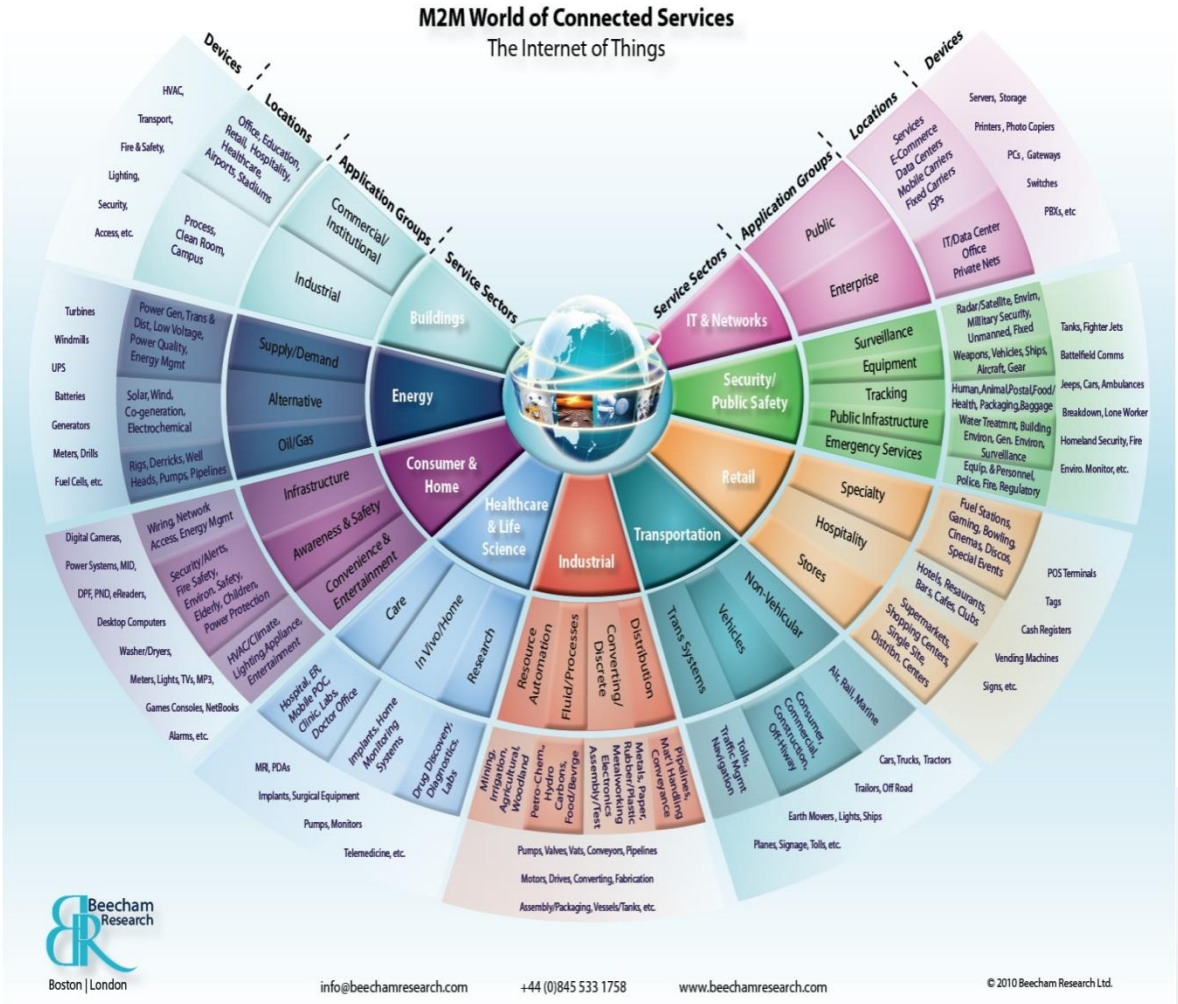
Does the world really need another standard?

