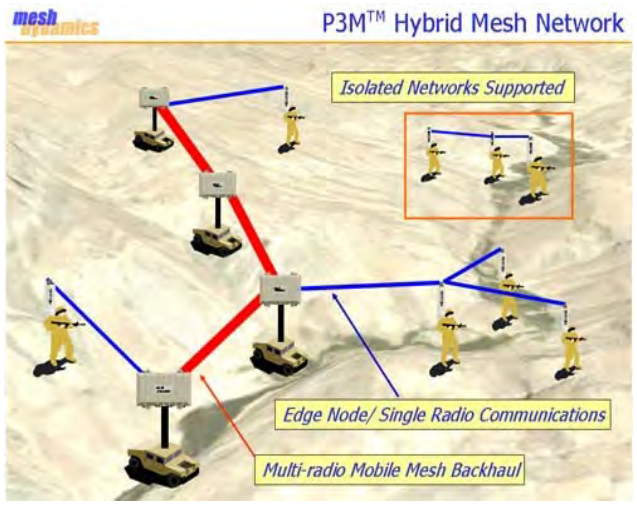
Scalable IoT

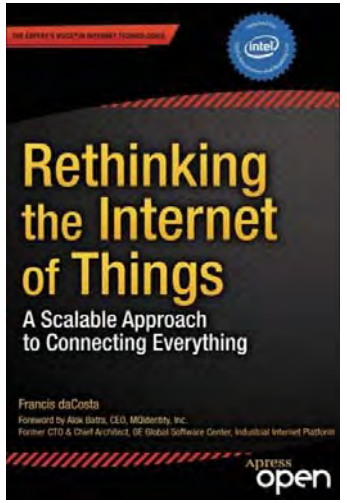


Francis daCosta

Founder and CTO

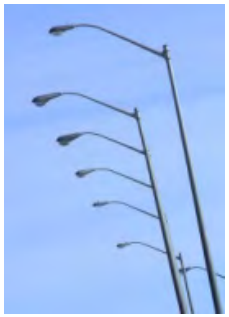
www.meshdynamics.com

Author, *Rethinking the Internet of Things*



Simpler Devices Will Rule the IoT

Next wave of the Internet is Machines-to-Machines Ecosystems



Man Oriented Ecosystem

Not (really) Resource Constrained

- Lots more Processor, Memory, Protocol stacks
- Human Oriented Consumption (external)
- Assumed often “Always On”
- Centrally-managed naming (MACID, et al)

Machine Oriented Ecosystem

Often Resource Constrained

- Often Limited or no processor, memory, etc.
- Consumption for local use (Internal)
- Many remote with Intermittent power
- Built by millions of manufacturers worldwide

