

Observations on Internet Evolution



Jari Arkko

Chair, Internet Engineering Task Force
(IETF)

Expert, Ericsson Research



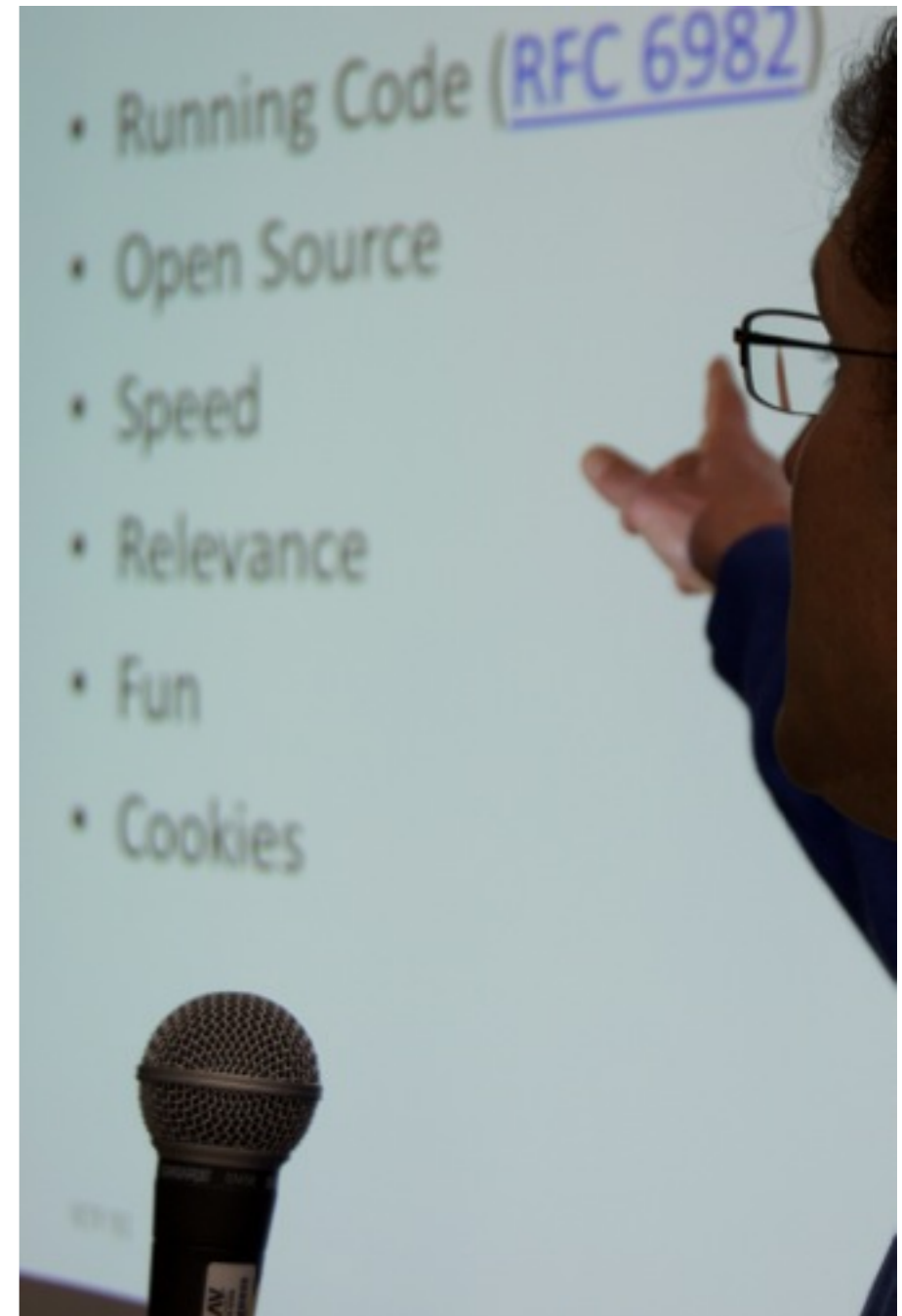
ERICSSON

Photo and graphic credits in this presentation: Olaf Kolkman, www.ietf.org,
webdesignerledger.com

