Towards an
Information-Centric Internet
with more Things

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Terminology

- Internet of Things
  - A term for a funding source – not a technology

- "Things" have always been part of the Internet
  - … And will be in the future

- The Internet is evolving all the time
  - And so are Internet protocols

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The question is: how many things and how we want to deal with them

Why People Care

- Perceived increasing relevance
  - Smart metering, remote actuation deemed business-relevant
  - #Nodes, constrained devices and networks: technology/standards-relevant

- IETF 6lowpan, roll, core
  - Make IPv6 work well on constrained devices
- 3GPP MTC
  - Make LTE survive expected increase of #Nodes
- ETSI M2M
 - Make devices talk to service platforms and applications

History of Things

- Even constrained devices change

- TI MSP430 ultra-low power MCU
  - 2004: http://focus.ti.com/lit/ds/symlink/msp430p112.pdf
    - 4kB ROM, 256B RAM, 200ns cycle, 300uA, 3V @ 1MHz
  - 2011: http://focus.ti.com/lit/ds/symlink/msp430f169.pdf
    - 55KB+256B Flash, 5KB RAM, 330uA, 2.2V @ 1 MHz

- Not all challenged things are tiny
  - http://down.dsg.cs.tcd.ie/s10inf/
  - Intel Atom CPU, 1GB RAM, 32GB flash, 750mA/12V, 21AH batteries, 60W solar

History of Things

- Battery technology evolving
  - NEC Organic Radical Battery: $1mWh/cm^2$, 30s charging time
    - http://www.nec.co.jp/press/en/1011/0503.html

- Working assumptions
  - Enhanced storage and processing capabilities quite likely
  - Energy consumption/storage might still be crucial in the immediate future – but there is hope
  - More devices and more information to be shared in future networks

