# Observations on Internet Evolution



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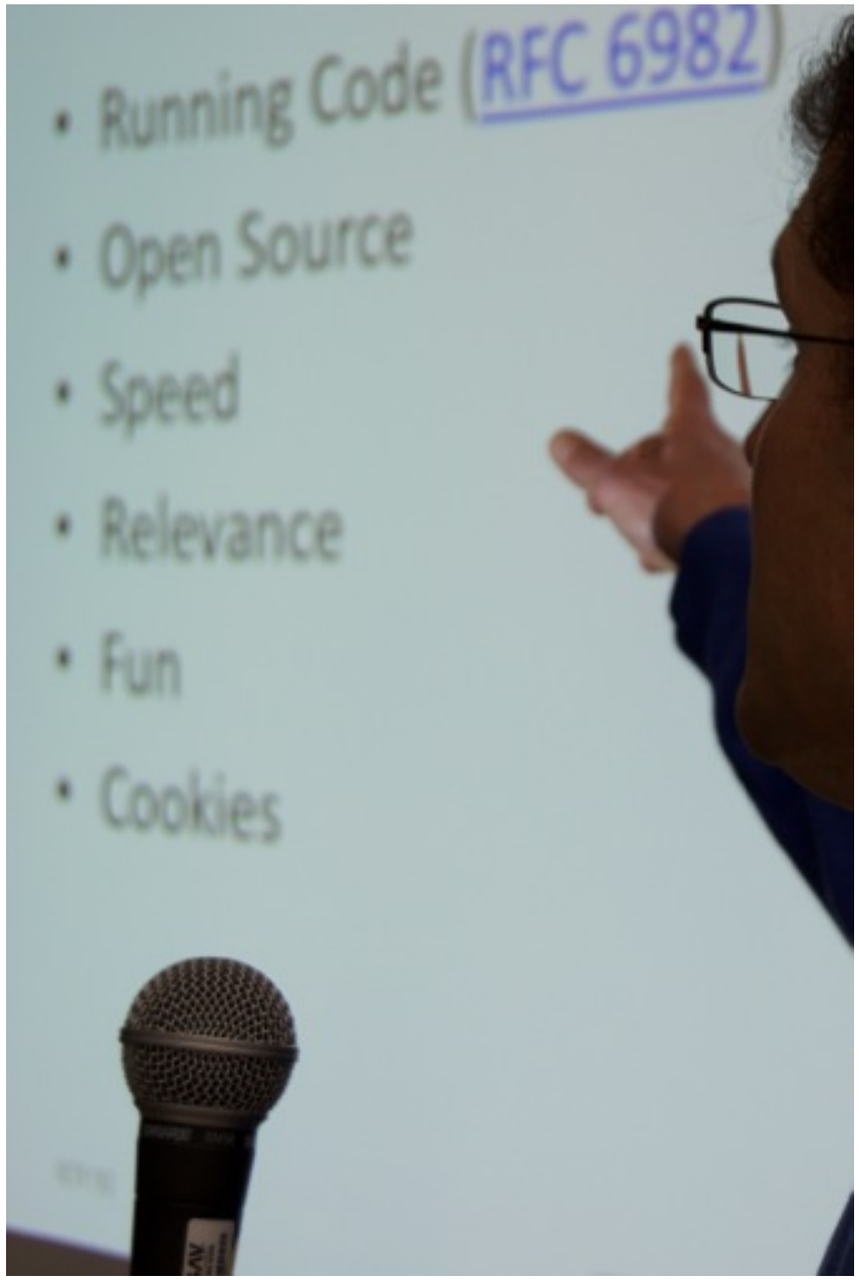
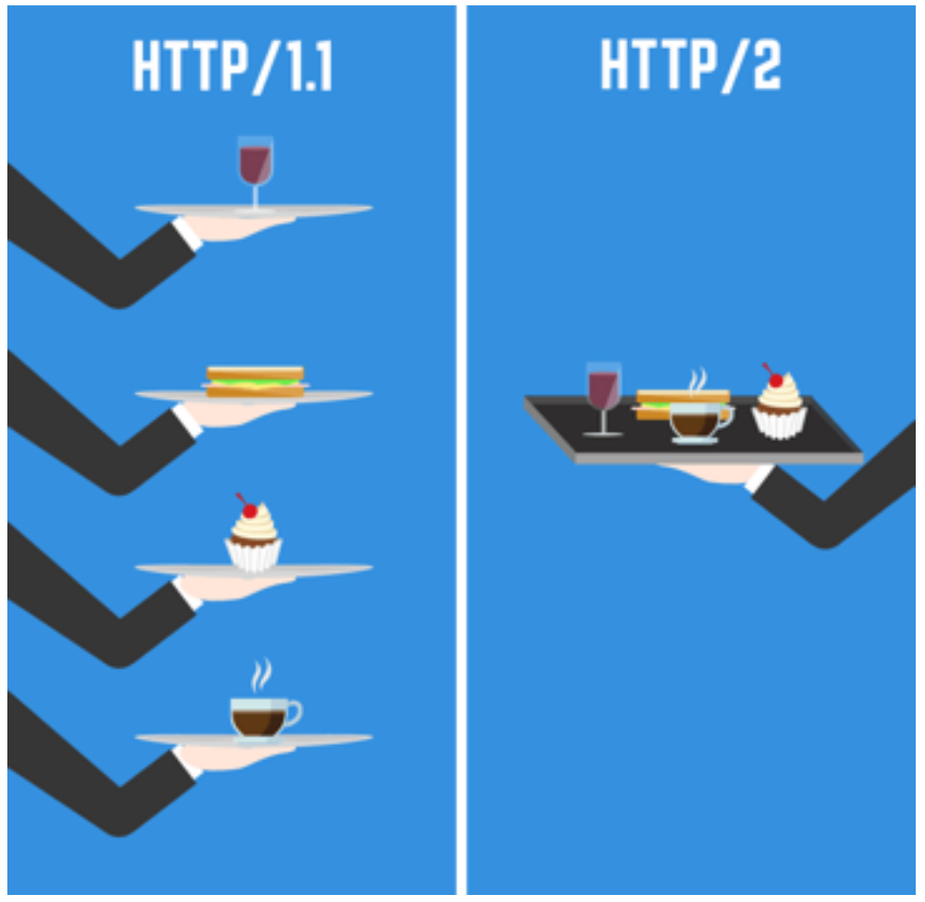
# Some Areas of Active Work at the IETF

