



Musings on Hyperconnectivity

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Finding innovations. Founding companies. Funding success.

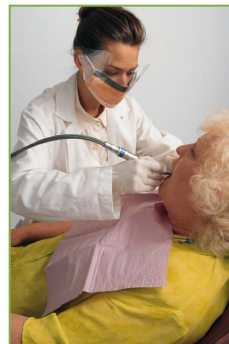
Spectacular opportunities for impact



Finance



Government



Health / Life Sciences / Agriculture

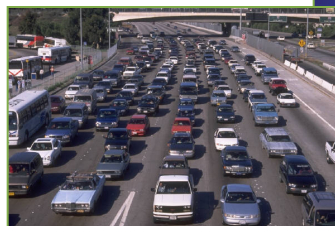


Environment

IT



Retail



Transportation & Distribution



Manufacturing

The future will be shaped by developments such as:

- The deployment of gigabit connections
- **Mobile broadband and wireless sensor networks**
- **Big data and the cloud**
- The tidal wave of streaming video and social networking
- **Changes in user behavior and interfaces**

Hyper-connectivity and...

- The (asymmetric) Internet
- Proactive vs. Interactive Computing
- The Second Economy

Internet *asymmetry* continues to grow

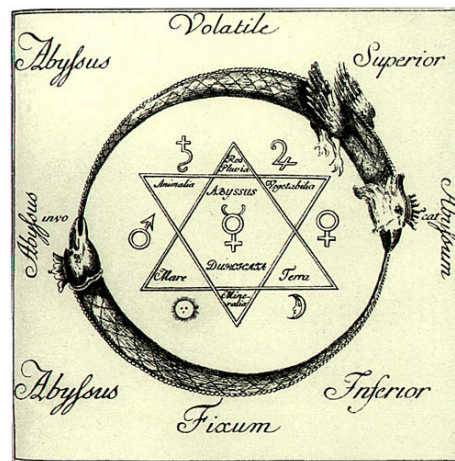
Very different properties seen by:

- Clients / Edge Devices (Billions of nodes at Kbps=>Mbps)
- Cloud Services / Data Centers (Tens / Hundreds of nodes at Gbps =>Tbps)

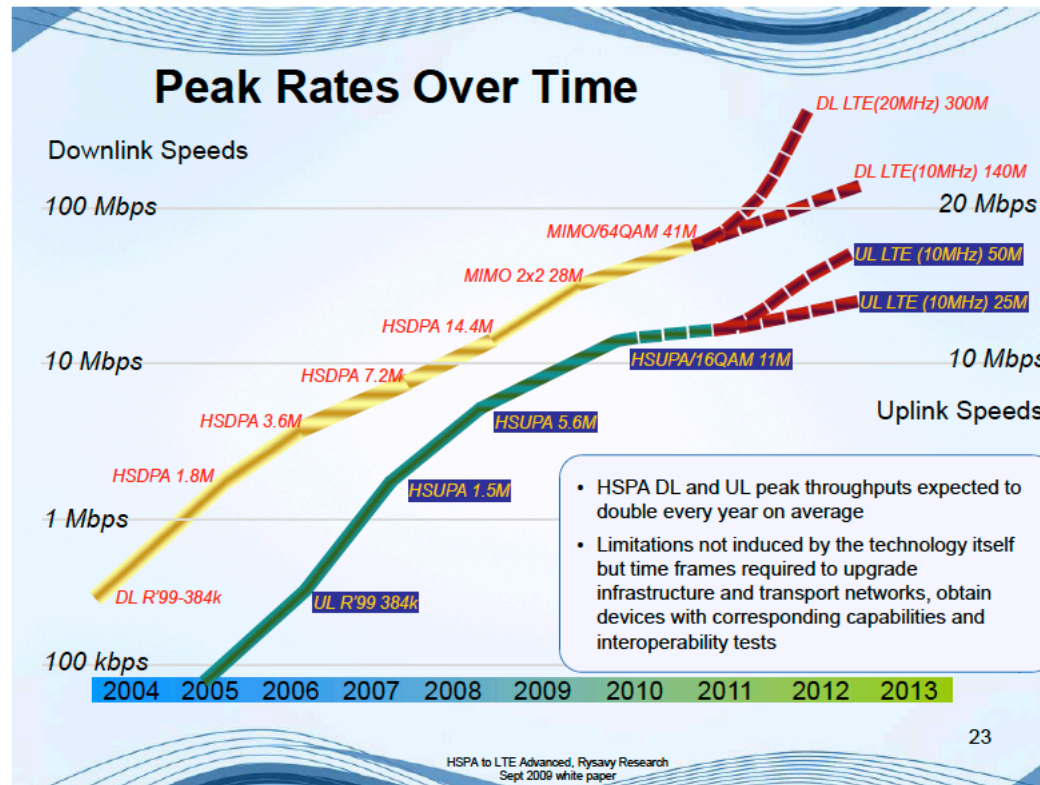
Mobile has been consumed by the Internet
....and Internet access will be consumed by Mobile



