Beyond IP: Network Protocols to meet the demands of 2030

Kevin Smith, Vodafone : ITU-T FG NET-2030 Workshop, Feb 2019

Information superhighways of 2030

Optical	Radio	Other…

The legacy Internet protocol suite persists…despite being designed under very different conditions:

Everything changes…..

2020s

- Wired access
- No mobility
- Memory is scarce & slow
- Bandwidth is fixed and limited
- Not secure
- Mains-powered clients
- Delivery acknowledgements

- Wireless access
- Frequent, rapid mobility
- Memory is plentiful & fast
- Bandwidth is high but volatile
- Security by design
- Battery-powered clients
- Quality guarantees

TCP/IP on cellular: report card

	Network issue:	Network workaround:
☒ Low application bits per Hz/s	Reduced spectral efficiency	Power, ROHC
☒ No native mobility/multihoming	Overlay required	Encapsulations
☒ No native security	Overlay required	IPsec, DDoS controls
☒ E2E congestion controls	Radio volatility	TCP optimisers
☒ No intrinsic QoS/context	Best effort delivery	DPI/traffic detection

= costly overheads and workarounds, reduced performance

This impacts the mobile operator challenge:

- Deliver much more data over a wider coverage area
- Offer low latency, faster mobility, guaranteed reliability
- Support low-power connections, in challenging environments
- And do this securely and sustainably

Increasing capacity alone will not meet new demands

User plane latency	eMBB: 4ms URLLC: **1ms**	Single user for small IP packets for both DL and UL (eMBB and URLLC)
Control plane latency	20ms (encouraged to consider **10ms**)	Transition from Idle to Active (eMBB and URLLC)
Connection Density	1M devices per km^2	For mMTC
Reliability	99.9999% success prob.	32 L2 bytes within 1ms at cell edge

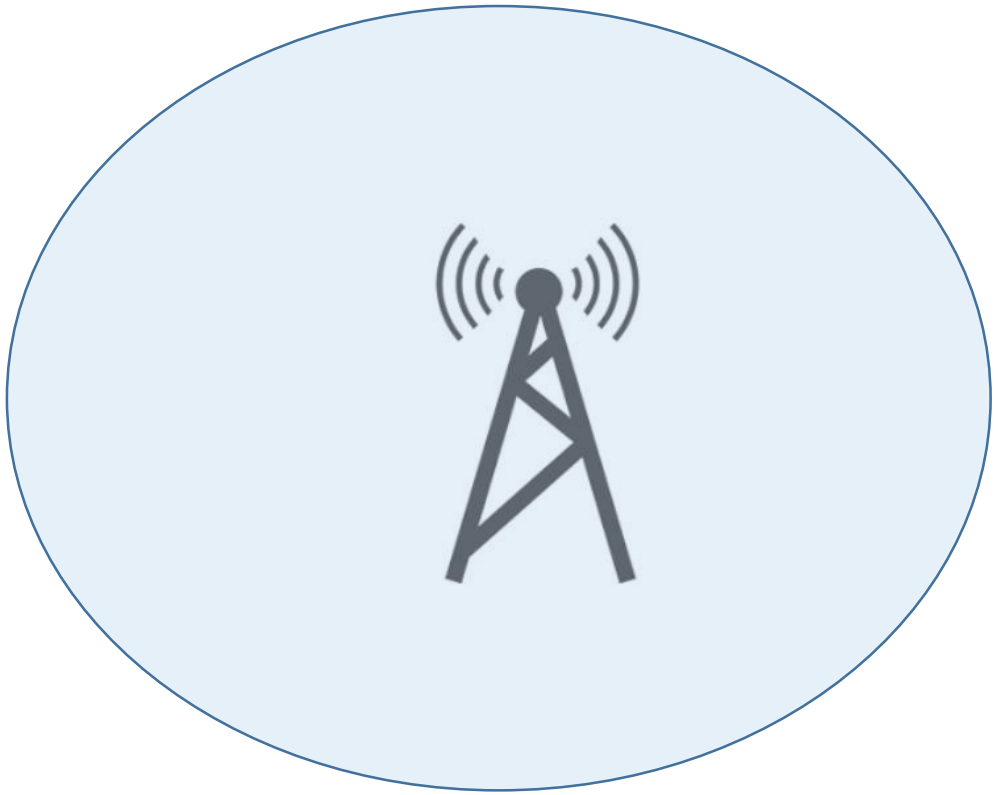
Not just the application bits!

