Addressing the Budgetary Challenges of IPv6 Deployment

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Addressing the Budgetary Challenges of IPv6 Deployment

- The budgetary challenges of IPv6 deployment

- The fundamental IPv6 budgetary principle

- Strategic approaches to budgeting for IPv6

- Minimise IPv6 budget requirements through policy

- Some IPv6 deployment is zero cost

- Difficult to avoid costs

- Case studies in successful budgeting for IPv6 projects

The Budgetary Challenge of IPv6 Deployment

Budget is the most common barrier mentioned amongst member states

Both small and large member states

Member states see IPv6 as an additional cost

The Budgetary Challenges of IPv6 Deployment I

- Difficulties in obtaining budget for IPv6 deployment is a key barrier to deployment

  - It can be difficult to budget for an initiative that is only a "transition to IPv6"

  - Why pay extra for something you already have – the internet?

- Aligning IPv6 deployment with other strategic activities in the MS is essential

- The budget barrier is a category which includes:

  - Staffing

  - Capital costs

  - Operational costs

  - Planning, design and project management

  - IPv6 readiness audit activities

  - Staff training and technology transfer

- Even MS which begin with an IPv6 budget may find it reduced as time passes

The Budgetary Challenges of IPv6 Deployment II

- Some member states have no clear budget assigned to IPv6 deployment

  - Belgium has no budget assigned to the infrastructure upgrades that are a prerequisite to IPv6 deployment – deploring IPv6 opportunistically as upgrades occur for other reasons

- Some member states have reduced their IPv6 ambitions due to budget cuts

  - In Slovenia economic downturn led to cuts in budgets for IPv6 training

The Fundamental IPv6 Budgetary Principles I

Integrate IPv6 into your normal on-going budgets

Don't budget for IPv6, just include it in everything that you do budget for!

Regardless of whether you have an on-going IPv6 deployment project ensure that everything is moving to IPv6 readiness through refresh cycles and new purchases

The Fundamental IPv6 Budgetary Principles II

You don't have to do everything at once

IPv6 is designed to be deployed piecemeal, avoid a single, costly budgetary item

Strategic Approaches to Budgeting for IPv6

- There are a number of strategic approaches to budgeting for IPv6 deployment:

  - Implement strategic IPv6 policies to minimise unnecessary expenditure

  - Carefully limit the scope of your IPv6 deployment project

  - Include IPv6 by default in other non-IPv6-specific network projects

  - Embed IPv6 in to everything that you would normally do with IPv4

  - Utilise zero-cost options whenever possible

  - Make sure that greenfield deployments are IPv6 from day-one

  - Some key project activities should already form a part of other budgets; for example you should already have a security policy that includes IPv6

  - Only specifically budget for key essential IPv6 deployment activities

Minimise Budget Requirements by Policy

- The polices recommended in an earlier session can significantly reduce budget requirements for IPv6 deployment:

  - Mandate that all purchases must be IPv6-ready and capable of IPv6-only operation

  - Mandate that all software development is IPv6-ready and capable of IPv6-only operation

  - Mandate that all ICT job descriptions that include a knowledge of networking and particularly IP specifically require IPv6

- These three policies help address several of the budgetary barriers to IPv6 adoption; staffing, capital equipment costs, operational costs, staff training and technology transfer

- However, whilst these policies minimize these costs, they do not eliminate them completely

Some IPv6 Deployment is Zero Cost

- Not all aspects of an IPv6 deployment incur additional costs

- Maximising zero cost options reduces deployment costs easing budget pressures

- Strategic mandates to avoid future waste are often zero cost (see earlier)

  - Suggested strategic mandates embed IPv6 readiness into business activities

- IPv6 in your existing infrastructure and services is zero cost

  - Modern operating systems are IPv6 by default and are IPv6 enabled by default

  - Windows has an IPv6 stack that provides legacy support for IPv4

  - Equipment refreshes will often be IPv6-ready even if you didn't mandate it

- Optional IPv6 capability in existing services can be zero cost

  - A number of cloud and CDN operators will IPv6 enable your services at the edge for no additional cost (often all this requires is checking a tick box – in some instances the default is for this to be enabled)

  - Most transit providers are IPv6 enabled

Examples of Zero-Budget IPv6 Deployment I

- Microsoft Windows is IPv6 enabled by default

    - The Windows IPv6 stack is an IPv6 stack with legacy IPv4 support

    - Turning off IPv6 in Windows is not tested or supported by Microsoft

    - If you have deployed Windows then you have already deployed an IPv6 operating system environment

- Microsoft Applications

    - Most Microsoft applications have been IPv6-ready since 2008

    - If you use Exchange, IIS etc you are using IPv6-ready products

    - Active Directory is IPv6-ready and is IPv6-enabled by default

- Linux Distributions

    - Linux has had an IPv6 stack for almost twenty years

    - Almost all Linux distributions have IPv6 turned on by default

    - The majority of core applications are IPv6-ready and enabled by default

Examples of Zero-Budget IPv6 Deployment II

- *If* you have a regular equipment refresh, then, since most modern enterprise network equipment is IPv6-ready and is often IPv6-enabled by default, your infrastructure may already be IPv6-ready