- Near ubiquitous coverage & Massive number of client devices
- BYOD also means BYON (end of the LAN? end of the enclave?)
- **BUT... not at Gbps...at least not right away**
 - Average access b/w goes down – and then back up again



4G: Staircase vs. Forklift



1G/2G/3G **Forklift**: Highly “quantized” transitions

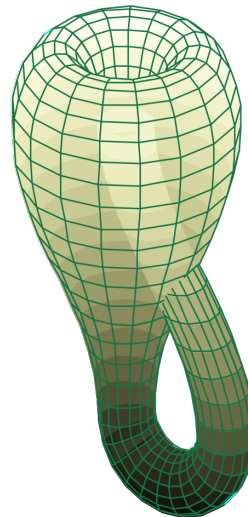
4G **Staircase**: series of 2x+ improvement (similar to Moore’s Law)

- 4G is overtaking landlines for many consumers/SMB’s
- **unwilling innovator’s** dilemma

- Hyperconnectivity
 - ⇒ Extreme bandwidth
 - ⇒ Near zero latency
 - ⇒ Opaque: Near zero transparency
- Massive internal networks
 - 25K servers *common*; >100K in some cases
 - 10 Gbps / server, with 40/100 Gbps uplinks
 - 100 Gbps links between *pods* and between data centers



- Chewy on the inside but opaque to the outside
 - Potential to use open flow, hybrid packet/circuit switching, etc.
 - Phenomenal opportunity for network researchers
- The data & its processing are deeply hyper-connected, yet largely disconnected from the broader Internet



Hyper-connectivity and...

- The (asymmetric) Internet
- **Proactive vs. Interactive Computing**
- The Second Economy

Late 1960's

Goal: Interactive Computing

- Human-centered (vs. "batch" / punched cards)
- Problem: We are always waiting for them or vice-versa

Late 1990's

Goal: Proactive Computing

- Anticipate our needs and (sometimes) act on our behalf

Clients Computers are becoming far more Interactive

- Tremendous spurt of UI innovation
- Sensing, inference and mobility enabling context awareness

AND

Clouds are becoming Proactive

- They are starting to anticipate our needs and act on our behalf
- Lots more still to be done

BUT...what about M2M & the Internet of Things?

How do enterprises / utilities *interact* with billions of edge nodes?

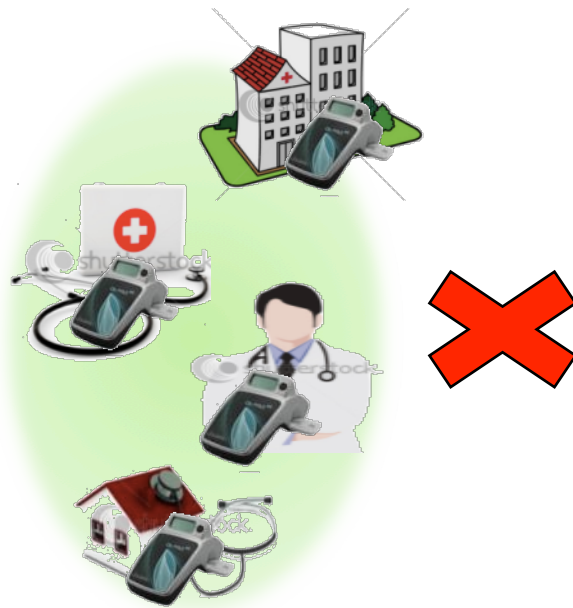
How do enterprises avoid *interacting* with billions of edge nodes?