Extending the Diameter

DTNs
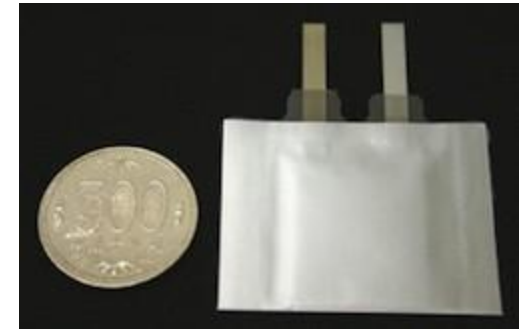
PANs

Internet

Vehicular Networks
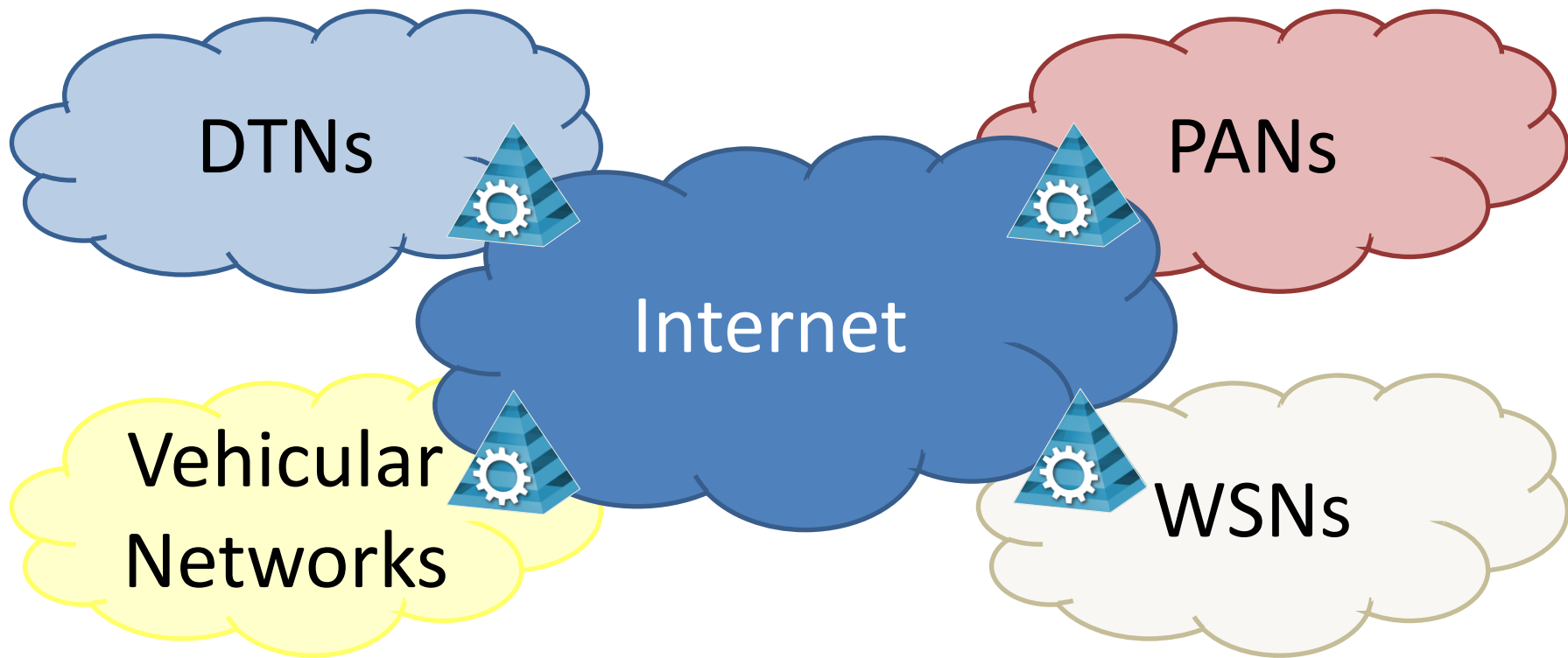
WSNs

Extending the Diameter

- One Internet
- No assumptions on where the network ends
- Support for diversity

DTNs

PANs

Internet

Vehicular Networks

WSNs

Dealing with many Nodes in Constrained Environments…

- Identifying information by name, not by sensor node address etc.
  - Scalable
  - Secure

- Robust communication
  - With domain-specific dissemination/routing mechanisms
  - Leveraging in-network storage and processing capabilities

- Interworking with and migrating from
  - Existing Internet and applications

Approach
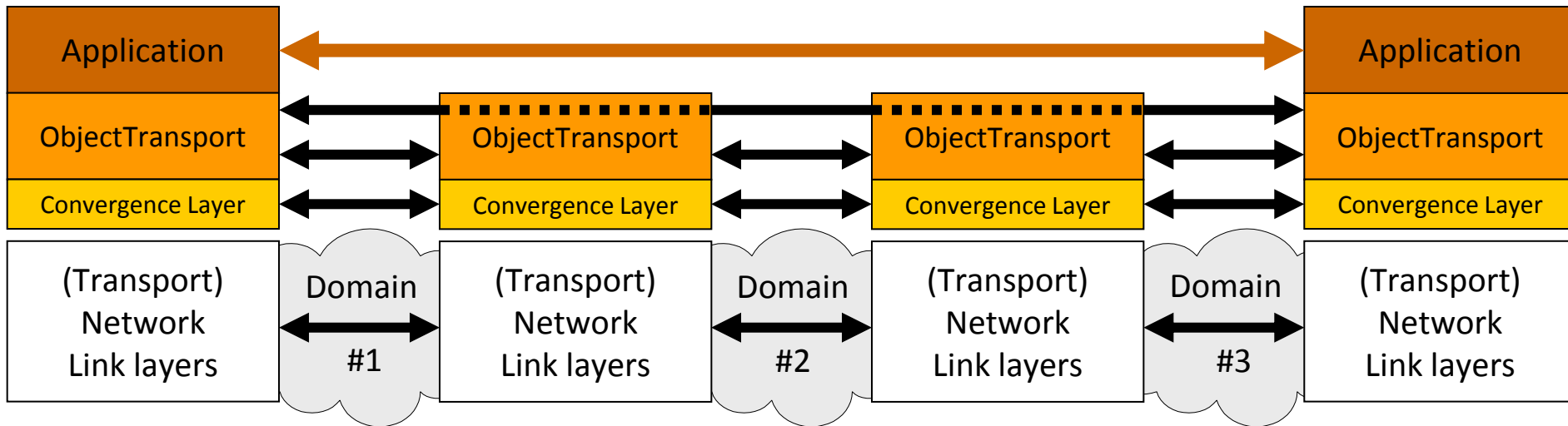
- Object naming as thin hour glass waist
- Message/Chunk-based transport between technological/administrative domains
- Caching, local retransmission as inherent node features
- Different transaction types
- No application layer gateways in network

Protocol Work

- Naming
  - Unique object identification
  - Binding of names to objects and owners via hashes/signatures
  - Names for request/content routing
  - `draft-farrell-ni-00.txt`
    - (to be published next week)
  - `draft-farrell-dtnrg-bpq-00.txt`
    - Using object names in DTN Bundle Protocol

- Transport
  - Evolving RFC 5050
  - Supporting different interactions types and in-network-storage

- APIs
  - Enabling applications to access named information in the network

What's the Payoff?

- Ability to mix capable and constrained nodes at the application layer without knowing which is which
  - With whatever security etc. stuff handled the same regardless

- Maybe: Real-as-possible-time video - like Google Earth but with the latest video sources stitched the way Microsoft do images with Photosynth
  - Capable well-connected devices, plus battery powered sensor like things, plus passers-by video from phones
  - Why not an architecture that allows mixing whatever works best?

Conclusions

- ~~Internet of Things~~ → Evolution of the Internet
- Avoid developing next NGN, IMS for things
- *One Internet* approach
  - Common naming and transport abstractions
  - Domain-specific routing
  - Application-specific, e2e semantics