  - You will *usually* have little trouble with IPv6 support in networking products from the major vendors

  - There are edge cases, especially if you are doing something unusual

- Suppliers of cloud services and applications rarely charge extra for IPv6 support

Costs That May Be Difficult to Avoid

- A significant proportion of the costs of IPv6 deployment may not need an explicit budget. Even so, there may be costs that cannot be avoided

  - You should budget for project management

  - You must budget for the creation of an IPv6 deployment strategy which includes essential design decisions

  - You must budget for the development of an IPv6 address strategy including an IPv6 address schema and allocation policy

  - You must budget for the necessary IPv6 education and training

  - You *may* have to budget for hardware replacement if you have legacy equipment that is not going to be refreshed in time for IPv6 deployment

  - You *may* have to budget for hardware upgrades if current hardware does not have sufficient resources to support IPv4 **and** IPv6

  - You *may* have to budget for new management tools

  - You *may* have to budget for IPv6-enabling IPv4-only applications

Can These Costs Be Avoided?

- Sometimes…

- Examples:

  - If you find a publicly available IPv6 deployment strategy that fits your requirements – consider using it (don't blindly do this)

  - If you find a publicly available IPv6 address strategy that fits your requirements – consider using it (don't blindly do this – you will need to tailor your address schema)

  - If you can find training that includes an element of consultancy to carry out the above activities then this may be a lower cost option

  - Some activities can be pushed onto your suppliers – but, be aware, they may give a supplier-biased solution

- Don't forget that sometimes problems just go away. IPv6 is designed to be deployed piecemeal. Leaving some elements of an IPv6 deployment IPv4-only until a solution presents itself can be the most cost-effective solution.

Savings due to IPv6 Deployment

- Usually deploying IPv6 increases costs

- However, occasionally you can make savings through IPv6 deployment

- IPv4 address costs

  - Deploying IPv6 can be used to avoid IPv4 conservation measures that require costly network renumbering

  - Deploying IPv6 can be used to avoid the need to purchases additional public IPv4 addresses from the address transfer market

- Infrastructure costs

  - IPv6 can be used to reduce the need for or eliminate certain types of infrastructure:

    - VPN concentrators can be replaced by technologies such as Microsoft DirectAccess

    - Additional layers of NAT44 or implementation of CGN can be avoided

    - Management overheads of complex RFC1918 addressing

Some Costs Should not be Directly Attributed to IPv6 Deployment

- Your network is already dual-stack and has IPv4 **_and_** IPv6 vulnerabilities

- You must implement IPv6 security regardless of when you officially deploy IPv6

- This is an unavoidable security cost and should not be attributed to the deployment budget

Generating Income from IPv6 Deployment

- Some organisations (including governments) are selling unused IPv4 address space on the IPv4 address transfer market

  - For example in 2015 the UK government sold off unused IPv4 address space

- Organisations can use IPv6 to free-up IPv4 address space

  - Microsoft is working to deploy IPv6-only networks thereby allowing them to reallocate IPv4 public address space for use in their cloud services

- Deploying IPv6 can free up IPv4 addresses for sale or reuse

  - Sale of IPv4 addresses can generate revenue

  - Reuse of IPv4 addresses can lead to reduced costs elsewhere

- The IPv4 address price is time sensitive. It will decline once IPv6 is deployed

  - The IPv4 Market Group expects IPv6 user count to exceed 50% world-wide in 2019, and with that, the start of the decline of the IPv4 address market.

  - Price in July 2018 is over $18 per address (https://www.ipv4auctions.com/)

Maximise Opportunities

- Align IPv6 deployment with other strategic activities in the MS

    - Internet of Things (IoT)

        - All major IoT platforms are based on IPv6 (6LoWPAN)

        - Even Zigbee-IP is based on 6LoWPAN

        - All IoT deployments should be standards based – they should be IPv6

    - Mobile Solutions (5G/4G)

        - Both 4G and 5G are based on IPv6

        - Use of native IPv6 on mobile platforms has advantages

        - For example, Apple Apps must be IPv6-only capable

    - Cybersecurity

- Greenfield/New Build

    - New office, new data centre, new equipment, new application – all are opportunities to deploy IPv6

The Fundamental IPv6 Budgetary Principles III

As much as possible decouple IPv6 from budget

Case Studies in Successfully Budgeting for IPv6 Projects

- Public administration
  - Belgium
- Commercial
  - Comcast

Case Studies in Successfully Budgeting for IPv6 Projects

- Note regarding case studies:

  - It is easy to assume that large commercial deployers of IPv6 have no budget constraints and are instead driven by, for example, IPv4 address exhaustion. However this is not always the case. Each have, at least to some extent, stated that one of the reasons for deploying IPv6 is financial. For example, when we look at Microsoft later, we will see that amongst their drivers are two financial ones:

