

Towards Re-architecting Today's Internet for Survivability

The Role of Standardization

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Thoughts are my own and do not represent a position of NIST.

Does today's Internet have an architecture?

- **Historically protocols have defined architecture.**
 - TCP/IP – network of networks, end-to-end functions
 - DNS – global naming system
 - BGP – autonomous system interconnection
- **IETF does not standardize architecture**
 - [RFC 1958](#) Architectural Principles of the Internet (1996).
 - “..a snapshot of the current principles of the Internet architecture. This is intended for general guidance and general interest, and is in no way intended to be a formal or invariant reference model.”
 - [RFC 3439](#) Some Internet Architectural Guidelines and Philosophy (2002).
- **Are protocol design principles enough?**
 - Does a collection of protocols define an architecture?

Network Working Group Request for Comments: 1958 Category: Informational	B. Carpenter, Editor IAB June 1996
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Architectural Principles of the Internet

Status of This Memo

This memo provides information for the Internet community. This memo does not specify an Internet standard of any kind. Distribution of this memo is unlimited.

Abstract

The Internet and its architecture have grown in evolutionary fashion from modest beginnings, rather than from a Grand Plan. While this process of evolution is one of the main reasons for the technology's success, it nevertheless seems useful to record a snapshot of the current principles of the Internet architecture. This is intended for general guidance and general interest, and is in no way intended to be a formal or invariant reference model.

Network Working Group Request for Comments: 3439 Updates: 1958 Category: Informational	R. Bush D. Meyer December 2002
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Some Internet Architectural Guidelines and Philosophy

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Abstract

This document extends [RFC 1958](#) by outlining some of the philosophical guidelines to which architects and designers of Internet backbone networks should adhere. We describe the Simplicity Principle, which states that complexity is the primary mechanism that impedes efficient scaling, and discuss its implications on the architecture, design and engineering issues found in large scale Internet backbones.

What and how we standardize?

- **Holes in the protocol collection (architecture)**

- Middle boxes – load balancers, proxies, caches
- Security functions – firewalls, IDS/IPS, DNS-BL
- Network function virtualization / SBA disaggregation
- Software defined networking
- Interface specifications

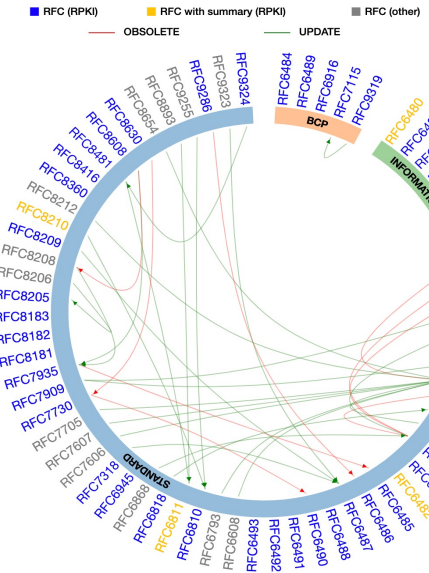
- **Internet Standards**

- Disaggregated, lack test specifications, often lack operational guidance.
 - E.g. top image of current RPKI-ROV specifications

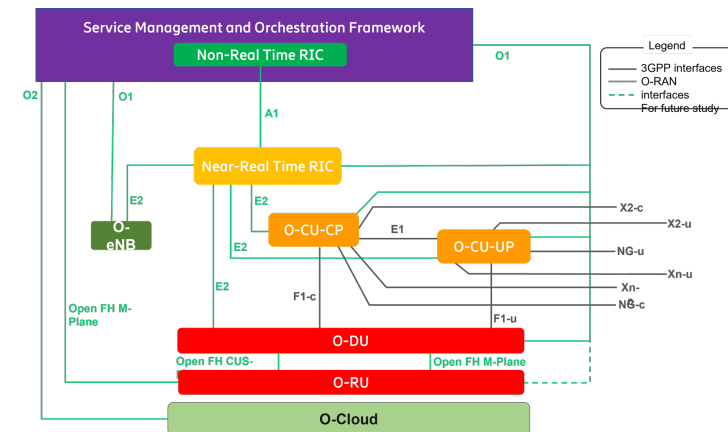
- Standardize individual protocol / information models – not composite network function behavior.

- **Constant and unbounded evolution**

- Engineer around missing standards / functions.
 - E.g., foo over HTTP
- No notion of periodically documenting a consistent / coherent snapshot of protocols.
 - E.g., Internet release 2025 ☺



Source <https://rpki-rfc.routingsecurity.net/>



Source: <https://www.o-ran.org/>

Network Security vs Protocol Security

- **Security Considerations**

- Typically apply to individual protocols not systems or functions.

- **Authorization often overlooked**

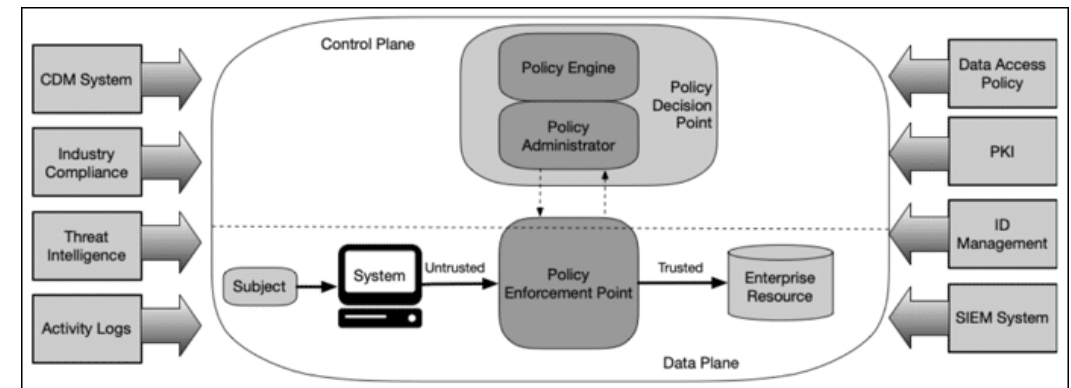
- Possibly because authorization controls often transcend protocols / layers.

- **Internet designed to interconnect all devices**

- Multi-billion dollar industry emerged to ensure that 99.99% of those potential instances of communication can't happen.

- **Zero Trust Architecture**

- Default deny – unless explicitly authorized.



Implications for this program?

- **Many will argue that the issues previously noted are a strength of the Internet / IETF process.**
 - I won't challenge that, but this program suggests that the resulting status quo is not enough.
- **Is it possible to “re-architect” the internet to achieve the goals of this program without addressing these issues?**
 - Will protocols define the future architecture?
 - Or is there a need for more explicit architecture?
- **Are we trying to raise the survivability bar for all Internet protocols / services?**
 - Or just providing the tools to enable those will market incentives to do so?



[See recent crash](#)