Or more!

Think of the power!!!

Example: a reliable low-latency service

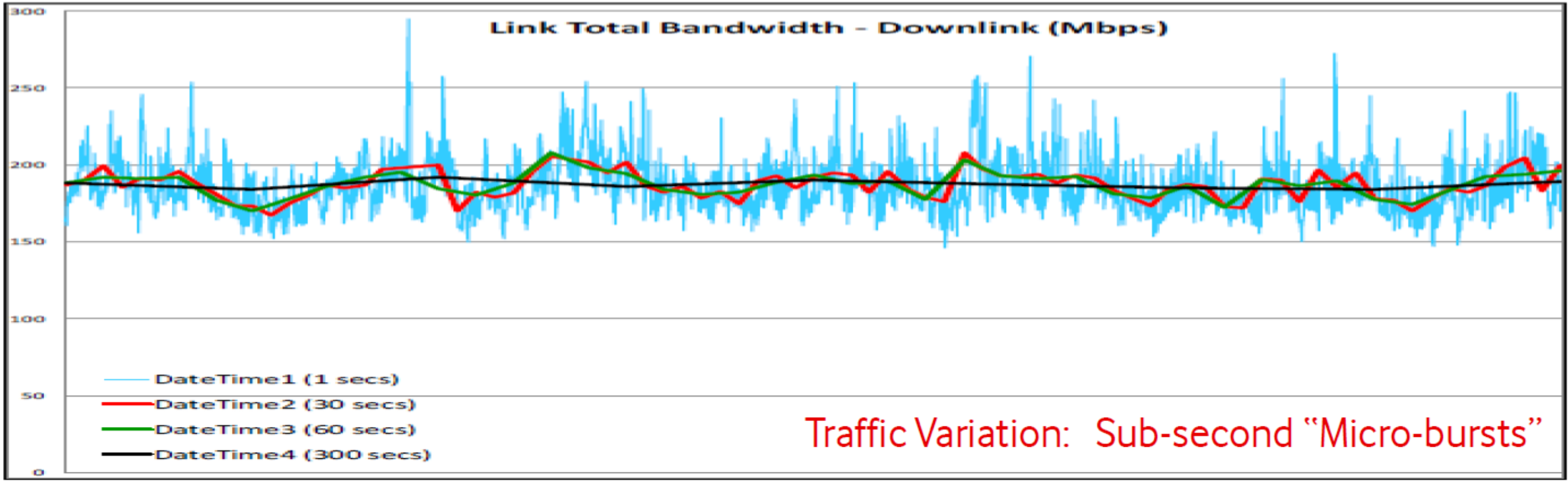
- A network dimensioned for 1Mbps uplink at cell edge



- Low-latency: first packet must arrive with high reliability
- Packet Error Rate 10% -> 0.1% = 10-20dB extra link budget
- Either: the distance to terminal is reduced; or the power is increased; or the data payload is reduced.
- ~18 bytes per ~140µs transmission time interval
- TCP/IPv4 header alone is 40 bytes. Header compression is not sustainable

Providing bandwidth-> delivering quality

- Historic model: throughput, Mb/second
- Variance *within a second* impacts reliability for sub-second use cases.
- Supply predictable quality, not 'average bandwidth'