Some Areas of Active Work at the IETF



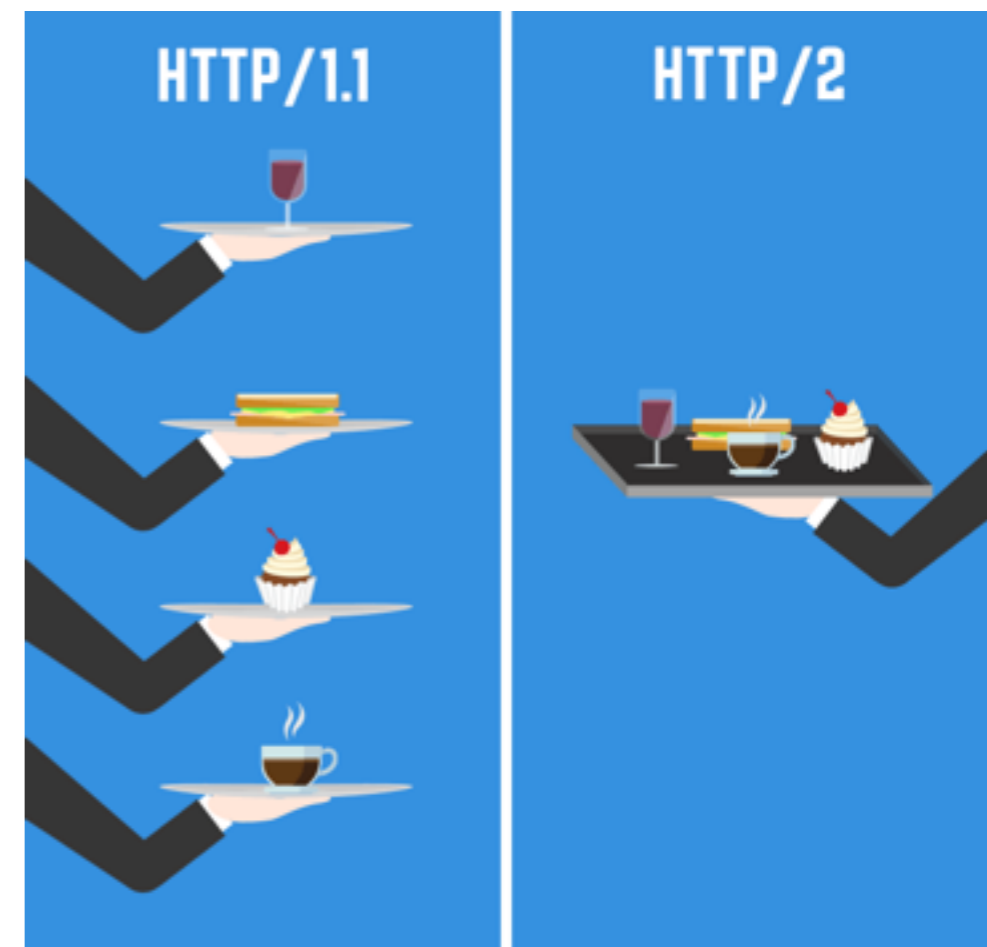
- Web protocol stack evolution (HTTP2, QUIC)
- Security and privacy (RFC7258, UTA, DPRIVE, TLS1.3, ...)
- Enabling real-time communications from browsers (WebRTC)
- Management, orchestration, virtualisation, and data-model driven networking (NVO, SFC, YANG)
- Internet of Things
- Running code and open source



Web Protocol Stack



- Overall, much change in last few years: HTTP2, certificate pinning, HSTS, webpush, increased use of encryption, WebRTC, TLS 1.3, ...
- Now tackling even bigger changes: QUIC
- Why is this happening and what does it mean for the Internet?



Background



- We needed all this those things...
- And if you haven't noticed, *everything* runs on top of the web
- But also, consolidation of Internet services, traffic, OSs and applications plays a role
- Internet architecture and role of endpoints plays a role as well, as does the ease at which software today gets updated

Observations 1



- Prediction: Big shifts so far, even bigger ahead
- Functionality moves to applications & browsers, fast change
 - Encryption change was just an example — others will follow: specialised transports for movie download, etc.
- Applications are firmer in control: e2e security, browsers, now transport — what's next?

