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# How the IETF Chooses Architectures and Protocols: SDN in the IETF

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# Background

We don't implement Internet protocols in a vacuum.

Each protocol costs money to develop and test, and so each additional protocol increases the cost of the network equipment, decrease its stability, and complicates the management and operation of the network.

Network operators and equipment vendors look for help and advice choosing architectures and deployment models so that they select the correct set of protocols.

One place they look is standards bodies like the IETF.

# Agenda

- Reminders about the IETF
  - What is it for?
  - What does it do?
  - How does it work?
  - Who are the Internet Police?
- What is an architecture?
  - Why is it helpful?
  - Timing: a blueprint or a survey
  - Time to call the Internet Police?
- Which protocols do we use?
  - Extend a protocol or invent a new one?
  - Choosing between protocols
  - Where are the Internet Police?
- Consensus, market, interoperability, competition



# The Mission of the IETF

“To make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet”

<https://www.ietf.org/about/mission.html>

- **Open process** - any interested person can participate in the work.
- **Technical competence** - often referred to as “engineering quality.”
- **Volunteer Core** - participants and leaders come to the IETF because they want to.
- **Rough consensus and running code** - judgements based on real-world experience in implementing and deploying.
- **Protocol ownership** - when the IETF takes ownership of a protocol or function, it accepts the responsibility for all aspects of the protocol.

# What Does That Mean?

- Ideas can be brought to the IETF by anyone
- Ideas only become IETF specifications when...
  - There is consensus that they are good ideas
  - When there is support to implement/deploy them
- The IETF is the participants
  - There is no leadership team making decisions
  - If you want something done in the IETF *you* must do it
- The purpose of a specification is to enable interoperation
  - You can implement and know you will interwork
  - They can buy from multiple suppliers

# The IETF is not the Internet Police Force

- Sometimes there is a call for “someone” to make a rule
  - What is the correct architecture?
  - Which protocol is best?
- The IETF does not do this!
  - But if there is agreement, the IETF may document that



- There is no one to tell you...
  - What to implement
  - What to sell
  - How to build your network
- You have to make your own choices

# What is an Architecture?

- In building...
  - A plan that tells you what to build
  - A map that tells you what has been built
- In software...
  - A document that tells you what to code and how it fits
  - A record of how the software is built to help you debug it
- In networking...
  - A guide of how to deliver services using
    - Functional components
    - Physical elements

# A Typical Architecture in Networking

- It is all boxes and lines
  - Boxes are components
    - Routers and switches
    - Blobs of software (or implementations of software)
  - Lines are communications
    - Wires
    - Protocols
- Keep it simple!
  - “This is not a proper architecture, it has too many boxes and lines” – Parviz Yegani, Juniper Networks, IETF-93