- 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

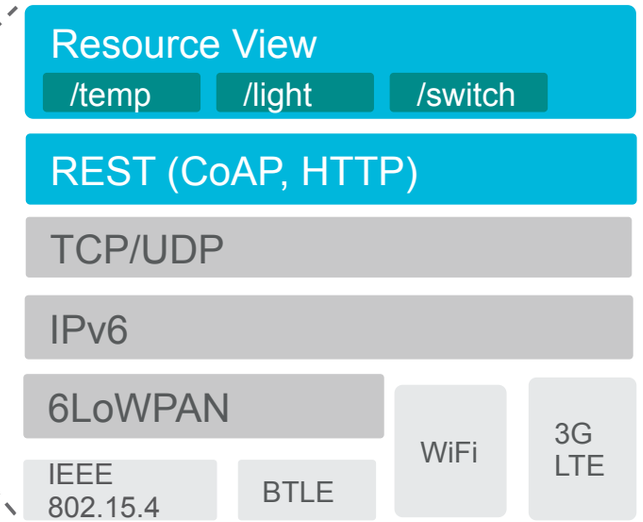

- IETF role: Specify the underlying, fundamental Internet technologies

- “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

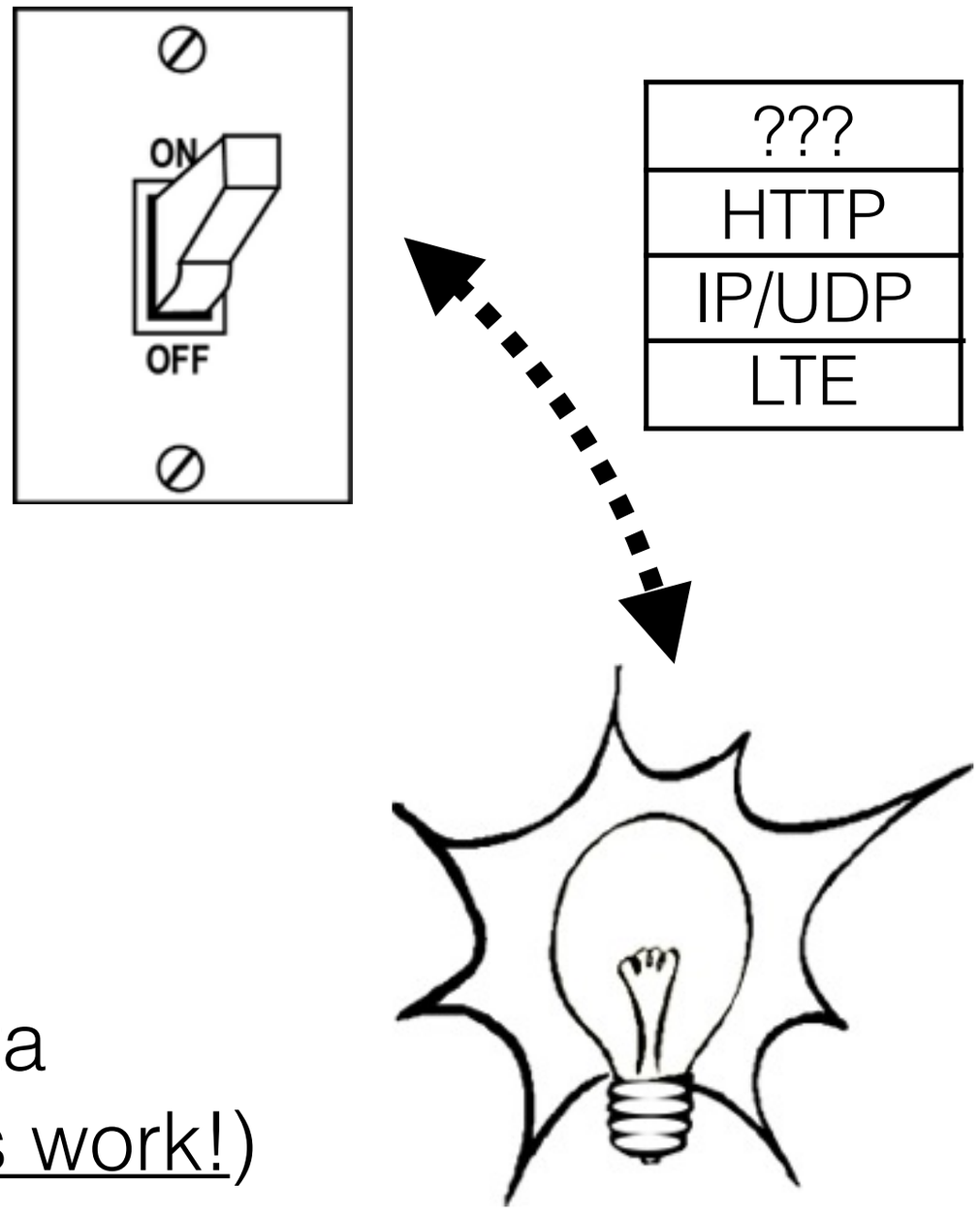
# Semantic Interoperability

- 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