPv4 is an extremely limited resource and in order to allow our customers to succeed we have to support this new protocol.
- ❖ No

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ I personally started the deployment of IPv6 once I considered that customer need was large enough.
- ❖ This took less than 30 days, primarily carriers took the longest to set up BGP sessions/etc.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Our customers demand IPv6 prefixes. They have determined that they are unable to provide services without offering both options to their customers.
- ❖ Not really, we didn't do an announcement when we started offering IPv6.

Additional information

21. Brasil - Banrisul – Banco do Estado do Rio Grande do Sul (Latin America)

Banrisul – Banco do Estado do Rio Grande do Sul
Brasil
Latin America
Submitted by Renato Barreto

Activities:

- ★ a. Corporate network infrastructure (web server, mail server, Internet connectivity to corporate network users)
- ❖ My activities are coordinate the team of support network security infrastructure. We are responsible for the management and maintenance of Firewalls systems, IPS/IDS systems, authoritative DNS and VPNs in Network Infrastructure Unit of Banrisul.
  In planning the IPv6 deployment we have adopted the following assumptions:
  - Provide IPv6 only for Internet Banking services.
  - Configure IPv6 only in edge routers and Internet firewalls.
  - Provide a WiFi network for laboratory using only IPv6 connectivity.
  - Configure Internet Banking application servers with dual-stack, IPv4 and IPv6.
  - Maintain database servers on the local network only with IPv4.
  - Configure DNS servers, DHCPDv6 servers, RADVD.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ There were two motivations:
  1. Allow new clients who already use IPv6 connectivity can have access to Internet Banking of the Banrisul.
  2. Orientation of FEBRABAN - The Brazilian Federation of Banks – (The main entity representing the Brazilian banking industry) so that all financial institutions implement until July 2016 the IPv6 protocol for access to Internet Banking services.
- ❖ The pressure of FEBRABAN made the company management took a favourable position and with that we can mobilize the main areas (development, security, infrastructure, etc.) and overcome initial challenges of mobilization and commitment to the project.
  I say the main challenge is to maintain the mobilization and commitment to the project.
  I see the IPv6 training as an issue that needs to be addressed with more emphasis. Maybe repeat the training in some areas.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ The economic and business factors were attracting new customers that are in line with new technologies and already have IPv6 connectivity.
- ❖ Banrisul sees the IPv6 deployment as a long-term investment. We are a financial institution and we have to be at the forefront of technology, often regardless of the short-term costs. We believe that the benefits of IPv6 for our customers outweighed the costs, which in our project were low.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The decision to deploy IPv6 IPv6 was taken by our unit (Technology Infrastructure Unit).
  Were involved the Systems Development Unit, IT Security Unit.
- ❖ Planning began in July 2011 when we got the IPv6 block 2801:80:280::/48.
  We completed the IPv6 deployment in the Internet Banking services in 09 June 2016.
  The goals were to provide IPv6 only for Internet Banking services and we can complete the project before stipulated by FEBRABAN.
  Now we have the long-term project of IPv6 deployment for all Internet services. We are way ahead of schedule since most of the challenges were overcome.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ The main lesson learned is that training is essential.
  As I said earlier the commercial and economic incentives are attracting new customers that are in line with new technologies and require alternatives to access services available on the Internet.
- ❖ We don't measure the financial impact of the IPv6 deplyment in the Internet Banking services, yet. What we have to say is that we were surprised with the amount of IPv6 connections. Exceeded all our expectations.
  Our project was of low cost. In addition to the internal costs of the teams involved, the cost of hiring a consultant expert in IPv6.
  To improve the deployment we could have included at the beginning of the project a IPv6 training for all teams involved. That would be crucial to overcome some challenges we found, especially in the Development Unit.
  As a financial institution, we must capture the source IPv6 address and store logs for legal purposes. It was a challenge to the Development Unit. With a specific training we could be a faster result.