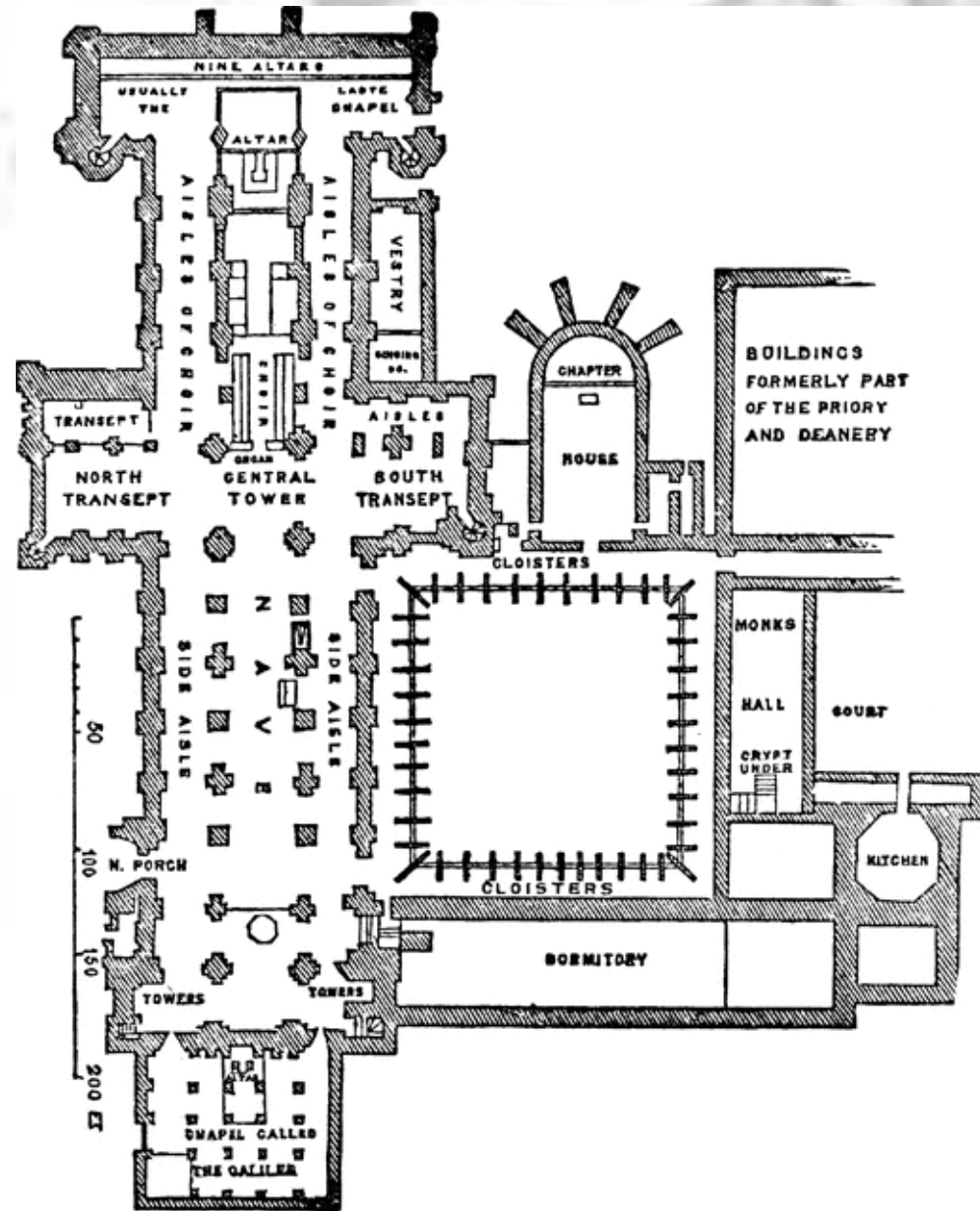
# Why Do We Like Architectures?

- It is always useful to have a map
- What should we build?
  - What does the customer want?
  - Why is it all so complicated?
- How do we make the network work?
  - Why can't the supplier just hand us a plan?
- But why should you tell your competitor how to succeed?
  - Sometimes the architecture should be a private thing
- And when should we write an architecture? ...