… many *cannot afford* traditional IP protocol overhead

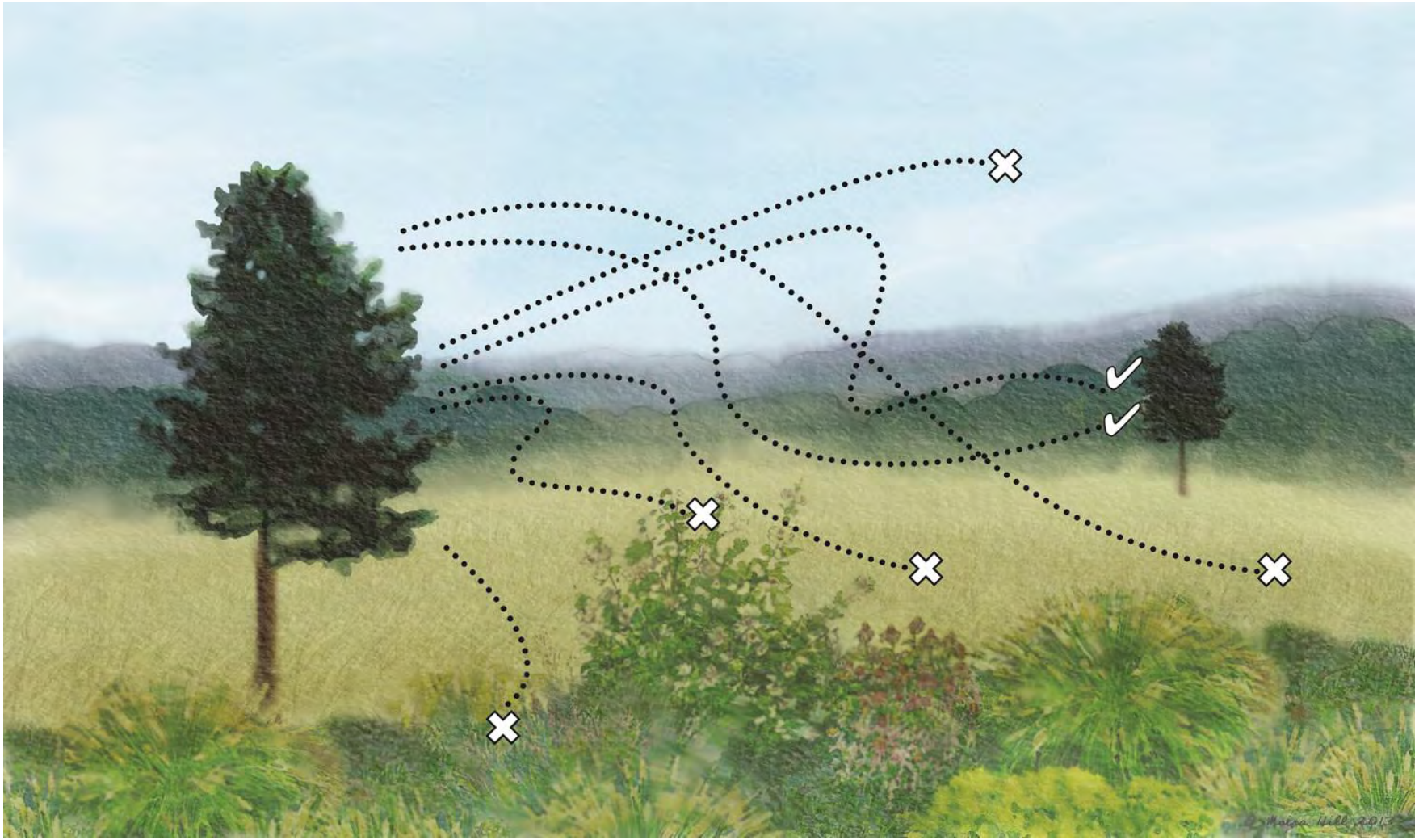
IoT Data Characteristics

Machine to Machine (M2M)

- Terse – not oriented to humans
- Repetitive
- Individual messages not critical
- Meaning comes from *combination* with other data sources:

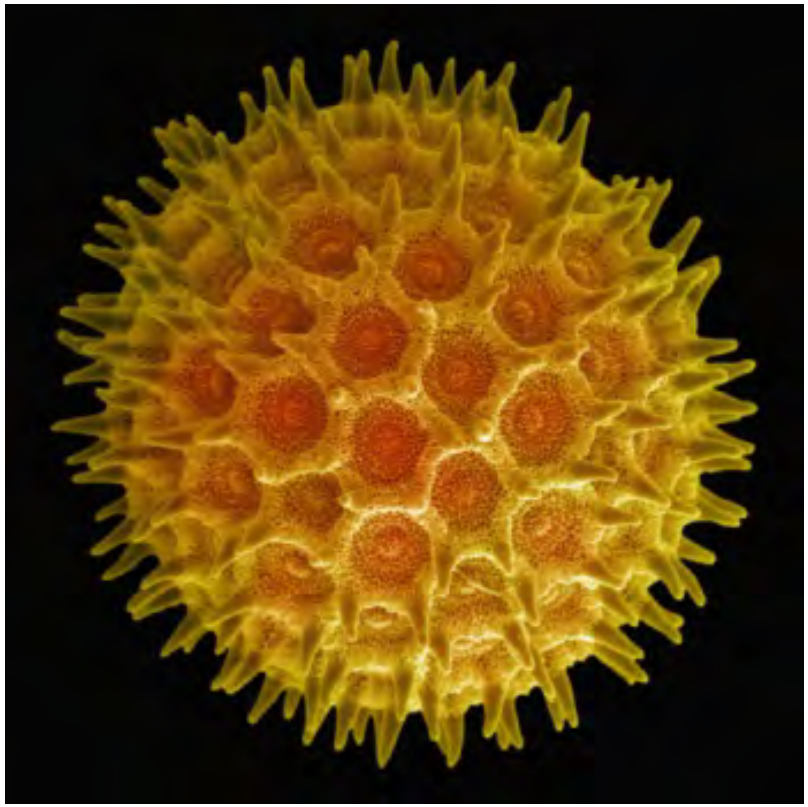
  "Small Data"
- Consumption and generation is mostly Local
- Usually unidirectional
- Self-classified: new concept, based on Nature

