LESSONS ABOUT SUCCESS IN INTERNET EVOLUTION

IFIP Networking Conference 2021

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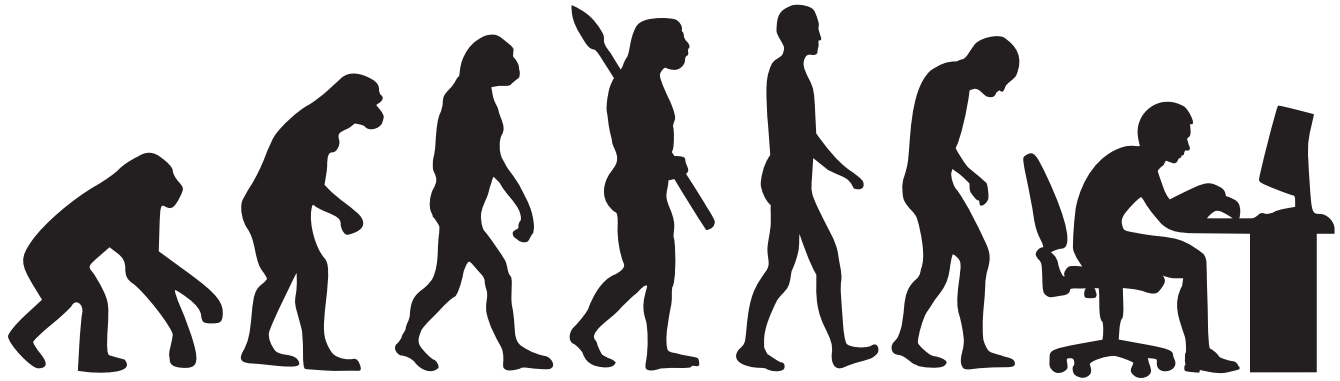


*) A lot of credit for the work going to my colleagues at IAB and Ericsson (Kühlewind, Huitema, Camarillo, Mansfield, Sarker, etc.) but opinions expressed here should be interpreted as mine only

Agenda

Is there evolution?

- Examples: Covid-19 impact, case of encryption, QUIC

What are the key ingredients of success?

- General or optimized? Modularization

What challenges are relevant for the future?

- Too narrow focus only on communications security, losing collaboration, trend towards centralization & consolidation

Internet Is 50 Years Old, But Is It Agile?

Source: D. Clark, IAB workshop on Covid-19

COVID-19 impact on networking

› Large traffic scale changes

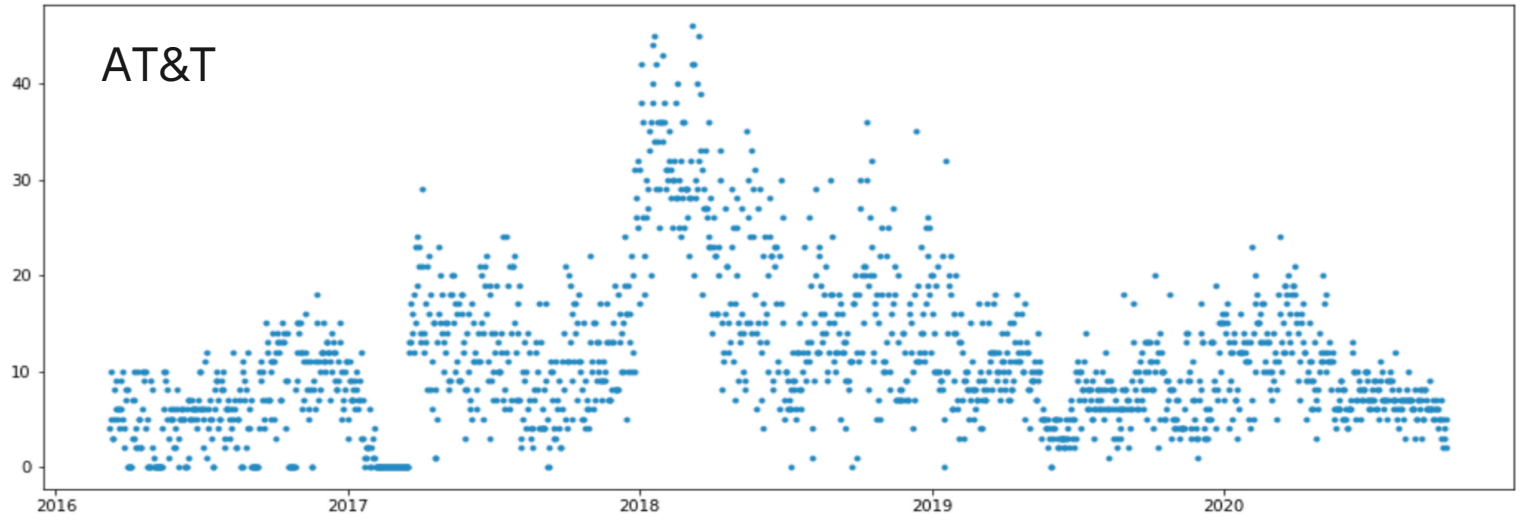
› Perceptions

What happened in the background?

› Capacity additions

› Highly motivated people to improve

› Cloud model helped the app switch



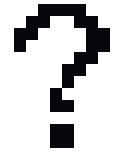
How did the Internet do?