# A Guide or Map?

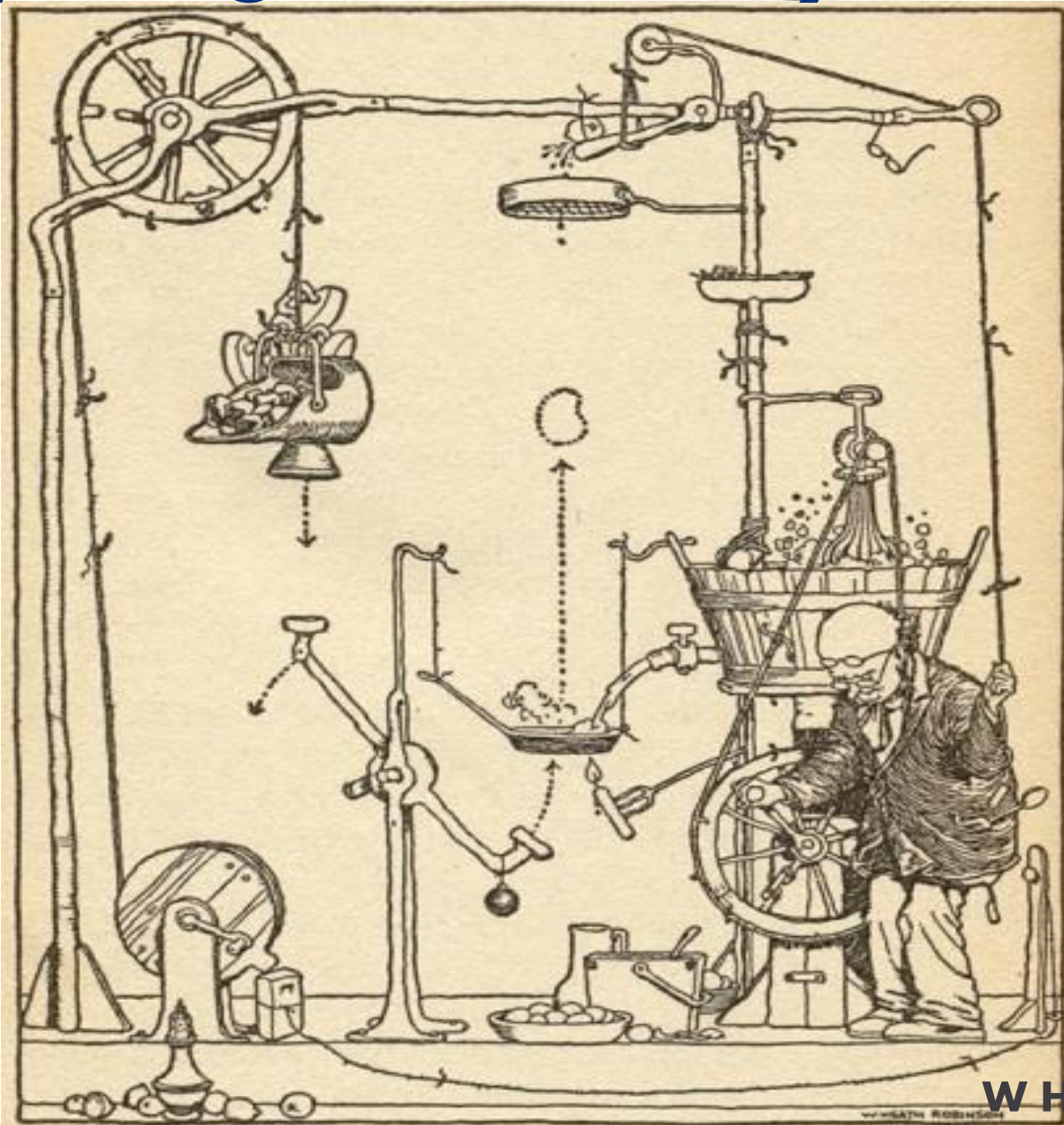
- Let's work record how what we have works
  - How does it plug together to deliver the function?
- Then we can build networks and understand what is deployed



# What Can I Build?

- “It’s only software”
- You can build anything you want
- You can glue together many functions and many protocols
- The result is “an architecture”
- It is probably *your* architecture
  - Maybe it is your secret way to keep ahead of the competition
  - Maybe you publish it in marketing or journals
  - Don’t expect the IETF (or anyone) to...
    - Agree
    - Bless it

# Everything is Probably Possible



W Heath Robinson

# Not Everything is a Good Idea



**W Heath Robinson**

# Time to Call the Police?

- The IETF does both approaches (but not a lot)
- Architecture as a Plan
  - Not very popular because...
    - Reveals commercial secrets
    - Assumes we know what we are doing
    - Hard to get agreement up front
  - May be easier if the pictures are simple
- Architecture as a Map
  - Sometimes called a “Framework”
  - Sometimes an “Applicability Statement”
  - Not very popular because...
    - Most of the work has already been done
    - Little value for assisting interoperability
  - Sometimes stops people trying to invent new solutions



# SDN Architectures

- Everyone is looking for an SDN architecture
  - Because no one really knows what SDN is?
  - Because it is hot and exciting?
- But the IETF hasn't published an SDN architecture
  - Because there are plenty out there?
  - Because no one really knows what SDN is?
  - Because it would be impossible to get agreement?
  - Because it doesn't help the IETF in its work?