Scalable Communication Lesson from Nature: Pollen



Pollen propagates everywhere, but only *specific* receivers decode “message”

The “Lightness” and Elegance of Pollen



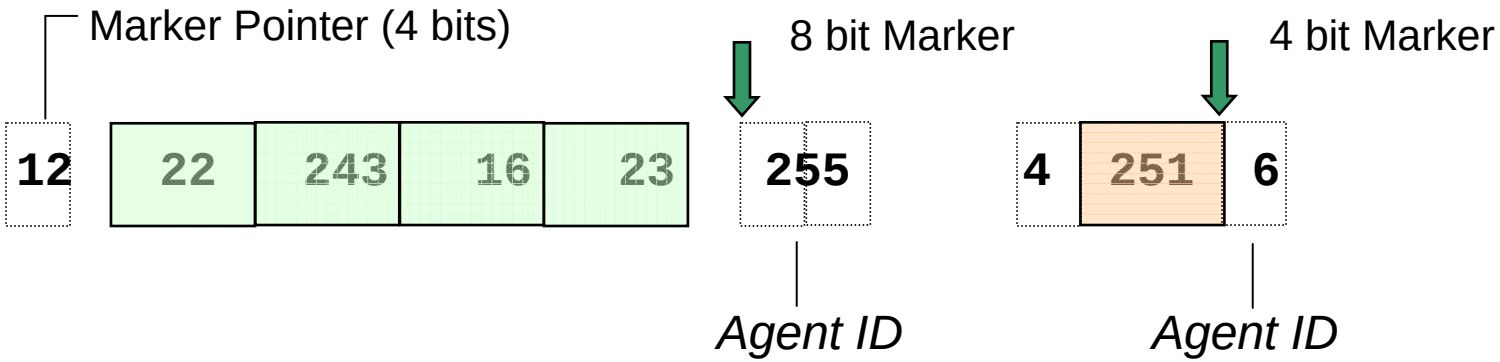
- Self-classified (by species)
- Extremely lightweight
- No inherent transport mechanism
- Uni-directional
- Single-function
- Individual “message” not critical
- *Receiver-oriented sensitivity*

… these are the reasons that pollen *scales*

Self-Classification (Pollen-like) for IoT: “Chirps”

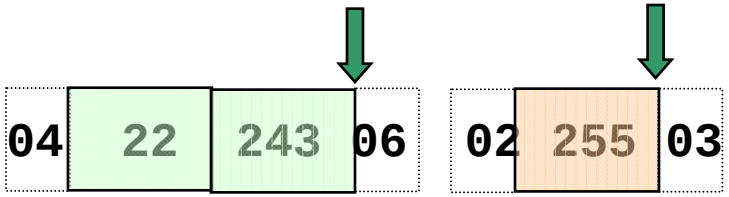
Public Section (mandatory)

Private Section (optional)

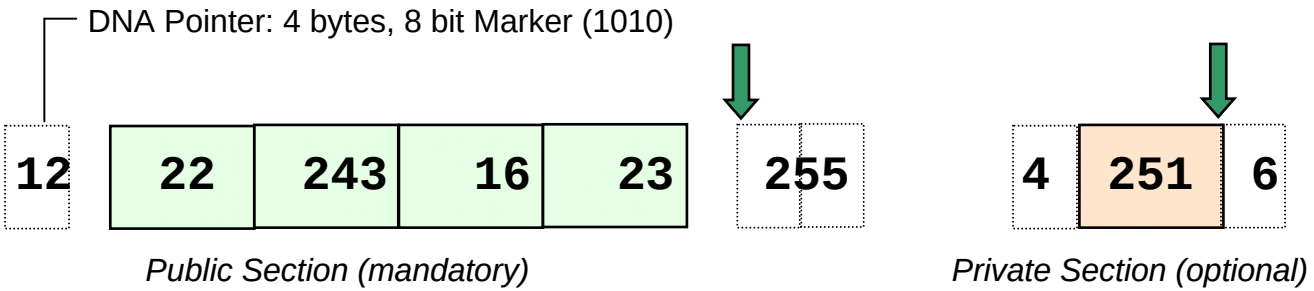


Total chirp length with 2 Byte Public Field, 4 bit Marker, 1 Byte Payload = 5.0 bytes

5.0 Bytes with 1 Byte Payload
6.0 Bytes with 2 Byte Payload
7.0 Bytes with 3 Byte Payload
8.0 Bytes with 4 Byte Payload



Security Must be Incremental



Public Agent ID is 4.8.255 (4 byte Public, 8 bit Marker, DNA 255
(Subscribed) Agent states: Classification is 8.8.8.8 (1 byte each)
Decrypted Chirp Class: 4.8.22.243.16.23.