Professor William Webb

Do we have the standards we need for the IoT?

- There are many devices that could usefully be connected if only it was cheap and simple enough to do so
- Increasingly we have been connecting through cellular but this trend is reversing
- If we take a different path it should be a standard – but how to bring about a new one?
- Weightless – a new dynamic spectrum access solution

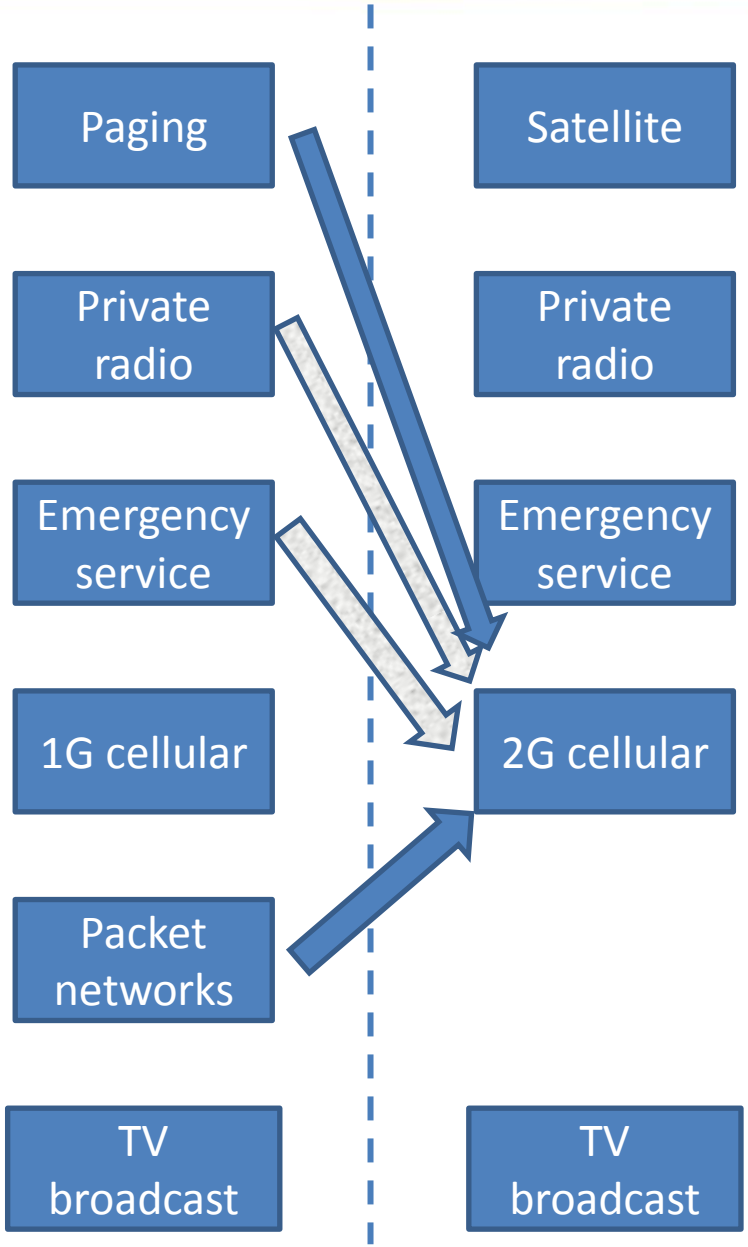
There are many devices that could be connected



The 1G world (circa 1985)

- Paging
- Private radio
- Emergency service
- 1G cellular
- Packet networks
- TV broadcast