# Why Can't the IETF Agree an SDN Architecture?

- Other bodies can do it, surely the IETF can as well
- Consensus can be hard to find
  - Some other bodies have “forced through” their architectures
    - If you don't agree, you can go to a different organisation!
  - The IETF will not make progress without consensus
- Engineering quality can be hard to achieve
  - Some SDN architectures are a little vague
    - What is the difference between an Orchestrator and a Super Controller?
    - Which components can see topology?
  - It's understandable – we are still inventing SDN
- The architecture is not the deliverable

# IETF SDN Architecture Documents

- “Hey, Adrian, you said there aren’t any!”
- There are some partial pictures
- RFC7491 “Application-Based Network Operations”
  - Informational RFC without a working group
  - Lots of existing IETF protocols can be used to achieve things
  - Some new interfaces may exist
- draft-zhao-teas-pce-control-function
  - Informational draft being adopted by TEAS working group
  - How a Path Computation Element is central to some SDN
- draft-wu-opsawg-service-model-explained
  - Informational draft
  - What is a service model and what is north of the NBI?
- These show how protocols fit together, but there are so many...

# Choosing Protocols

- We are all engineers
  - We like to make new things
  - We like to use old things for new purposes
- Most protocols can be made to do most jobs
  - That does not mean it is a good idea
  - But sometimes it is!
- There are many ways to do the same thing
  - This leads to discussions and arguments



# Engineer (ɛndʒɪˈnɪə)

- **noun**

1. A person who designs, builds, or maintains engines, machines, or structures
2. A person who controls an engine, especially on an aircraft or ship
3. **A skilful contriver or originator of something: *the prime engineer of the approach***

- **verb**

1. Design and build (a machine or structure)
2. Modify (an organism) by manipulating its genetic material
3. **Skilfully arrange for (something) to occur**

# Other useful vocabulary

- **Bodge** (bɒdʒ) **verb**

1. **Make or repair (something) badly or clumsily**

- **Hack** (hak) **verb**

1. Cut with rough or heavy blows
2. **Program quickly and roughly**
3. Manage; cope

- **Contrivance** (kən'traɪv(ə)ns) **noun**

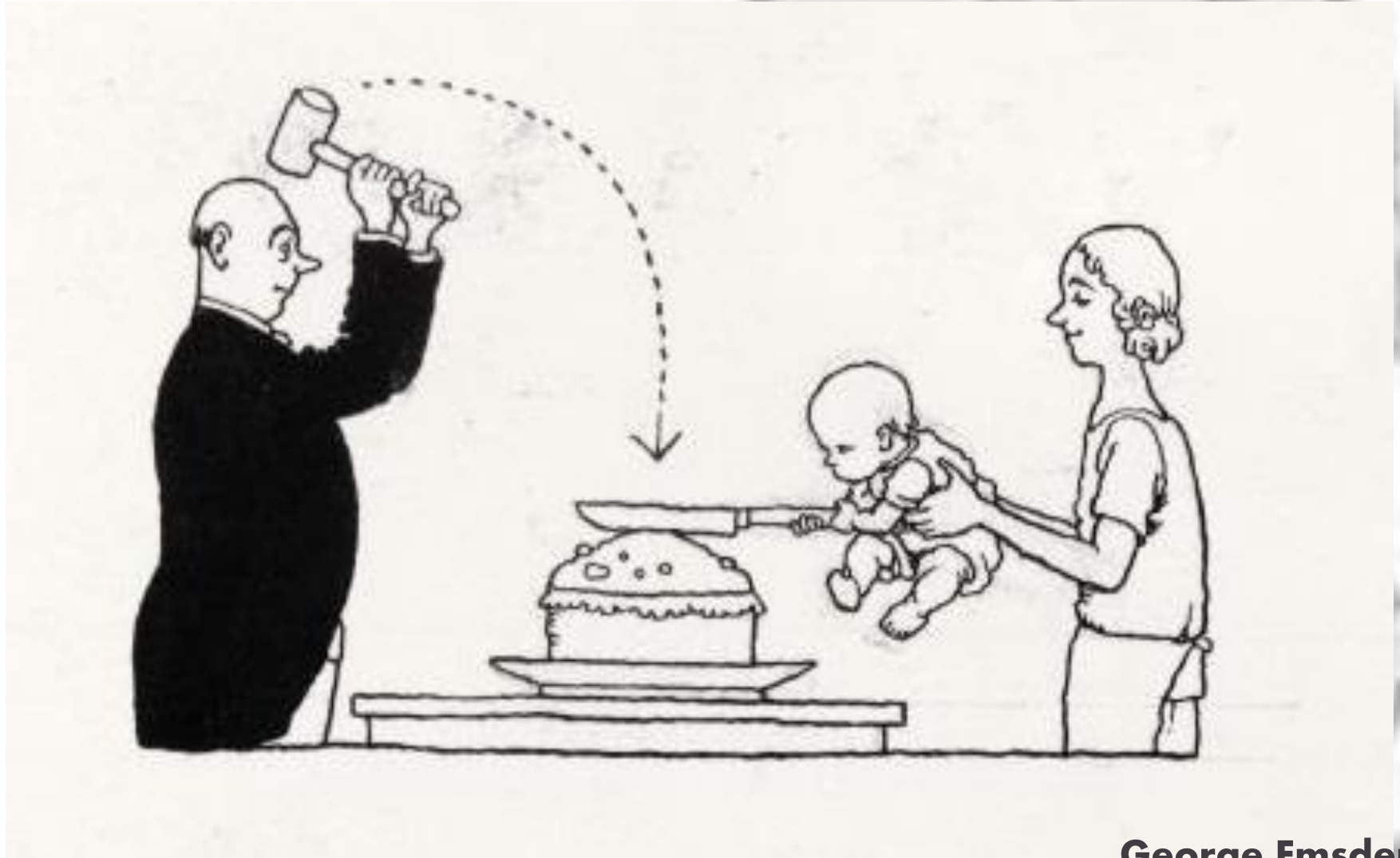
2. A device, especially in literary or artistic composition, which gives a sense of artificiality
  - 2.1. **A thing which is created skilfully and inventively to serve a particular purpose**