Its payload requires another Agent
Private Agent 1.4.6 (for 4.8.22.243.16.23) decodes value (251)

Chirp with public (open) payloads have shorter classifications
e.g. Chirp Class 4.8.22: Temp=243F Pressure=16psi Humidity=23%.

Enterprises define their (internal) classification schemes.

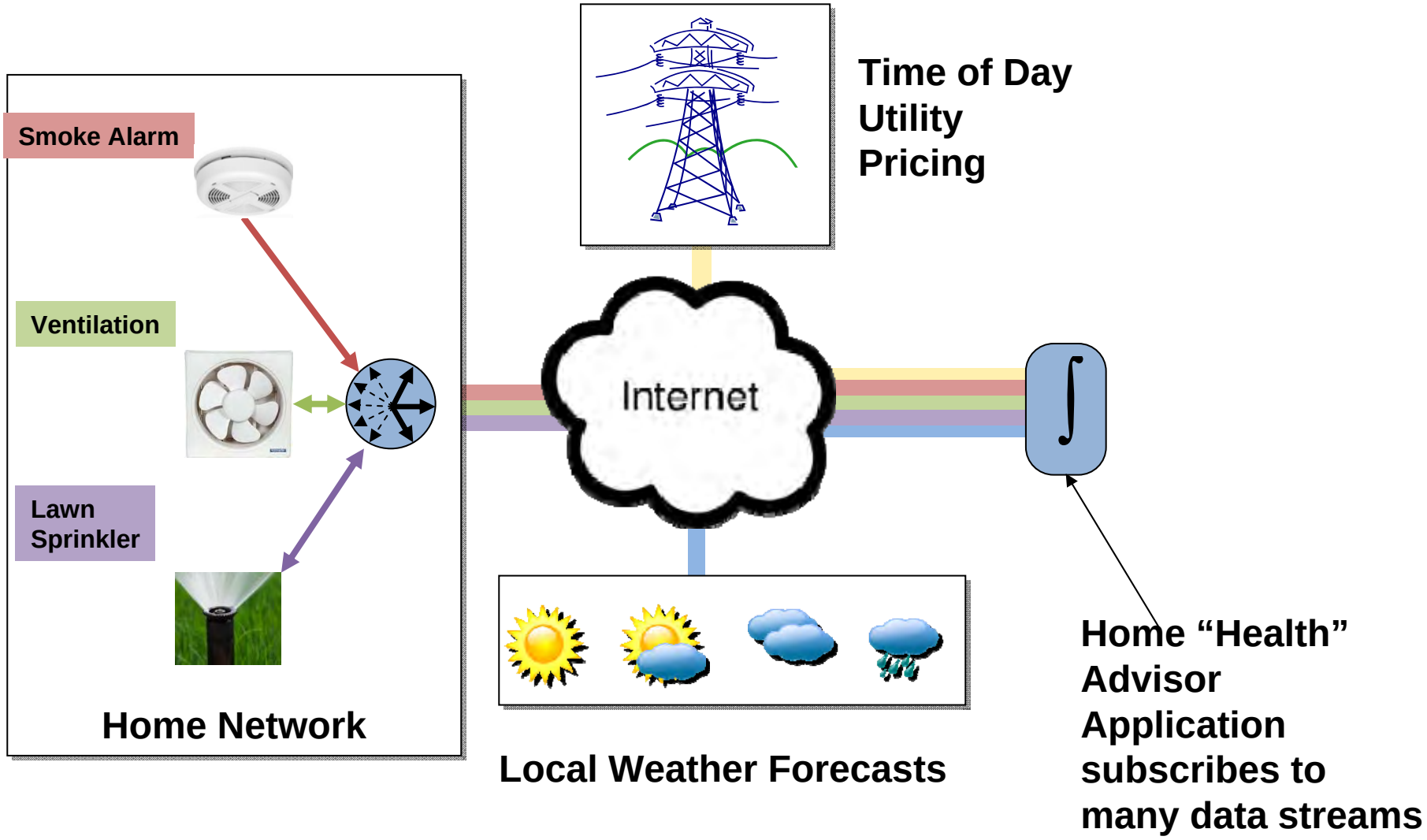
Discovery of “unknown” chirp classes detected, addressed in SIGs.