Additional information

www.banrisul.com.br
Ir.banrisul.com.br

22. Tunisia - IPv6 Deployment at Higher Institute of Technological Studies (ISET Charguia)

IPv6 Deployment at Higher Institute of Technological Studies (ISET Charguia)
Tunisia
Africa

Activities:

- ★ Other: We are an end-user and exactly we are a university so we have an academic activity
- ❖ The high Institute of Technological Studies (ISET Charguia) is a tunisian university located in Charguia in Tunis. It is composed mainly of Computer Science department and the business administration department. The average annual number of students is 1300 and the number of teachers is almost 110.
  ISET Charguia is connected to Internet through universities ISP named CCK (Centre de Calcul Khawarizmi) which is connected to the local Internet registry ATI (Agence Tunisienne d'Internet).

  Our IPv6 action plan is based on three major axes namely are:

  Outreach and Capacity Building: Raising awareness for both public and private sectors on a national level to creating and enabling environment for IPv6 adoption. As well as Technical training on IPv6 for IPv6 stakeholders : ISPs' engineers, teachers, and network administrators.

  Pv6 internet connectivity: ISET Charguia is an end-user, so, we should have IPv6 connectivity as well as a block of IPv6 addresses also called IPv6 prefix.

  IPV6 deployment on internal ISET Charguia network : Once we obtain an IPv6 prefix we will be able to adopt IPv6 in our local network.

Motivation: What was the motivation behind the decision to deploy IPv6?

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  IPV6 deployment on internal ISET Charguia network : Once we obtain an IPv6 prefix we will be able to adopt IPv6 in our local network.
- ❖ To achieve our goal and persuaded of the importance of stockholder collaboration in creating and enabling environment for IPv6 adoption, several work meetings were organized, during 2014 and 2015, with our Internet Service Provider CCK and ATI to convince these organizations to allocate ISET Charguia an IPv6 prefix and establish IPv6 internet connexion.

  The challenges that we face are mainly:

  The stakeholders are not aware of the importance of starting to deploy ipv6 now: To deal with this situation, we decide in 2014 to aim larger public. Hence, we organized , in april 2015, an advanced IPv6 workshop and a panel in favor of operators, ISPs and academics sector. The two days workshop was animated by international IPv6 experts from RIPE NCC "Steffan Sander and Nabil Ben Ammar". In the panel, discussions took place dealing with the evaluation and national strategy in IPv6 deployment in Tunisia and experiences university. The result of this seminar led to choose ISET Charguia as a pioneer site to deploy IPv6.
  There is No procedure to get an IPv6 prefix from our provider : we have overcome this challenge by raising awareness for end-users to deploy IPv6 and request their IPv6 prefix from their respective ISP. These requests will push ISPs to create and enable environment for IP6 adoption and set up procedures for obtaining IPv6 prefix. So, we have started to organize several awareness days and participate in conferences to explain that Pv6 is inevitable. We cite for example awareness day at ISET zaghouan (may 2016) and ISET Rades (october 2016).
  Lack of financial resources: This challenge has been resolved in part by sponsoring

Business case: What are the economic and business factors that you have taken into consideration?

- ★ Although we have not a business activity, some considerations are taken in our IPv6 strategy:
  short term: Awareness must also affect the economic and business community: For example a member of our team have participated to the International Conference of Digital Economy (ICDEc may 2016 to raise awareness to this community (see P.S presentation "IPv6 deployment at ISET Charguia")
  mid term: Elaborate an IPv6 testbed which allow to universities, ISPs, enterprises,... to test their IPv6 applications and make IPv6 measurements.
- ❖ -.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ We are a voluntary IPv6 committee at ISET Charguia, so, we took the decision together by consensus.
- ❖ The starting point of this project was triggered by our participation in a training in the Afrinic Internet summit in April 2013, organized by Afrinic and hosted by ATI. The topic was “IPv6 and Internet governance”.
  After this, we organized an IPv6 awareness Day in favor of teachers of ISET Charguia to expand the outreach and to make an IPv6 team within our University.
  In 2014, we decided to aim a larger public. Hence, we organized in april 2015, an advanced IPv6 workshop and a panel in favor of operators, ISPs and academics sector.
  In addition to awareness, 2015 was also devoted to the simulation phase, in particular we achieved the IPv6 internet connectivity via Hericanne Electric.
  2016 was devoted to the establishment of IPv6 Internet connectivity via our ISP CCK In fact, ISET Charguia is now the first university in Tunisia having deployed IPV6 as end user. On this occasion and having always the target of outreach, we have organized a seminar on the 7 April 2016. It was inaugurated by the Minister of Higher Education and Scientific Research. Conferences dealing with the experience of ISET Charguia in deploying IPv6, strategies of ATI, CCK as well the CNI (National Computer Center), IPv6 security and IoT were presented.
  Currently we are in phase of deployment IPv6 in our internal network. At this level, we have realized:

  we start this phase with the inventory of devices and applications
  we deployed IPv6 services: the website jst is accessible by IPv6.
  we are now working on an IPv6 testbed

  So, our goals are:
  outreach and capacity building: in progress, we want to continue with raising awareness for all universities and other end-users
  establish IPv6 internet connectivity: reached
  install IPv6 services in our institute: reached
  supporting IPv6 student projects: reached
  participate at the IETF and work to develop RFCs: in progress
  elaborate an IPv6 testbed: in progress

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Nowadays, we speak about big data , Internet of things, digital economy like e-business, e-health, e-banking, e-learning, etc, but all these technologies are based on the internet. So, Internet is now a critical global infrastructure for socio-economic development and growing faster in developing countries, it is also a crucial element in building any foundation for future innovation.In fact, the internet's sustainable growth depends on IPv6 adoption.
  So, our message on the commercial and economic incentives is that IPv6 has become an urgent global issue and in next few years, universities, companies who didn’t yet deployed IPv6, will find themselves alone in the desert. The reason why, they must start now and being competitive, having IPv6 skills and having a long term sustainability of the digital economy.
- ❖ -

Additional information

IPv6 events organised by ISET Charguia: WWW.jst.tn
AIS botswana:

https://internetsummitafrica.org/fr/programme/agenda (study case of IPv6 deployment at ISET Charguia Anissa BHAR – Friday 10 June 2016)

International Conference on Digital Economy (ICDEC2016) : http://http://www.aten.tn/ICDEc2016/icdec2016-program.pdf (study case of IPv6 deployment at ISET Charguia Afifa Hariz Frikha– Friday 29 April 2016)

Presentation " IPv6 deployment at ISET Charguia": Afifa Hariz Frikha ICDEc2016 ; https://drive.google.com/drive/folders/0ByoWlWeYUQ82bE1oQ1hGS1BycGc

23. United Kingdom - IT Concept Co.

IT Concept Co.
UK
Europe

Activities:
- ★ Other: IT Consultation services
- ❖ business continuity strategy

Motivation: What was the motivation behind the decision to deploy IPv6?
- ★ Cost saving
- ❖ Internet's architectural issues

Business case: What are the economic and business factors that you have taken into consideration?
- ★ N/A, this will be based on the budget that each company dedicated (I can't tell as I only provide IT consultation and I don't own the technology)
- ❖ (A)Deploying IPv6 to save costs comes back in several case studies, Some calculated the cost of continuing to buy IPv4 addresses to the cost of enabling IPv6 and dual stack technology and concluded that IPv4 is not a good decision to support future customer growth

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?
- ★ CTO, CIO
- ❖ A: 2014, 3 month (B) 2015, business growth , Yes

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?
- ★ Think in a wide vision , sometimes you don't have to wait for the others to try first , sometimes you have to take the initiative
- ❖ (A) No, (B) No, (C) No

Additional information
Nothing to add here , good luck

24. Mexico - UNAM / IPv6 project in UNAM

UNAM / IPv6 project in UNAM

Mexico
Latin America and the Caribbeans
Submitted by Azael Fernandez Alcantara

Activities:

- ★ a. Corporate network infrastructure (web server, mail server, Internet connectivity to corporate network users)
- ❖ The National Autonomous University of Mexico (UNAM) began researches in IPv6 since December of 1998, when is constituted the IPv6 project in our University and the first IPv6 test-network in Mexico.