TaaS – Things as a Service

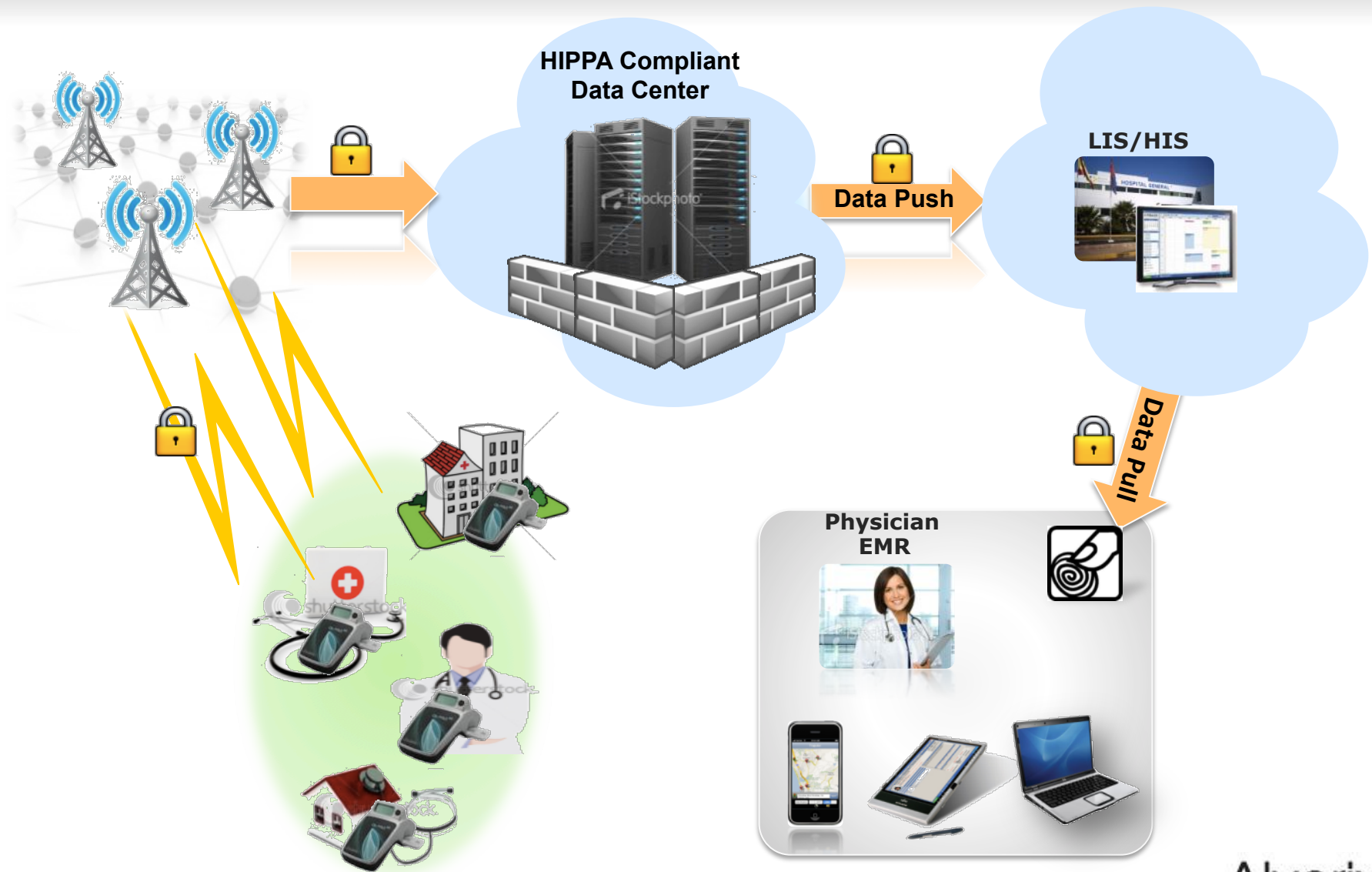
Data goes *around* users and their LANs, instead of “through” them