    - The increasing cost of purchasing public IPv4 address space

    - And, for the move to IPv6-only, the cost of managing dual stack

IPv6 Case Study: Belgium

General IPv6 development :
50.6% (Google) - 46.4% (Akamai)

- History

  - Pioneering deployments in Belgium from 1998 onwards, by 2010 still <1%

  - Plan for IPv6 adoption in public administration in 2012

- Key Stakeholders

  - Suporrted by Council of Ministers

  - Central organisation: SPF Economie (Federal Economy Ministry)

  - SPF BOSA (policy and support ministry)

  - IPv6 Council

  - Local ICT agencies (Belgium is a federal state)

- Drivers to Adopt IPv6

  - Exhaustion of IPv4 address space (always on broadband, mobile and IoT)

  - Code of Conduct: restriction of Carrier Grade NAT (CGN) to 16:1

IPv6 Case Study: Belgium - Planning

- Project Scope

  - IPv6 deployment scope is public only (however there was a move to IPv6 outside of government at the same time)

- Features

  - Budget cuts affected deployment - no specific budget for transition upgrades

  - Plan to deploy IPv6 before end of 2014 – only partially achieved

  - Significant deployment both in public and private sectors

- Key Initiatives

  - Plan to deploy IPv6 in public administrations by 2014

  - Public procurement rule requires IPv6 compatible equipment

    - Belgium did not use IPv6 profiles instead they require equivalence with IPv4

    - Both in compatibility and in connectivity – default IPv6 on

  - IPv6 Council played a key role, as did major ISPs

IPv6 Case Study: Belgium - Procurement

- Belgium has implemented an IPv6 procurement policy

    - This pushes the responsibility for providing IPv6 capability and connectivity onto the supplier/vendor

    - The rule expects at least equivalence with IPv4 – this avoids specifying detailed requirements for each and every IPv6 feature

    - Expectation is that IPv6 will be on by default in new installations and services

- Belgium budget cuts have delayed deployment since there is no specific budget for hardware/software upgrades to support IPv6

    - Therefore, IPv6 is deployed as and when upgrades occur

- Widespread adoption of IPv6 by major ISPs and now mobile providers has made the adoption of IPv6 much easier and has meant that IPv6 is default in many providers and services in Belgium

- Despite budget cuts deployment of IPv6 in public administrations within Belgium is very well advanced

IPv6 Case Study: Belgium – Addressing

- Belgium is a federal government

- There is no single government organisation responsible for IP address space

- Public administrations obtain IPv6 address space from their providers

  - There remains a debate over the use of Provider Aggregatable (PA) and Provider Independent (PI) address space

- Structure is down to individual public administrations

IPv6 Case Study: Belgium – Deployments

- Many IPv6 deployments have taken place within both in public and private sectors

- **Examples:**

  - Most of the major public administration websites including e-government services are IPv6-enabled

    - E.g. social security, tax services, open data services…

    - Many federal websites have been consolidated on one IPv6-enabled website

    - Remaining ones are dependent on budget for prerequisite upgrades

  - Major ISPs are IPv6-enabled

  - Mobile providers are moving to IPv6

  - Media providers (TV, news etc) have IPv6-enabled websites

  - Academic sites are IPv6-enabled

  - Attempted an IPv6-only datacentre deployment in 2012/2014

    - Was not successful then **BUT** could work now

IPv6 Case Study: Belgium - Training

- Free (basic) IPv6 workshops for federal administrations

  - Organised by Belnet (research/government network) and Fedict (currently known as FPS BOSA DG BT, public and support ministry)

- Provision of an interoperability expert to provide help and guidance to system administrators

  - Organised by FPS BOSA

- IPv6 Council Belgium workshops and meetings

  - Healthy and informal exchange of ideas and plans

IPv6 Case Study: Comcast

- History

  - Large broadband cable service provider in US

  - Exhausted IPv4 addresses for managing modems in 2005

  - Now moving to IPv6-only and IPv4-as-a-service (IPv4 is a 2nd class citizen)

- Key Stakeholders

  - Enterprise commitment to IPv6 at all levels – clear business benefits

- Drivers to Adopt IPv6

  - Exhaustion of public IPv4 address space

  - Exhaustion of internal IPv4 address space

  - Growth of 100% in customer base could not be supported by IPv4

    - Clear business driver

  - IPv6 is a "platform for innovation"

IPv6 Case Study: Comcast - Deployment

- Project Scope
  - Everything must be IPv6-only capable
  - Priority: management and operations over IPv6
- Features
  - Now moving to IPv6-only and IPv4AAS (IPv4-as-a-service)
  - Almost all cable modems are managed over an IPv6-only connection
- Procurement
  - IPv6 is embedded in procurement
  - Educating purchasing departments has been a challenge
  - Large base of existing infrastructure (e.g. Cable Modems) has required some phasing of the deployment with equipment refresh

Questions and Discussion