Motivation: What was the motivation behind the decision to deploy IPv6?

- ★ To participate in the 6Bone network and contribute to IPv6 deployment and research.
- ❖ The challenges were the lack of adecuate support from equipment vendors, but also the lack of external native IPv6 connectivity, the first ISP to provide it only took place in April 2012.
  These challenges were overcomed with test-beds with Linux machines and using OS beta versions.
  (C) The remaining issues are: to convince the proper main decission makers to deploy in a massive scale, production IPv6 services.

Business case: What are the economic and business factors that you have taken into consideration?

- ★ Since we are a public university the economic factors have included for example that some vendors have had expensive OS version with full IPv6 support, and the business only apply from an academic point of view.
- ❖ (A) Since the university has enough IPv4 addresses for years to come (we have 2 class B IPv4 blocks, one almost exhausted) , we have to convince others and work together with programers and applications staff responsible.
  (B) Already mentioned.

IPv6 deployment: Who took the decision to deploy IPv6 and who else at the management level was involved?

- ★ The Telecommunications Director and her staff, including me (which is like the ISP inside the university)
- ❖ As mentioned, back in 1999. It has taken many years, until 5 years ago, when other network segments are already providing IPv6 connectivity.
  Not yet 50% deployed.

  Our goals have been:
  - Investigate, test, and implement IPv6 in the Integral Telecommunications Network of the UNAM.
  - Participate in the development of national and international IPv6 projects.
  - Participate in the fortification and diffusion of IPv6 and its applications.
  - Provide IPv6 services in Mexico and Latin America.

Experiences and lessons learned: What is the main lesson learned and your message on the commercial and economic incentives behind a successful IPv6 deployment?

- ★ Sooner than later, mainting two versions running is more expensive (from a technical and expertise of the staff)
- ❖ (A) Not yet seen.
  (B) Not really because of our context and the big IPv4 addresses pool.
  (C) Working closer not only with the network staff, but also with the application staff.

Additional information
More than 70 IPv6/IPv4 tunnels were configured to provide IPv6 connectivity and services in Mexico and Latin America.

http://www.ipv6.unam.mx/site
http://www.ipv6.unam.mx/site/history.html

http://www.ipv6.unam.mx/site/latinamerica.html

UNAM has been a member of the IPv6 Forum since April 2000, and in September of the same year, the Mexican Chapter of the IPv6 Forum (http://www.ipv6forum.com.mx) began to increase the promotion and use of IPv6 in Mexico and Latin America.

Case studies collected from additional sources

25. Canada - Telus ** (North America)

Deploying IPv6 at Scale as an ISP
Clinton Work, presentation at NANOG 65, October 2015
Youtube: https://youtu.be/361lEgkf3TI

26. Germany - BMW ** (Europe)

BMW Group - An Enterprise Introducing IPv6
Christian Huber, presentation at Cisco Live 2016, Berlin,February 2016
Presentation: http://d2zmdbbm9feqrf.cloudfront.net/2016/eur/pdf/CCSIP6-2006.pdf
Video: https://www.ciscolive.com/online/connect/flowPlayerRedirect.ww
(free registration needed for video)

27. USA / Global - Cisco ** (North America/global)

Cisco IPv6 Deployment and Plans
Khalid Jawaid, presentation at at Cisco Live 2016, Berlin,February 2016
Presentation: (p 37-72) http://d2zmdbbm9feqrf.cloudfront.net/2016/eur/pdf/COCIP6-1013.pdf
-> p 49-57 'lessons learned'
Video: https://www.ciscolive.com/online/connect/flowPlayerRedirect.ww

(free registration needed for video)

28. USA / Global - NetFlix ** (North America/global)

Netflix, the Internet tv streaming service is dual stacked.
When devices support IPv6, the Netflix Client supports IPv6. When supported devices run on dual stacked networks, the Netflix client uses IPv6 as a default, but can fall back to IPv4 if needed.
In August 2016 around 10% of global traffic was IPv6 based, with traffic in Western Europe and the US higher than this global average and IPv6 traffic in Africa almost non-existent.
Source:
Nina Bargisen, Netflix, 30 Aug 2016, at AfPIF
Recording & slides :
https://www.internetsociety.org/afpif-2016/day1-presentations-and-livestream

