IPv6
Opportunities and Challenges

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Topics

- Business Case and the Human Capacity for Predictions

- The Evolution of the Internet

- IPv6 101

- Why should you introduce IPv6 now?

- Is there an IPv6 Killer App?

- Planning and Methodology

- The 7 most important stepts

- The biggest stumbling blocks – Theory and Practice

Evolution has no Business Plan

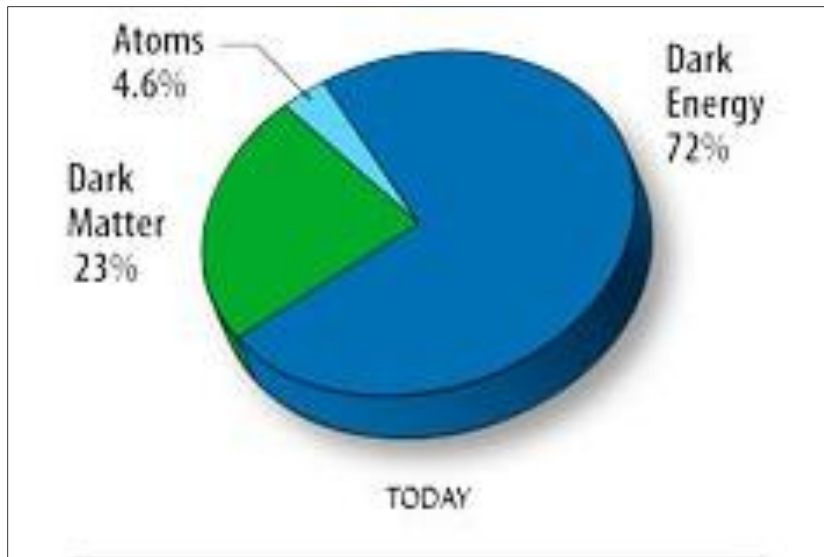This upgrade solved the horse dung issue.

Horse dung issues threatened society.

Evolution simply happens

There is a lot we don't know!

One example:

- **In genetics they used to call 95% of our DNA "Junk DNA" because they don't understand it.
  Since September 2012 they call it the control center of our DNA)**

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The human capacity for predictions

- Our capacity to assess a business case:
    - Personal Computer
    - Cell phones and text messages (SMS)
    - Google, Facebook, Twitter…..
    - Internet!

- Has anyone foreseen or predicted these business cases?
- Would we have created the Internet if we had tried to calculate the buiness case first?

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Evolution of the Internet

- IPv4 was developed in the 70-ies and introduced in the Internet on the Flagday in January 1983.

- 1991 the WWW was developed at CERN.

- The Internet was mainly created by us all using it, strong expansion in the late 90-ies.

- The Internet grows exponentially and cannot continue to grow without IPv6.

- The consumation of IPv4 addresses has more than doubled in 2010.

- Vint Cerf is standardizing and testing the Interplanetary Communicationprotocol with the NASA – Business Case?

- 2012 - June: World IPv6 Launch Day
  - December: End of the Mayan Calendar

Depletion of the IANA IPv4 Pool

No /8

Average consumption rate was approx. 10 /8 per year until 2010

2010 consumption rate was more than doubled (Asian Broadbandproviders)

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Internet Growth

The IPv4 based Internet will not stop working, but it will stop growing, while the IPv6 based Internet is designed to grow for generations to come. (Tony Hain)

- Online World population in
  - 2001   360 Mio
  - 2005   938 Mio   14% global penetration rate
  - 2009   1.4 Bio   21% "
  - 2011   1.9 Bio   28% " 99.9% IPv4 users
  - 2012   2.3 Bio   End of IPv4 - go figure
  - 2015   5 Bio?   Percentage of IPv6-only users?

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Error 405 - You have reached the end of the... +

http://www.blaha.at/
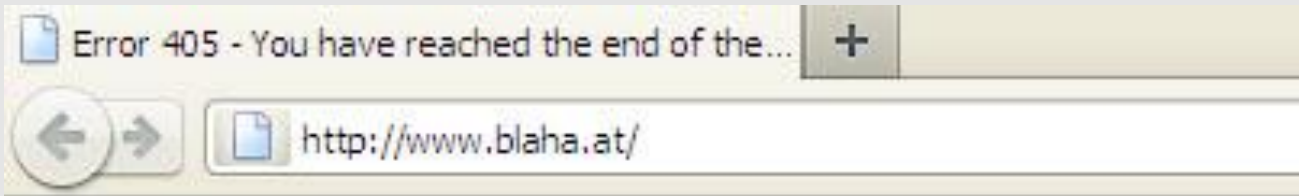
ℹ **You have reached the end of the Internet.**

You have reached the end of the Internet. Open a bottle of cold Lager and lean back.

Please try out the following options:

- Get outside in the fresh air.
- Start reading the books you never found time for.
- Gain further qualifications.
- Start living healthy.
- or, alternatively, try to find me.

HTTP 405 - End of Internet reached

Or else introduce IPv6!