# It Makes Sense to Re-Use a Protocol, Right?

- I've already deployed it for one purpose so I can...
  - Re-purpose it for something similar
  - Save money on development
  - Reduce training and operational costs
  - Give my development team a boost
  - Show how clever I am
- And new protocols have to be debugged from scratch
  - That's complicated
- But beware of...
  - Code complexity
  - Cross-feature impact of changes
  - Misunderstanding of details

**Just because you have a hammer...**



**George Emsden**

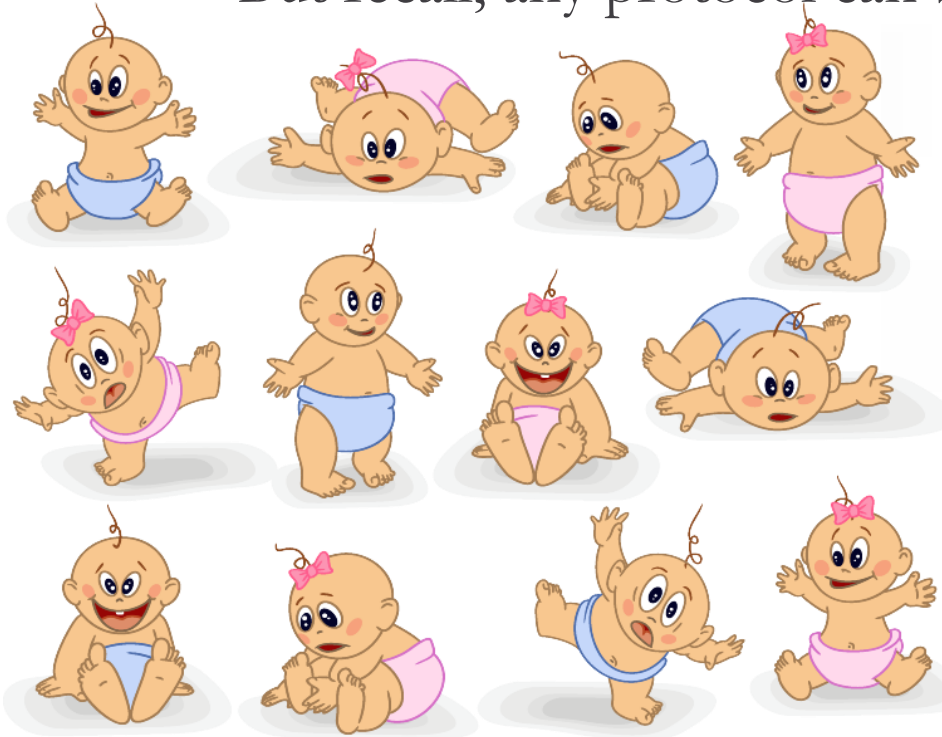
## For Example, IETF SDN SBIs...