29. Ecuador Corporación Nacional de Telecomunicaciones E.P. (CNT) ** (Latin America)

Case study based on LACNIC study
(http://portalipv6.lacnic.net/wp-content/caf-lacnic/CAF-LACNIC-IPv6-Deployment-Social-Economic-Development-in-LAC.pdf)

Success story: Corporación Nacional de Telecomunicaciones E.P. (CNT)

CNT adopted the early strategic decision to deploy IPv6 driven by two agreements by the Ministry of Telecommunications and Information Society in 2011 and 2012[16] for the development of IPv6 networks in Ecuador, and the anticipated shortage of IPv4 addresses.

CNT also began to experience the significant growth of its fixed Internet access customer base, which placed greater pressure on its stock of IPv4 addresses. As of 30 June 2015, CNT had 814,143 accounts for dedicated Internet access[17] and 57.47% of the market. This growth occurred several times in a few years, which, added to the shortage of IPv4 addresses, contributed to reaching a faster decision for IPv6 deployment on the fixed network.

Deployment in the fixed network involves the use of the dual-stack technique and CGNAT, in line with the decision of practically all operators in the region. At the moment the effort is concentrated on the fixed network, leaving for later the decision regarding the mobile network currently operating in CGNAT. One of the potential problems that require attention in this mobile network concerns terminals.

As for corporate customers, we were told that they do not want to move to IPv6.

Deployment in the fixed network had an early start in 2011-2012. Highlights of this deployment include the early use of wireless dual-stack CPEs (which started in 2012). Thanks to high replacement rates, for reasons unrelated to the CPEs themselves, today there are more

dual-stack CPEs than potential IPv6-enabled users. This means there has been great progress in access terminals, which will also lead to a significant increase in the number of users as soon as minor deployments are completed in the access network, such as some BRAS. Furthermore, the entire core is dual-stack and causes no issues in terms of systems and other backoffice equipment.

In short, this network is fully prepared for IPv6 with significant progress in the deployment of dual-stack CPEs; therefore, significant progress is expected in the near future with regard to the number of IPv6 accounts. The consultant notes that most of the operators find that CPE deployment costs are one of the obstacles for the rapid increase in the number of fixed IPv6 users. That is why, in general, they decide to move to IPv6 in the equipment replacement stages. In this case, an early replacement for CPE IPv6 compatible equipment occurred.

Customers have not found any perceptible differences. Deployment was performed carefully through two consecutive pilot plans. Problems were solved as they arose and today IPv6 deployment poses no problem at all.

Pilot tests were conducted with services with dual- stack in operation. In cases where some problems with the CPEs occurred, one of the alternatives was disconnected and a problem was detected which was solved through a software upgrade.

At this time, CNT is working on improving network management systems in order to increase operational efficiency.

In conclusion, early actions such as taking advantage of the natural replacement cycle to deploy new IPv6- compatible equipment results in a smooth transition without major problems and prepares the network for its evolution accompanying IPv6 content and applications progress, thus gradually reducing the use of IPv4.

30. UK - Sky** (Europe)

Sky broadband IPv6 update
Ian Dickinson
UKNOF33, 19 January 2016
https://youtu.be/LoqGvZr4Uto?list=PLjzK5ZtLlc93ZfIotiPC4tLrYcbUIDMZB

31. US - AT&T** (ntia RFC) (North America)

Comments from ATT

32. US - Microsoft** (ntia RFC) (North Amerca)

Comments from NASCIO

33. US - Nascio (nitia RFC) (North America)**

National Telecommunications and Information Administration
Comments from NASCIO

34. US - NTCA/Rural Broadband Association (ntia RFC) (North Amercia)**

Comments from NTCA

35. US - Wells Fargo (ntia RFC) (North America)**

Comments from Wells Fargo

36. -