Observations 2



- At the same time, in the network, SDN and virtualisation are driving another change which also enables fast changes
- The networking industry needs to embrace this fast change, as well as to understand how the traffic it carries evolves
- The mobile industry is embracing a lot of this in 5G, but recognising speed of change is very important

Internet of Things



- IETF role: Specify the underlying, fundamental Internet technologies
- “Permissionless innovation” — others can build on top

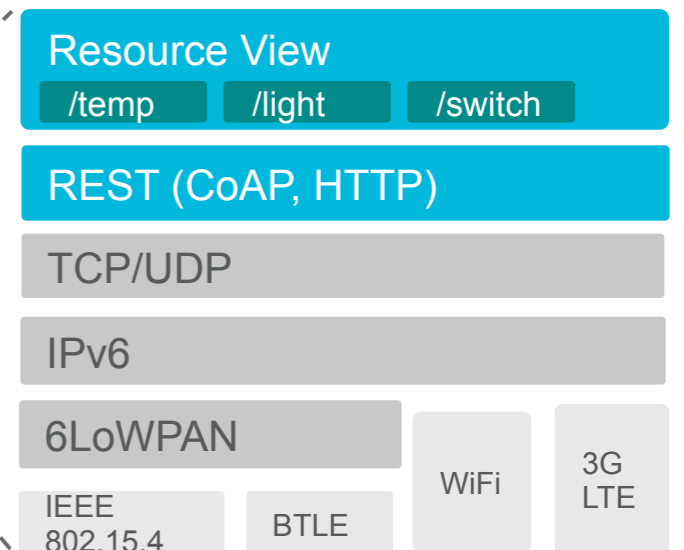
Run IP over <IOT media>	Security for IOT
Routing for lossy & low power networks	Thing-to-Thing communication (IRTF)
Web technology for IOT	Architectural oversight (IAB)

Observations 1



- A shift from closed, vertical solutions to open, general networking solutions (IP, IPv6, mobile networks, WLAN, web)

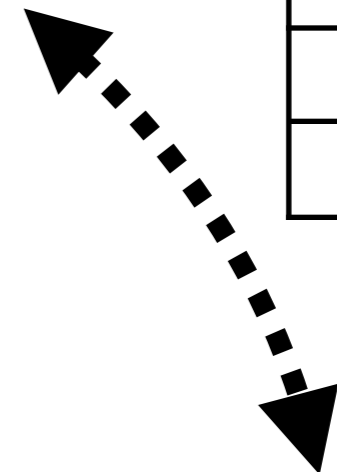
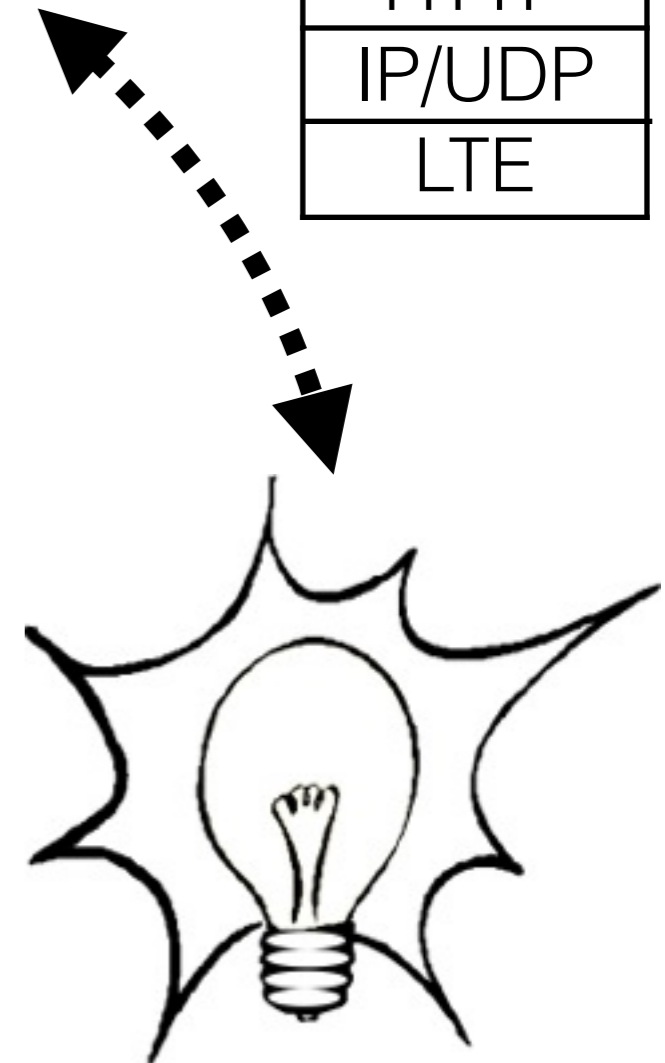
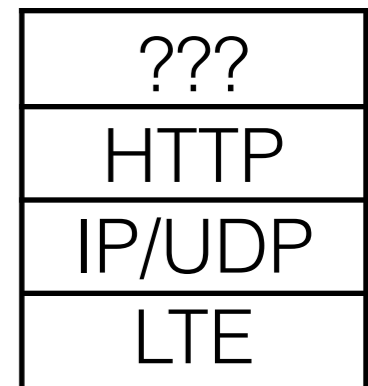
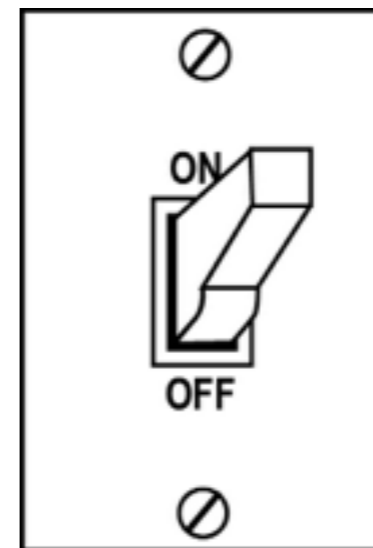
- Ongoing shift from devices to thinking about systems, connections between systems, analytics, etc.