Distributed, organic growth of chirp classification taxonomy.

Self Classification Lesson from Nature: Birdsong

All birds derive some information, but only *specific* receivers fully participate

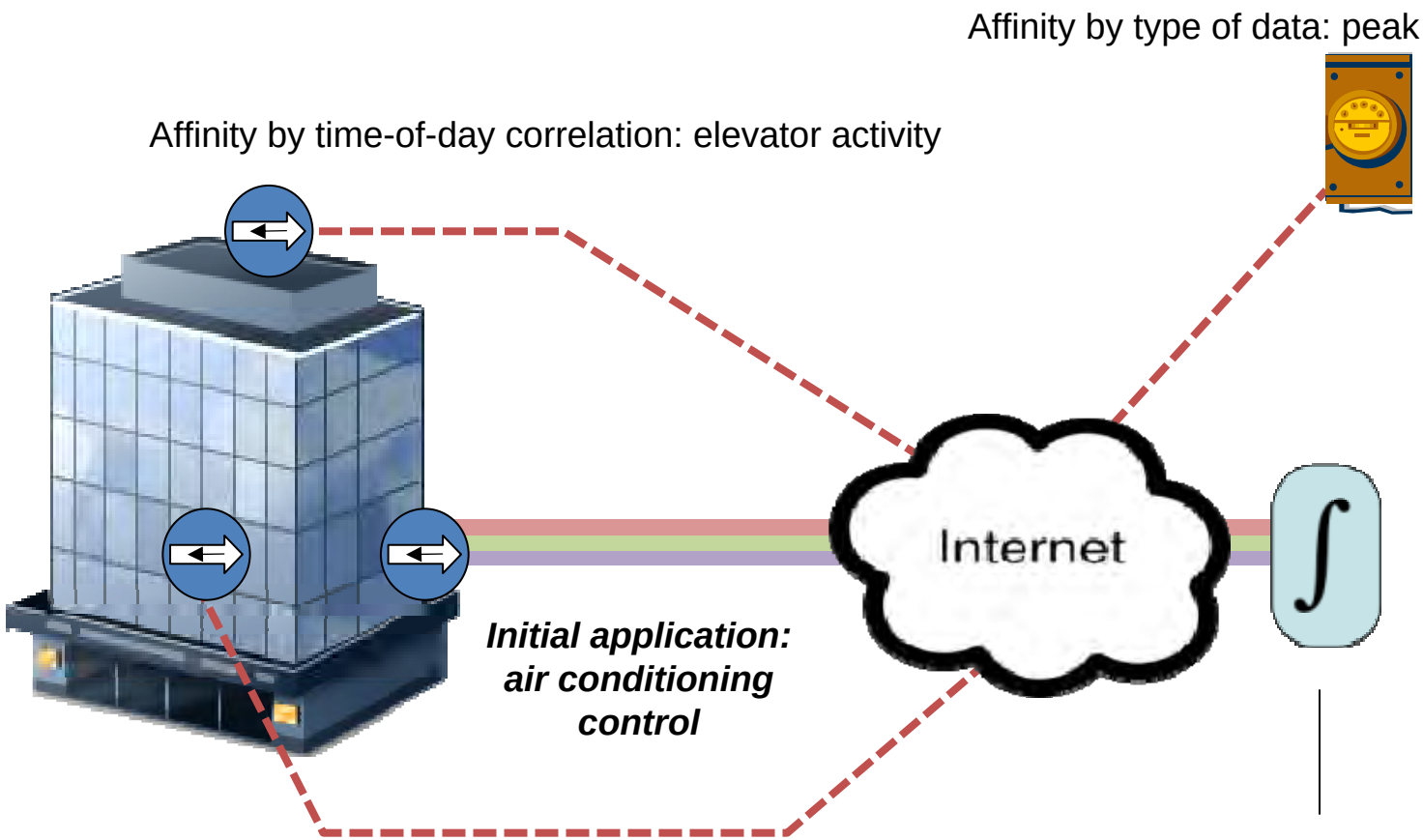
Known Publish/Subscribe Affinity ("Birdsong")