- PCEP was designed to allow routers to be told how to set up LSPs in an MPLS network
  - Means that the PCE talks to all of the routers
  - A single forwarding instruction is like a short LSP
    - So use PCEP to “program” the routers
  - Also use PCEP to collect network information
- BGP is a policy-based routing protocol
  - It has “Flowspec” to describe paths
    - So use BGP to program LSPs
  - And BGP pushes routing information
    - So use BGP to program routers (like in Segment Routing)
  - And BGP-LS already collects network information
- NETCONF is the IETF’s preferred configuration protocol
  - All information can be packaged up and carried by NETCONF
  - So NETCONF is already an SBI
    - Just add RESTful and define more YANG models



# My Baby Is More Beautiful Than Yours!

- We love our babies and think they are the best
- Comparisons of protocol solutions often turn into “beauty contests”
  - My protocol is better, your protocol sucks
  - But recall, any protocol can be made to do anything



- Don't make a choice based on beauty
  - What do you want to build?
  - What do you want to deploy?
  - What is already available?
  - What fits in best?
  - What is easiest?

# Having a Choice is Good

- It allows you to make the right choice
  - The competition is left in the dust
- You can show leadership to your customers
- You can use the right protocol for the right function
- Yakov Rekhter used to say:
  - “Let the market decide.”
    - He meant
      - I will persuade the market I am right
      - I am confident I will make the right choice

# Having a Choice Is Bad

- Inevitably each customer makes a different choice
  - You have to implement everything to make the sales
- Different vendors make different choices
  - You have to implement everything to interoperate with them
- You can't risk making the wrong choice
  - You have to implement everything before you know what the market will decide
- And it all costs money
  - Multiply the development and support costs
  - Operations and management tools become a mess

# Do We Need the Police?



- Do we need someone to make a decision for us?
  - Maybe the IETF could decide and tell us what to do
- Remember:
  - You are the IETF
  - The IETF makes choices based on consensus
- Deciding to stop is harder than deciding to start
  - Dropping CR-LDP and focussing on RSVP-TE took 6 years
  - OSPF and IS-IS continue to compete
- The IETF will not decide until you...
  - Decide to make a decision
  - Persuade others to make a decision
  - Agree to give up some things to reach consensus

# So How Do We Build An SDN System?

- Implementers want to know what to build
  - They care about cost, market leadership, competition
- Operators want to know what to deploy
  - They care about cost, timeliness, function, simplicity, choice of vendors
- The IETF cares about
  - Consensus and interoperability
  - You must reach agreement with your peers
- We can look for leadership or wait for evolution
  - Evolution is the default option
  - Leadership requires convincing arguments and cooperation



Questions?

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# About Adrian Farrel

- 17 years developing communications software
  - Portable OSI, ATM, MPLS, and GMPLS products for Data Connection, Ltd.
  - Advanced GMPLS for WDM Add-Drop, OEO, and PXC for Movaz Networks
- 14 years as independent consultant with Old Dog Consulting
  - Customers are...
    - Established equipment vendors
    - Early-stage start-ups (equipment and software)
    - Large network operators and service providers
    - Research establishments
  - Services are...
    - Standardization
    - Product strategy
    - Education and training
- Founding CTO of Aria Networks
  - Application of Artificial Intelligence to path computation
- Long history of standardization in ITU-T, IETF, ISO, etc.
  - Previously Chair of CCAMP, PCE, and L1VPN working groups in the IETF
  - Served six years as IETF Routing Area Director
  - Currently co-chair of L3SM and I2NSF working groups in the IETF
  - Technical advisor to the TEAS working group in the IETF
- Author of over 70 RFCs and 8 books (including two books of fairy tales)