- Security & privacy continue to be big challenges
- Management, interoperability, and updatability

Semantic Interoperability

- Most systems run on standard L2, on IP, and on top of the web protocols
- Good interoperability from a network perspective, mostly
- But is there application-level interoperability?
- Different applications, different data models across the industry (needs work!)



Ownership and Control



- Software updates are essential
- But this seemingly simple issue is actually complex — who has the right to update software on a device? Can the manufacturer EOL a device that you own?
- More generally, when you buy, say, a car, are you buying a tangible object, or the rights to use the cloud services that are behind it?



My car from 1992 runs on 10L/100km and uses no cloud services (yet)

Observations 2



- Underlying networking details are the bread and butter of IETF's IOT work
- Much work is still needed on that, security in particular
- But as a whole, a lot work remains at the level of systems, how they are connected and controlled, how they interoperate, and so on

Running Code And Open Source



- A big part of today's mainstream networking development happens in open source
- What's the relationship of open source and standards?
- How does this affect organisations like the IETF?

Open Source and Standards



- Both are needed
- There are often multiple open source efforts that need to interoperate

- Need to work together



- The usual patterns of what companies keep proprietary and where they work together in standards and open source still apply

Open Source @ IETF



- Running code always a big part
- IETF Hackathon series
- Our latest run in Berlin was our most successful one to date
- Working groups using open source style collaboration tools
- WGs on open source tech (e.g., BABEL)



Open Source @ IETF



- Future evolution? Culture changes?
 - Collaboration styles differ
 - Timescales and expectations on stability differ
 - Role of consensus building; consensus is valuable
- Further expansion of role of code within the IETF
- <Your ideas here>

Topics to Work On



- Interoperability where it matters
- Transport protocol evolution in the world where low latency matters even more
 - Low-latency communication is also interesting in general
- Enablers for permissionless innovation, e.g., enabling applications to do more, programmable networking, self-management, distributed or collaborative designs
- Web technology, 5G



Things to Avoid

- Networks that assume traffic patterns stay the same
- Technology that introduces further possibilities for identifying and correlating users and their data
- Complexity of centralised designs or designs that assume large-scale coordination among players
- Be careful with QoS — many past failures here
- Flag days

Thank You