BSI

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Internet, Cloud,Things

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IoT Challenges #1
Systems

- Scale
  - 1000 times size of current internet in complexity
- Offline-to-Online working
  - Has to work mostly offline
- Sustainability (batteries not included)
  - “things” last 3-300 times longer than computers
- Resilience
  - I have front door, back door, windows for fire escape
  - But only one broadband link – not good enough
- Security & Safety
  - Probably where regulation comes in
  - Liability etc

IoT Challenges #2
People i

- Not the Internet as we know it, Jim
  - E.g. COAP&IPv6&LowPAN not HTTP/TCP/IP/WiFi
  - People don't understand it much
  - Attacks are all new
  - Culture in embedded systems engineering is "security free"
- Invasive
  - sits inside your home, car, office, shoe, bloodstream
  - Is a Tussle Space
  - c.f. smart meter – nano-cloud in home
  - Utility/provider facing VM, partitions from:
  - User facing VM, running user apps, accessing:
  - Some of the shared data, but not all….

IoT/Cloud Challenges #3
People ii

- Human Privacy
  - Honest-but-curious IoT companies will look into your life
  - Will get it wrong – multiple occupancy is v. complex
  - Using smart phone to disambiguate doesn't work
  - e.g. in bath, shower, with babies, visitors etc
- Human Comprehension
  - Breaks principle of least astonishment, daily
  - People work out their own modus operandi
  - Won't work for others
  - Deep customisation run riot

Thing Legacy means… somethings old, somethings new

- We will have non-internet things for decades
  - Interop is a nightmare
  - Appliances, controllers, integration, billing/control
- Consider smart or autonomous car
  - Choose to go over cliff, or run down children
  - Seen with ABS already
  - But now we have feature interaction…
  - Smart city/roads – insurance companies “driving”

Cloudy Hope
+1

- Multipath
  - MPTCP – used in Data Center (and Siri)
  - Multipath routing match to wireless diversity
  - L2 solutions
  - Gives resource pooling
  - Is implemented (sort of)
- Sidestepping legacy IP
  - Data center does in many ways
  - So should IoT (analogy with data center scale)

Wireless hope
+2

- Contrary to apparent belief in cellular world..
  - There's a **lot** of IETF work on fixing TCP performance for cellular (and wifi)
- Stemming from Apple (QUIC) Google (SPDY) and others (Microsoft)
  - Given they own most the handset OS space between them, they are motivated to make "happy eyeballs"
  - are very aware of wireless link/net characteristics
- C.f. TAPS wg for example…

Conclusions

- It's a minefield
  - Few considerations of consequences of fails
  - Divergence/Diversity of technology
  - But no interop of IoT at any level
    - Device id, discovery, ontology, I could go on…. … .. .
  - Data Center scale (1M cores) might be match for IoT/ 5G in some ways
    - Resilience/fast failover/valiant load balancing/high availability/addressing, low latency
  - But IoT different in others
    - Low power/sustainable/latency on slow links…
  - Ongoing work in IETF suggests room for hope