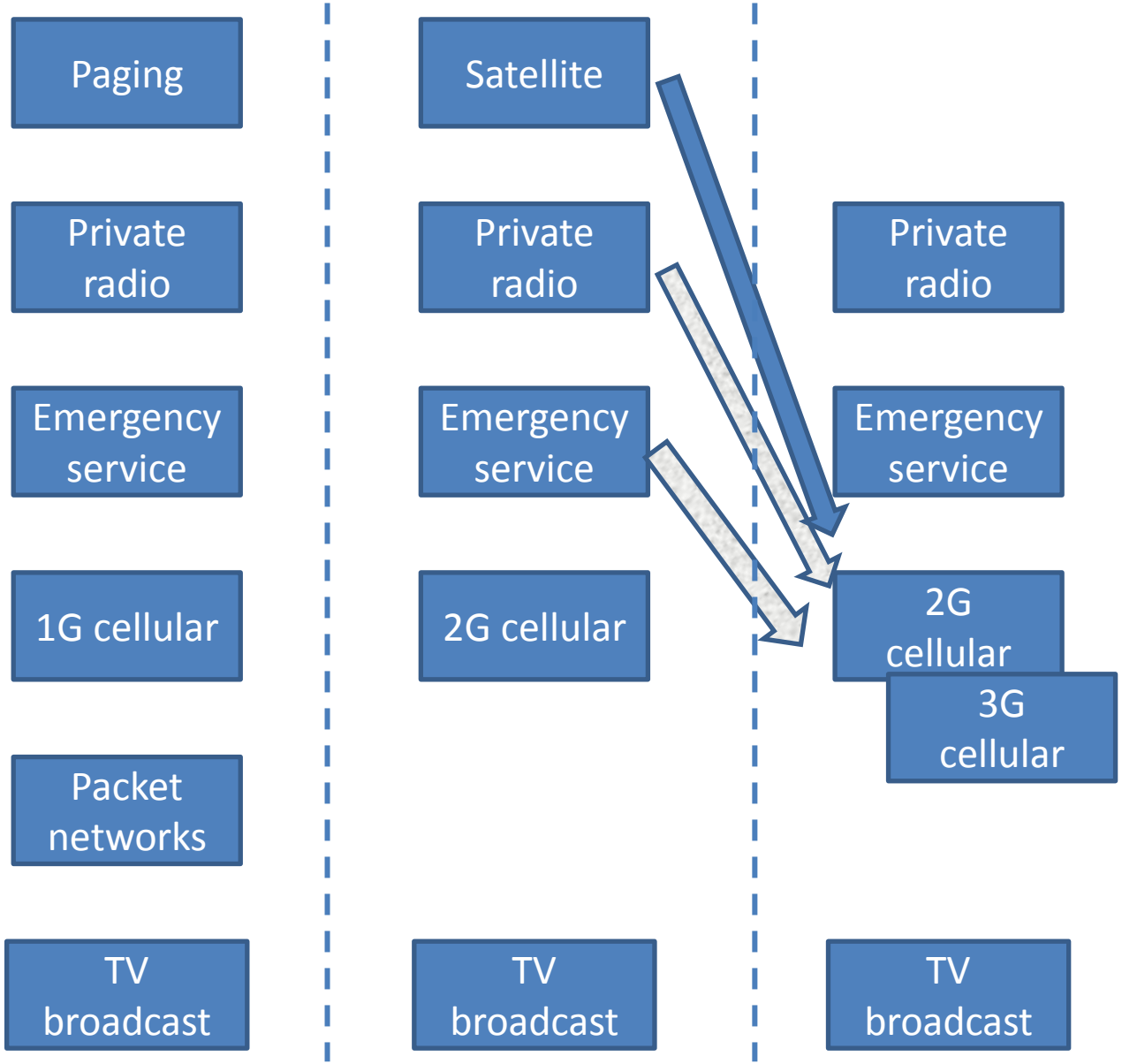
The 2G world (circa 1995)