Self-Classification Lesson from Nature: Pheromones

Underlying event not seen, but *affinities* are visible

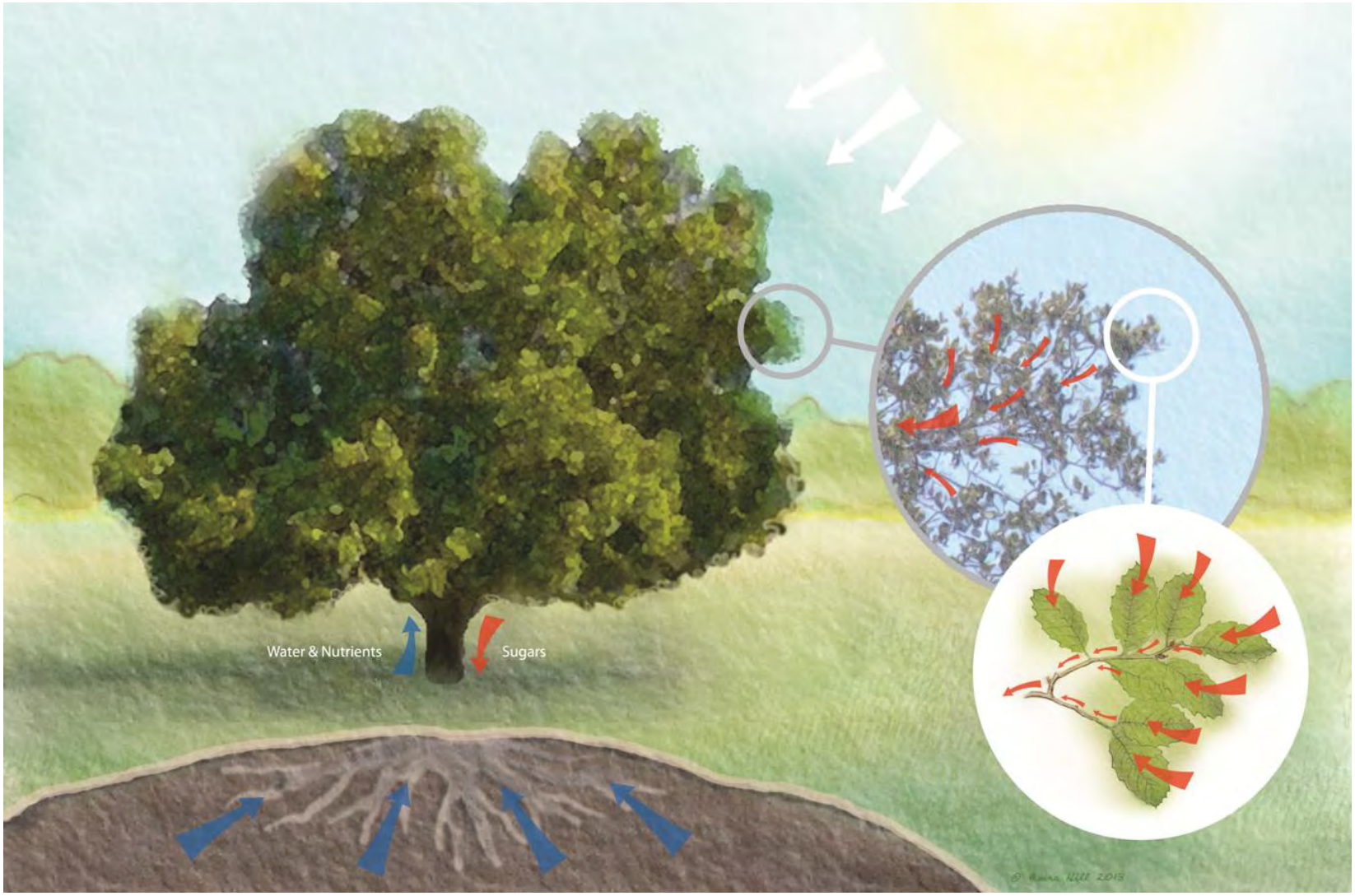
Discovered Publish/Subscribe Affinity (“Pheromones”)



Integrator function seeks additional candidate data sources by affinities.