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New Internet Users

- Will have:

  - NAT-ed IPv4 Internet Access (possibly multiple NATs with LSN)

  - IPv6-only Internet Access with translation for IPv4 Internet (NAT64/DNS64)

- Internet Access to IPv6 sites will soon outperform access to the IPv4 Internet

  - As a content provider you are interested in offering your content over IPv6 as soon as possible

  - **Business Analytics!**
    (Why do you think is Google so interested in IPv6?) ;-)

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IPv6 Killer App

Business Continuity and Business Agility

Quote from a CIO article, April 12, 2012:

At the North American IPv6 Summit being held in Denver this week, IPv6 experts seem to have converged around the idea that business continuity is going to be that reason CIOs finally purchase IPv6 products and services.

"We've seen a ridiculous spike in actual deployments of IPv6 in the enterprise around the Internet edge," said Shannon McFarland, principal engineer for data center technologies in Cisco's consulting engineering team. "Customers are doing Internet edge deployments for business continuity."

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IPv6 is inevitable

- **We have no choice because**
  - The global IPv4 pool is empty, so is the APNIC and RIPE pool
  - Internet growth is only possible with IPv6
    (or across multiple IPv4 NATs)
  - There are no alternatives to IPv6

Where is the business case?
  - Business Continuity
  - **Lean and costefficient integration**.
  - Use opportunities – create your next generation network!

This is only possible if we plan early and take the time to understand IPv6, its implications and dependencies.
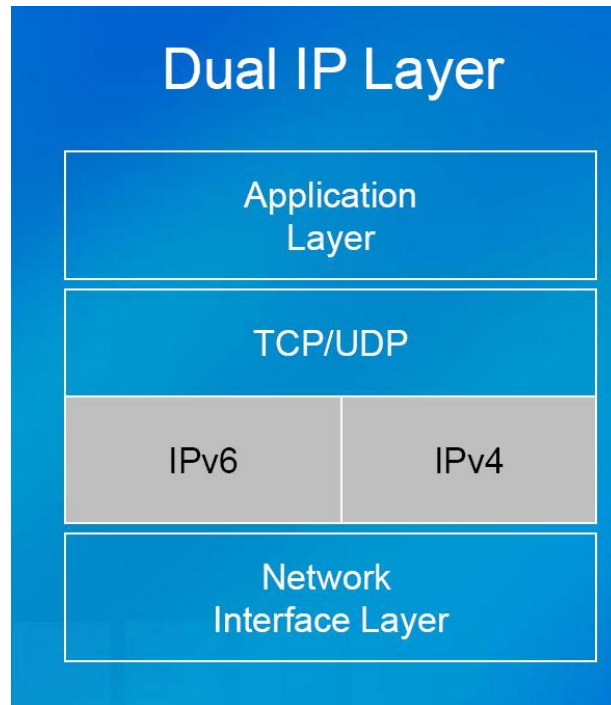
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Lean Integration?

- **Early planning allows for:**
    - Make use of product life cycles and refresh cycles
    - Investment protection by having clear IPv6 requirements for purchasing, outsourcing contracts and SLA's

- **Risk mitigation by:**
    - Secure unwanted IPv6 traffic in an IPv4 network
    - Education of all IPv6 team members and IT personel
    - Sufficient time for labs, testing and pilots
    - Time for bugfixing with vendors (early stacks)

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IPv6 101

Main Changes from IPv4 to IPv6

- Expanded addressing capability (128 bits)

- Expanded address architecture

- Expanded autoconfiguration mechanisms

- Simplification of the header format
(fixed length: 40 bytes)

- Improved support for extensions and options (Extension Headers)

- Extensions for authentication and privacy (security)

- Flow labelling capability (QoS – Quality of Service)

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Dual IP Layer

Dual IP Layer

- Application Layer
- TCP/UDP
- IPv6 | IPv4
- Network Interface Layer

- **Most applications that follow the OSI model have no issues in IPv6 networks.**

- **If you develop your own applications for yourself or for your customers, make sure your developers understand the implications.**

- **State of the Art applications have to perform in an IPv4-only network, in a dual-stack network and also in an IPv6-only network.**

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General Design Rules

- Native IPv6 where ever possible, dual-stack as long as necessary

- New services IPv6-only

- Tunneling only if necessary and only as a temporary solution

- No NAT, no translation (only with a gun to your head)

- Future networks are end-to-end

- The expanded address architecture allows for new security concepts
(embed service information in address and security concept)

- Consider new services (monitoring, sensors, health care, Car2Car … depending on industry) – many new services have a much higher demand for addresses and mobility requirements

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Methodology

1. **Discovery**
   Business Strategy, IT Strategy, Processes
   Current State – Future State (Infrastructure, services)
   Other IT projects, lifecycles
   Impact (risks and opportunities)

2. **Strategy**
   High Level Plan, Roadmap, Milestones
   Dependencies, align other projects and life cycles

3. **Assessment**
   Hardware, Operating Systems, Applications, Services
   Refine high level plan if necessary

4. **Planning**
   Design, develop, build, test

5. **Implementation**

Assessment

- Aligned with IPv6 strategy

- Definition of RFC requirements for all components

- Assessment of all components (Hardware, OS, Applications) according to RFC requirements

  - Systems that are IPv6-ready

  - Systems that need to be upgraded to be IPv6-ready (hardware and/or software upgrade)

  - Systems that are not IPv6-ready

- Vendor assessments

Only now you can estimate costs for deployment (investment and labor).