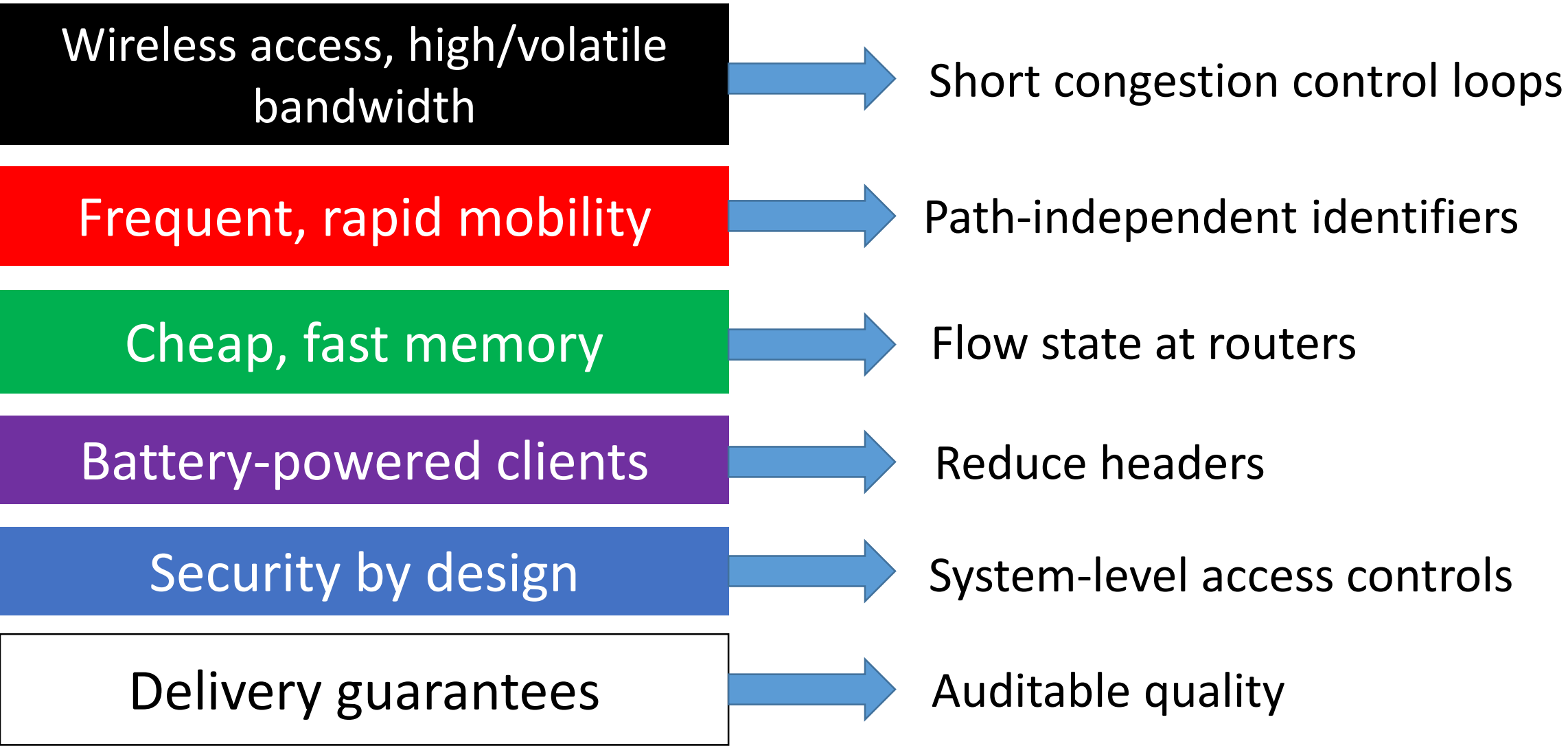


So…what are the options?