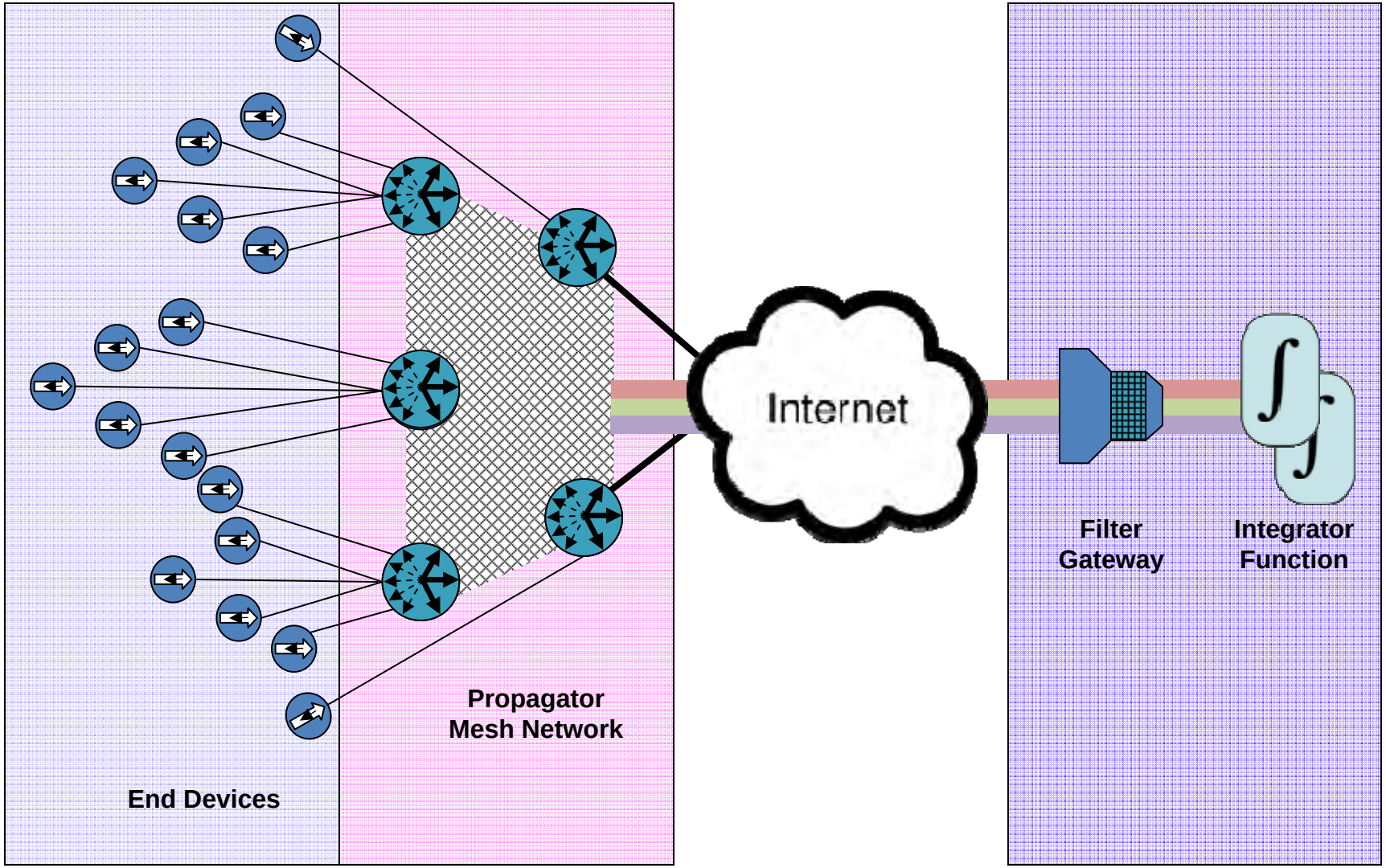
Builds more refined causal models. Accelerate Learning through Affinities