Paging and packet networks almost fully move to cellular

Private radio and emergency service make substantial move to cellular

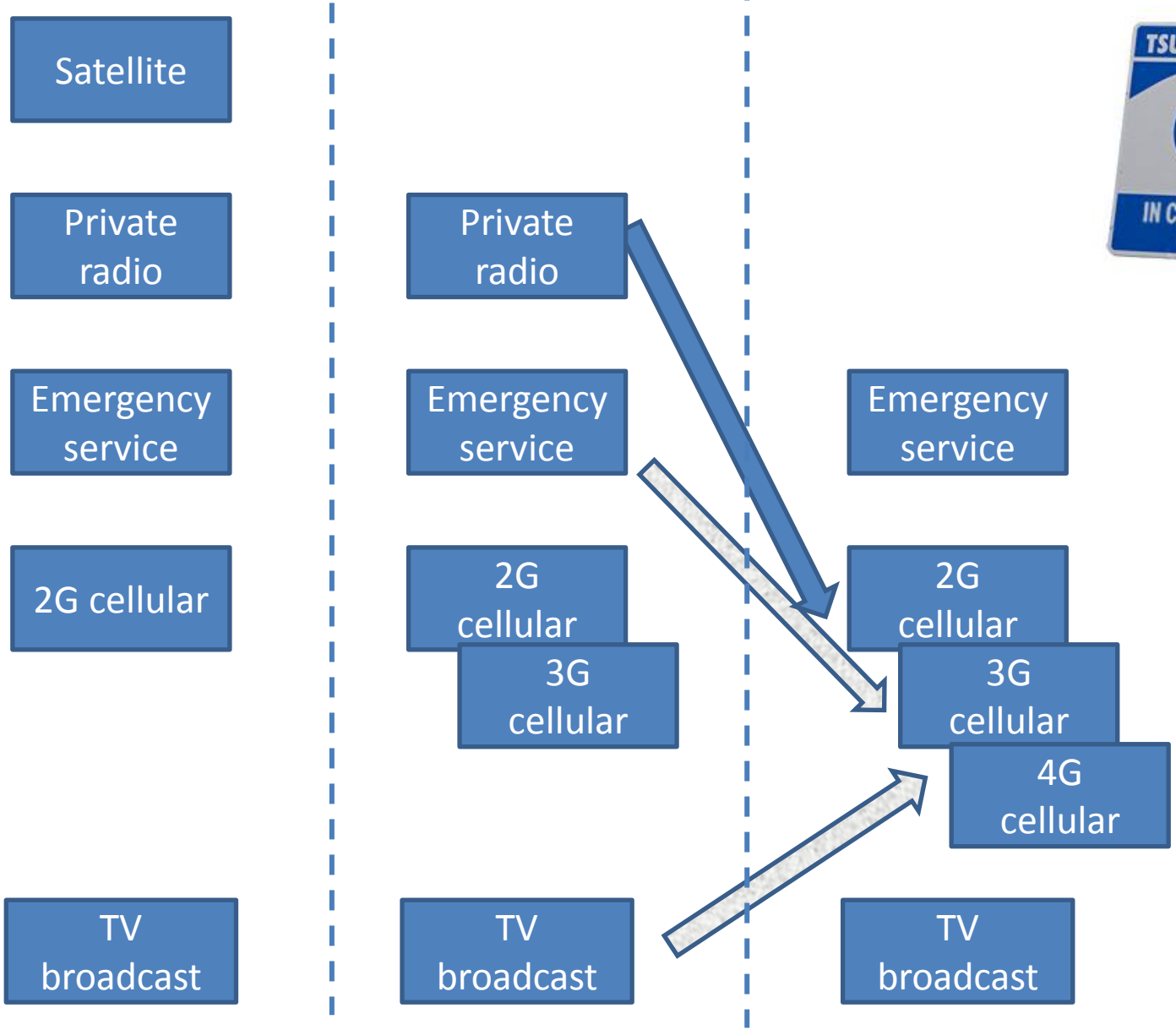
The 3G world (circa 2010)



Satellite fails as a consumer offering

Private radio and emergency service make further moves to cellular

The early 4G world (circa 2014)