› There are some results from a recent IAB workshop: "Internet did well" – reasonable results

› The Internet is well suited for adapting to new situations, but there are also issues:

  – Digital divide amplification

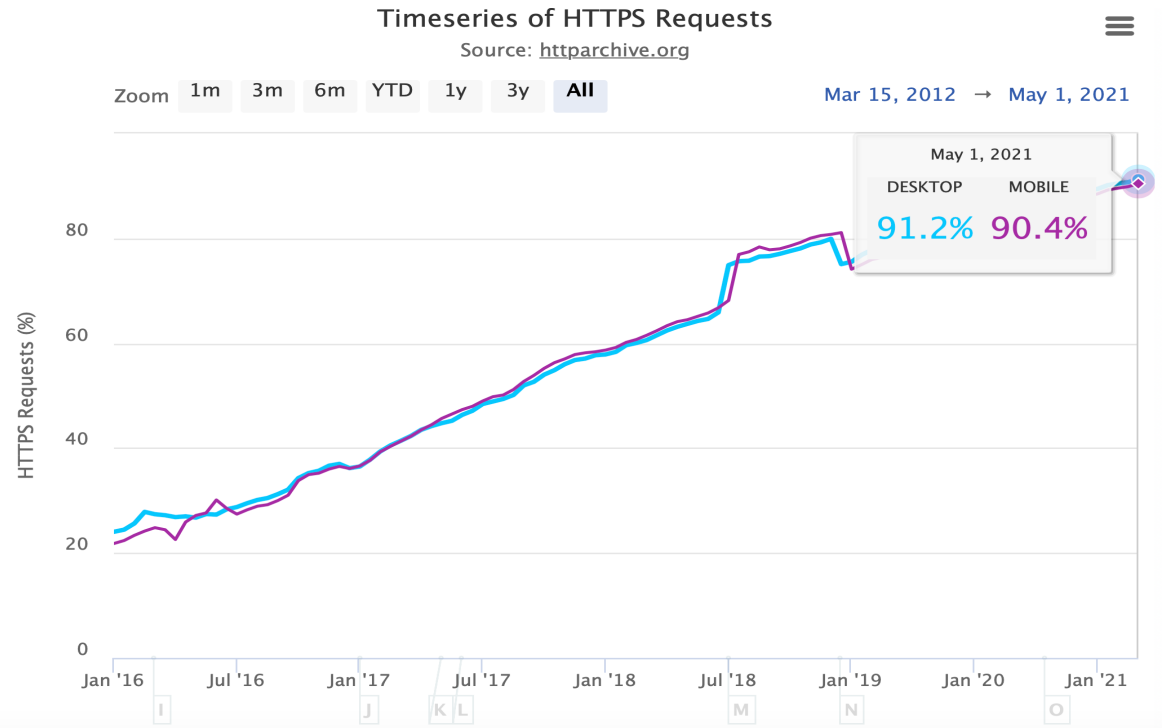
  – All the other improvements we need anyway



Case Encryption

Turning security on for almost all connections

- From 20% to 90% in five years
- Incentives, world events, and technology came together



Work continues

- Headers, control protocols

Case QUIC

New transport protocol ("Quick UDP Internet Connections")

- Standard developed by the IETF Nov 16 – May 21 (RFC 9000)
- Widely deployed on the Internet, 20+ implementations
- Improved latency, multiplexing, address migration

Side-effect: from now on, evolution will be faster

- Implementations are in user space, part of applications
- Middlebox interpretation of protocols no longer causes ossification

Key Ingredients of Internet's Success

General or optimized?

- Not particularly optimized for any application or technology generation
- Doesn't have all features

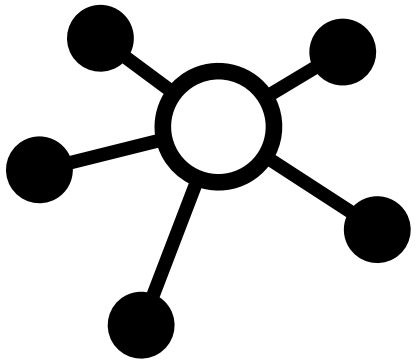
- But is available and (relatively) simple
- New applications doable without asking anyone ("Permissionless innovation")
- Modular

- Has managed to scale from 1.2 kbit to 1 gbit/s and to 4.7B users

"Internet doesn't support audio/video/VR/hologram/..."

- There is always a future application that cannot be used today
- Tradeoff: optimizing network, app, or waiting speeds to go up

Four Guidelines for Success



1. Do not coordinate unnecessarily

- Dependencies make for slow deployment

2. Keep a modular architecture

- Independent evolution for different parts

3. Do not attempt perfection

- Time to market

4. Remember the incentives

- There must be something for all parties who need to change, even early adopters

Challenges

Security, security, and security!

- Great success in communications security
- What about susceptibility to DDoS attacks?
- Resilience against failures?
- Commercial and other surveillance?

Losing collaboration

- Applications are becoming proprietary
- App-network interaction becoming extinct

Centralization and consolidation

- Risks for resilience
- Users may not have a real choice
- Or say in conditions of the service offers

Vision for a Better Internet

Challenges

- Security
- Collaboration
- Centralization

Possible directions

Broad approach to security

- Protecting data at rest and in use as well as in transit
- Work on resilience, reliability, fault tolerance, and DoS defences
- Security assurance practices

Collaborative Internet

- App and network awareness of each others' needs and current situation
- Explicit, engineered collaboration
- Globally interoperable applications

Distributed services for infrastructure functions

- Awareness, measurements
- Important to ensure federation, discovery, etc. are options in standards