Topology Lesson from Nature: Trees



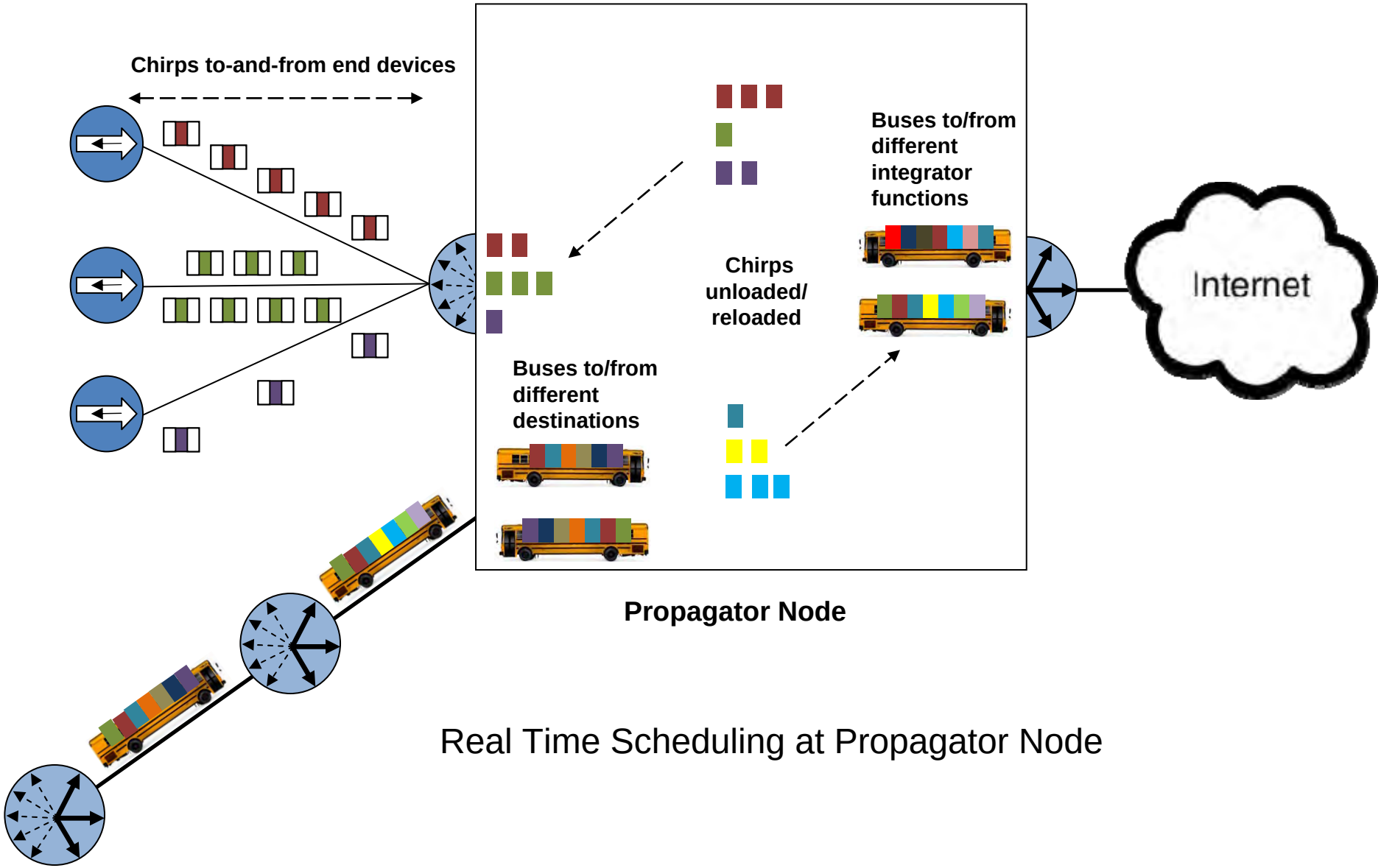
End devices don’t communicate with one another, so “tree” better than “web”

Emerging Tree Based IoT Architecture



Chirp Data Streams **"Small" Data Flows** **"Big Data" Analysis**

Scalability: Loading “Buses”



Real Time Scheduling at Propagator Node

Propagator Nodes –Networking Capabilities

- Developed on Open Source platform: OpenWrt, et al
- Build structured trees among themselves
  - Path discovery, routing, redundancy, fail-over
  - Simplicity through “near-optimal” routing
- Manage multicast: pruning, forwarding, spoofing, etc.
- Optional integrated Publishing Agents participate in publish/subscribe bus, machine learning
- Offer variety of end device interfaces: wired, wireless, optical, etc.

OEM Licensees for Propagator Nodes