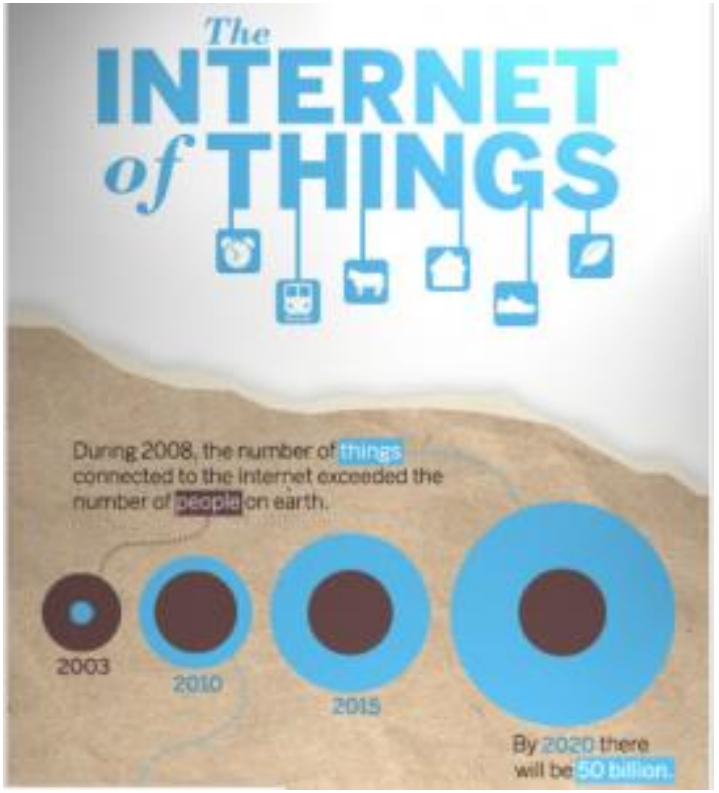


Some general trends in cellular

- Cost per chip ~ 2x per generation
  - Often a mix of complexity and royalty costs
- Power consumption growing per generation
  - Moore's Law improvement more than offset by added complexity
- Bill of materials may grow even faster than 2x
  - MIMO antennas, multi-core processors, etc
  - Ever-increasing number of frequency bands
- Becoming more data-centric
  - 2G voice with data added later
  - 3G a mix of both, circuit and packet switched
  - 4G doesn't fully support voice (being worked on)
- Reducing number of networks
  - Consolidation, network sharing, outsourcing to same partner

The Internet of Things barely works on 2G

- Requirements
  - ~$2 per chip
  - Battery life up to 10 years
  - Range of 5km+ with good indoor penetration
- 2G
  - ~$10 per chip
  - Battery life up to months with care
  - Range of 3km with indoor penetration
- 4G
  - ~$50 per chip, might fall over time
  - Battery life of days
  - Range probably less than 2G
- Time for something new?



The evolving 4G world (circa 2018)

Private radio

Emergency service

2G cellular

3G cellular

TV broadcast

Emergency service

2G cellular

3G cellular

4G cellular

TV broadcast

Wi-Fi "FON"

