Innovation at the Waist

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Why did I say that?

Once I said
DNSSEC will be done in 6 months

Who am I

Open, Global, Innovation, Trustworthy
We (technical internet community) introduced a number of technologies such as IPv6 and DNSSEC that have a difficult time being deployed.

Is it possible to innovate at the waist?
Everett Rogers
Diffusion of Innovation

5 Decision Stages

- Knowledge
- Persuasion
- Decision
- Implementation
- Confirmation
5 Decision Stages

Knowledge

Individual is exposed but doesn’t know much about the innovation.

- You might have seen an IPv6 configuration option
- You’ve heard about IPv6 at a conference
- A IPv6 task force may be active in your industry
5 Decision Stages

Individual seeks more information

- Persuasion
- Read the IPv6 Wikipedia article
- Take a course or workshop
- Talk to colleagues
5 Decision Stages

Individual weighs risks and benefits and takes the decision to adapt or reject.

- Often: Engineer decides to persuade the Management.
  - Once decision is made, it will take new persuasion to reconsider.
  - Management then is at stage 1.
5 Decision Stages

Individual implements the innovation and may seek further information

This is where the engineers do a lot of work and find out they lack information or skills
5 Decision Stages

Individual confirms the decision that implementation useful and deploy to full potential

Typically this is the stage where the pilot is moved to production.
New questions to ask

- Knowledge
- Persuasion
- Decision

How does knowledge spread?

How are decisions made?
Social network drives spread

Spread works most effective when: Shared values, but lack of awareness

Decision types: optional, collective, or authoritative

- **Optional Innovation-Decision**: This decision is made by an individual who is in some way distinguished from others in a social system.

- **Collective Innovation-Decision**: This decision is made collectively by all individuals of a social system.

- **Authority Innovation-Decision**: This decision is made for the entire social system by few individuals in positions of influence or power.

On Internet scale the decision to deploy IPv6 is Optional
We talked about Individuals making decisions about innovation.

What are the properties of the innovation that inform the decisions of that individual?
Relative Advantage
Compatibility
Complexity/Simplicity
Trialability
Observability
• Is the innovation difficult to use, if so the individual that needs to make the decision is less likely to adopt it

• Does the innovation bring relative improvement?

• Is the innovation compatible with what the individual already has deployed

• Can the individual try the innovation? Is it testable?

• Does the innovation have some cool? Can you talk about the innovation at the bar?
Relative advantage

Value
\[ n \log(n) \]
Application Layer: Applications use IP for connectivity

The Network Access Layer: Components in the Network Access Layer deliver IP connectivity

IP (IPv4!) is the common substrate
Mini note: HTTP is more and more the de-facto substrate

The IP API as the common open interface to the network

Permissionless Innovation
New applications are conceived and deployed almost daily

Proprietary
Open Source
No Imposed Business Model
Freeware
Privacyware
Payware
Adware

Imagination is the limit
Independent Autonomous Networks

Serving different markets
The Price of Bandwidth, in bulk, per Mbps

<table>
<thead>
<tr>
<th>Service</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A EUR80 fiber cross connect:</td>
<td>$0.01</td>
</tr>
<tr>
<td>Internet Exchange traffic:</td>
<td>$0.25*</td>
</tr>
<tr>
<td>Backbone traffic Western Europe:</td>
<td>$0.50</td>
</tr>
<tr>
<td>Transatlantic traffic, wholesale:</td>
<td>$1</td>
</tr>
<tr>
<td>Internet Transit, wholesale:</td>
<td>$2</td>
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<tr>
<td>Internet Transit, retail:</td>
<td>$15</td>
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<tr>
<td>Broadband Internet, consumer:</td>
<td>$50</td>
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<tr>
<td>National Ethernet service:</td>
<td>$180</td>
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<td>3G mobile data, national:</td>
<td>$11,400</td>
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<td>GSM voice call, national:</td>
<td>$483,840</td>
</tr>
<tr>
<td>3G mobile data, roaming low:</td>
<td>$834,000</td>
</tr>
<tr>
<td>3G mobile data, roaming high:</td>
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<tr>
<td>GSM voice call, roaming:</td>
<td>$3,338,496</td>
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<tr>
<td>SMS Text Messages:</td>
<td>$210,000,000</td>
</tr>
<tr>
<td>SMS Text Messages, roaming:</td>
<td>$1,166,400,000</td>
</tr>
</tbody>
</table>

Western Europe, early-mid 2011 (based on 10Gbps or 300GB)

Table courtesy of Remco van Mook, Equinix
Innovating the fabric is an internal decision.

Deliver IP to the edge and route with your peers.

Compatibility
Observability
Trialability
Innovative gear pushes the packets cheaper

Capex and (temporarily increased opex) have known risks

Early deployment advantage
Network Providers seek to monetize the network to fund their investments.

Most value creation in the top half is by different players than the investment on the bottom half.

Earnings don't make it through the waist.
Routing Security

• Innovation around the waist
Both Application and Network Layer need to transition

From the individual innovators perspective

- Relative Advantage
- Complexity/Simplicity
- Compatibility
- Trialability
- Observability

From the individual innovators perspective
The new kid on the block should not spoil the fun for the others

Any reduction to the value of the network is unacceptable

These numbers are estimates for argument sake

\[ n \log(n) \]

IPv4: \( n = 2 \times 10^9 \)
IPv6: \( n = o(10^6) \)
Innovative gear makes you having to debug

Early deployment disadvantage

Unknown risks

Market share

Innovators 2.5 %
Early Adopters 13.5 %
Early Majority 34 %
Late Majority 34 %
Laggards 16 %
Dark Picture
How to push the needle?
Group

Credible large N in the future:
Identify attractors
Share the sense of direction/vision
Reduce costs

Individual

Reduce complexity
Increase relative advantage
Maintain compatibility
Enable trialability
Make Observable
Group

Credible large N in the future:

Identify attractors

Share the sense of direction/vision

Reduce costs

Regulation

Subsidy

Market Creation

Standardisation

Availability in Products

Open Source

Subsidy

Regulation

Market Creation

Standardisation

Availability in Products

Open Source
Preaching to the choir is easy. The Social values are shared.
Adapt your message to the social values at the edge of your network

Or try to adapt your acquaintances to support your values/principles.
Why go through the effort in the first place?

6,000,000,000,000

(100 devices per user)

Open

Global

Innovation

Trustworthy

We have to make the impossible possible

to keep the impossible possible
Question, ideas, feedback?

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