Option 1:
Keep adding
compute power,
spectrum, energy
…and cost

Option 2:
Remove the burdens

Updated protocol design context



Candidate technologies under research

RINA:

Recursive Internet Architecture (non-IP, non-OSI, full naming and addressing architecture) (ETSI GR NGP 009)

Flexilink:

High-performance forwarding with synchronised, guaranteed and best-effort services (ETSI GS NGP 13)

Software Defined Radio:

Radios for general-purpose compute motherboards; programmable baseband

Quality Attenuation:

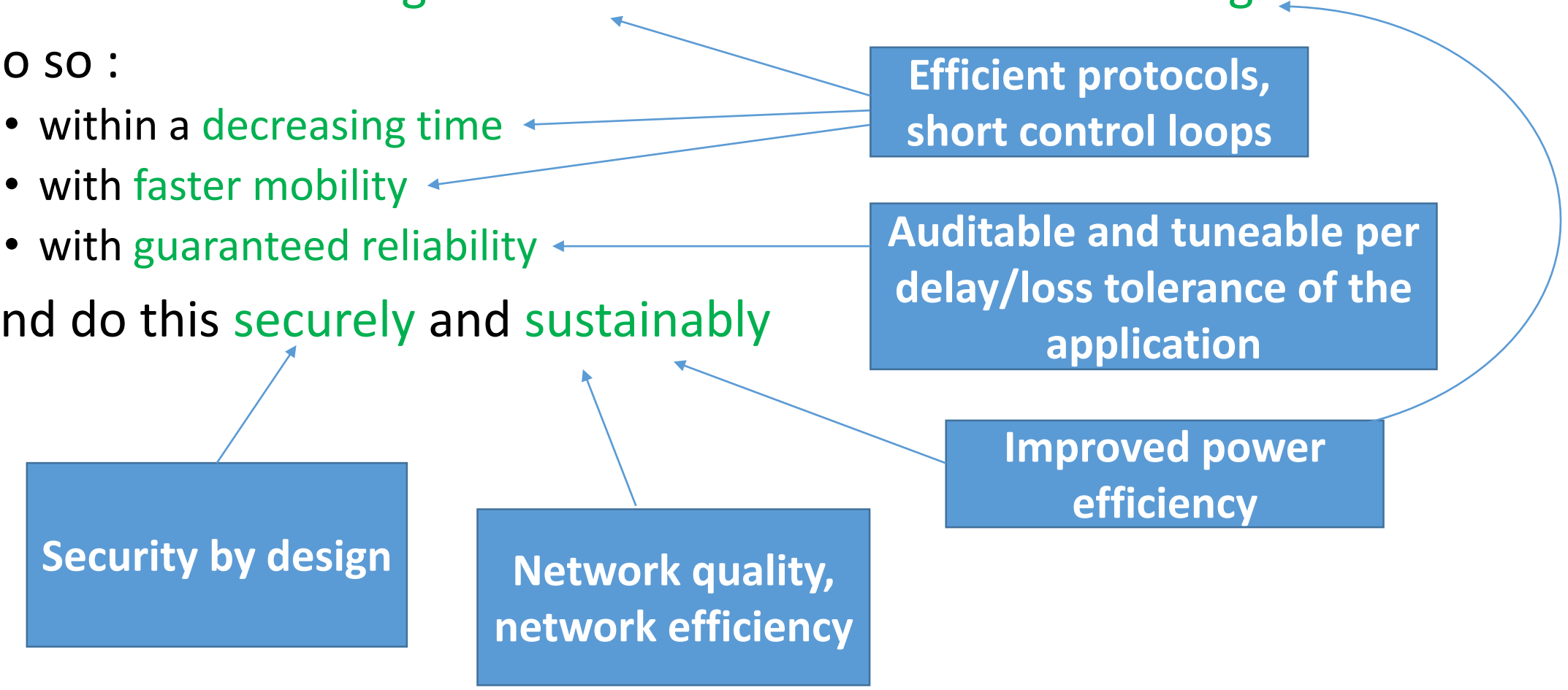
Network performance science to improve contention management (Reading list)

Open Source LTE stacks:

To work around dependency on legacy protocols.

How this can help our challenge

- Deliver an increasing amount of data over a wider coverage area
- Do so :
  - within a decreasing time
  - with faster mobility
  - with guaranteed reliability
- And do this securely and sustainably



It’s a wrap

kevin.smith@vodafone.com