M2M network

Emergency service

~~2G cellular~~

3G cellular

4G cellular

TV broadcast

Wi-Fi networks grow in maturity

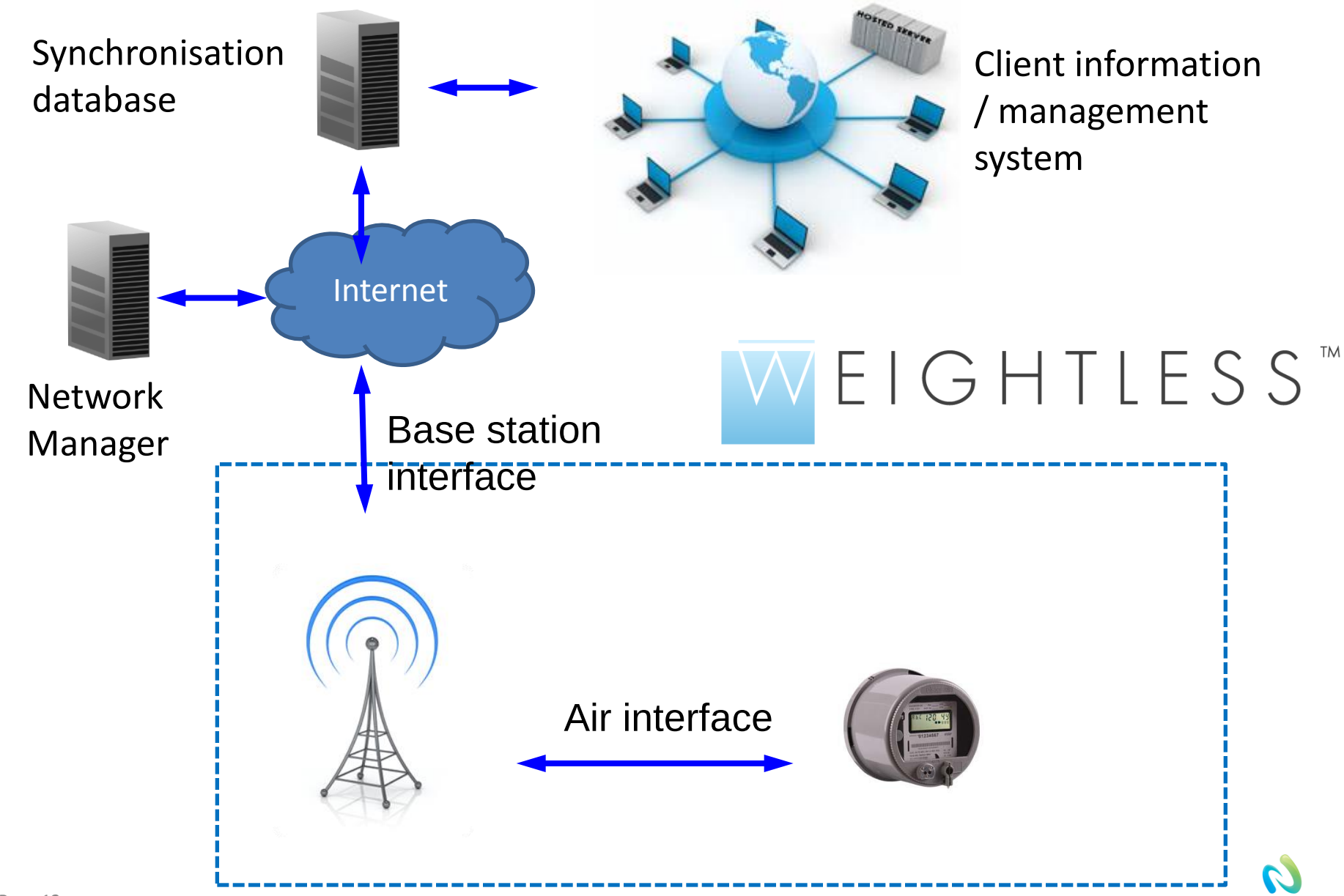
M2M networks emerge

Weightless: Standardised for IoT and white space

- A standard developed in a “SIG” using DSA
- Ubiquitous coverage implies a cellular architecture
- Deep indoor coverage with low transmit power implies spreading to extend range
- Spreading results in long frames – but this allows all core processing to be cloud-based
- White space operation implies TDD
- Unlicensed operation brings an interference risk requiring frequency hopping to mitigate
- Terminal-driven handover to keep signalling load low

WEIGHTLESS™

Architectural overview



In summary

- For decades different applications have consolidated onto cellular networks
- But with 4G, cellular networks are becoming less general and more expensive
- Increasing the need for other applications to split away from cellular, particularly the IoT
- A massive global market for machine communication
  - Drives growth and productivity
- White space provides a near-perfect solution to the spectrum problem
- Weightless has been custom-designed for this space, the standard is complete and roll-out is starting

Finding out more

- www.weightless.org
- Or contact me william.webb@weightless.org