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Address plan - Where to start

- We have an address plan, it has worked for over 10 years, let's just copy it

- IPv6 is not that different after all, let's just go ahead and make a plan

- You don't want to miss the opportunity to create the foundation for your future network!

- Use the new architecture and the unlimited address space!

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Rules

- Take the learnings from operating an IPv4 network into designing an IPv6 address plan

- Use all the rules you know:

    - Aggregation
    - Subnet Consistency
    - …..

- Get rid of all conservation rules (host counts)

- Value ease of administration over conserving address space. This results in saving operational cost!

- Reserve enough space for Growth-Growth-Growth

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Interface IDs

- **Interface ID**
  Interface Identifier, 64 bit, following formats
  - **EUI-64** Extend MAC address to 64 bits by adding FF FE between the 3rd and 4th Byte and "locally administered bit" must be set (2nd bit)
  - **Manual**
  - **Random (Privacy)**
  - **DHCPv6** static

- Choose traceability and ease of management (fixed IID) vs. anonymity (random IID changing in regular intervals)

- Consider using different method internally vs externally (verify address management tools! Talk to your vendors!)

Service-based vs topology-based Design
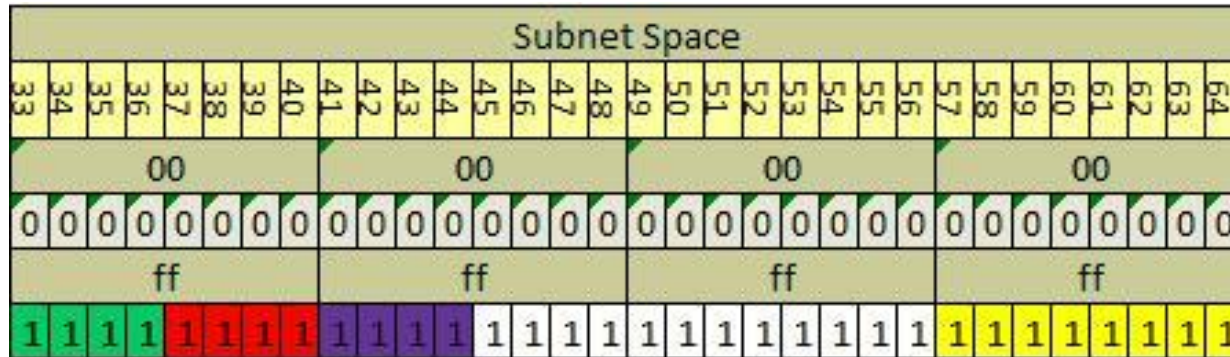
1 Nibble = 4 bits
2^4 = 16 Options, 2^{12} = 4096 Options, 2^8 =256 Options

Green: 16 Service Types
Red: 16 Applications
Purple: 16 Superregions
White: 4096 Locations
Yellow: 256 Subnets per location

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The 7 most important steps (+1)

1. Get management on board, appoint an IPv6 program manager
2. Education for all team members (focused and specific to groups)
3. Define Strategy, High Level Plan and Roadmap
4. Perform assessments (everything, HW, SW, OS, Services, Apps)
5. Refine strategy and roadmap, define detail projects, create budget for investments and work
6. Define addressplan and network design
7. Define security- and managementconcept

8. Test, test, test and deploy – (cycles)

The most common stumbling blocks

- Lack of management support

- Heads in the sand politics

- Processes (get in your own way)

- Shortterm thinking

- Lack of authority (across departments)

- Too many projects, not enough people, no time for carefulness

- Treat IPv6 as a network and infrastructure project (mind the apps)

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Executive Summary

- IPv6 is on its way. It will take you 3 to 5 years for a smooth and cost efficient migration. So you have to start today with the planning and testing.

- Every component in your network is affected. If you don't use the natural life cycles of your products, costs will be excessive.

- Why now?
    - Business Continuity
    - Reachability
    - Life Cycle Management
    - Investment protection
    - Time for education and to build experience

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Thank You For Your Attention!

IPv6 Grundlagen, Funktionalität, Integration

von Silvia Hagen, Deutsch
2. Auflage, Sunny Edition, 2009
ISBN 978-3-9522942-2-2
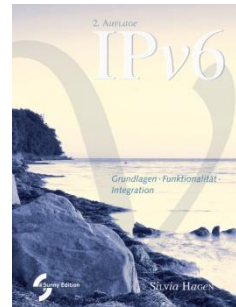
IPv6 Essentials

by Silvia Hagen, English
2nd Edition, O'Reilly, May 2006
ISBN 978-0-596-10058-2

Planning for IPv6

by Silvia Hagen, English
O'Reilly, July 2011
ISBN 978-1-4493-0539-0
eBook 978-1-4493-0538-3

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