TaaS Examples: Alverix, MuniSense, Intellex

Alverix: Point of Care Diagnostics



Alverix: Point of Care Diagnostics



INSIGHTNOW™



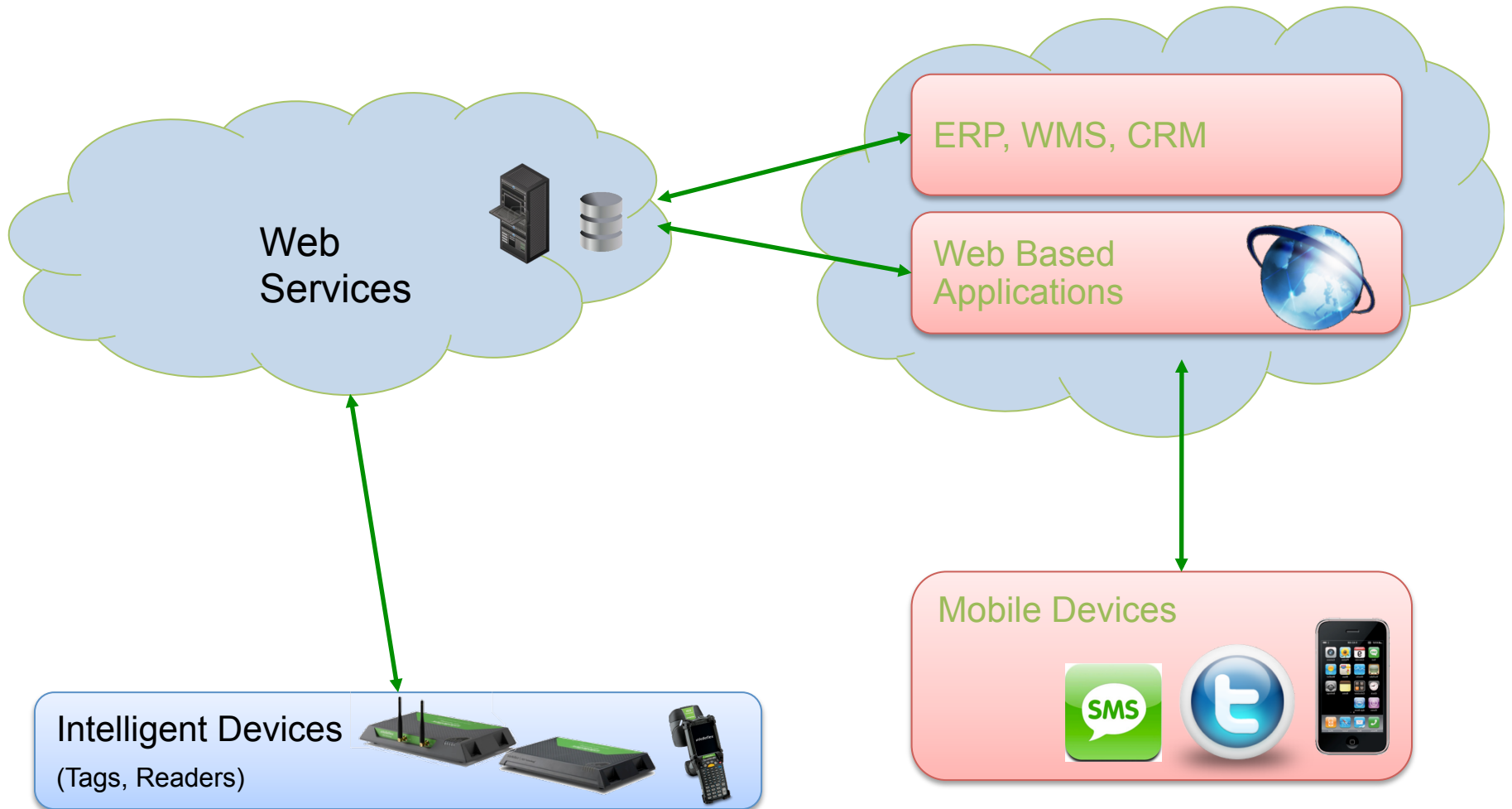
Monitoring of:

- Noise abatement
- Water / Air Quality

For regulatory compliance, liability, efficiency, etc.

munisense

ZEST System Overview



How do we avoid *interacting* with billions of edge nodes?

TaaS – Things as a Service

Data goes *around* users and their LANs, instead of “through” them

Benefits / Implications:

- Avoids need to deal with local IT organizations
- Significantly lowers sales barriers for new devices/services
- End of the LAN / enclave?

...Something deep is going on with information technology, something that goes well beyond the use of computers, social media, and commerce...

Business processes that once took place among human beings are ... taking place in an unseen domain that is strictly digital.

This unseen, underground conversation is happening among multiple servers talking to other servers...large and fairly complicated conversations... occur entirely among things remotely talking to other things....

...Processes in the physical economy are being entered into the digital economy, where they are "speaking to" other processes ... eventually connecting back with processes and humans in the physical economy.

A second economy — of all of these digitized business processes...is silently forming alongside the physical economy.

It is vast, silent, connected, unseen, and autonomous...it is self-configuring...self-organizing, self-architecting...

Hyper-connectivity: Is asymmetry a transient or fundamental?

- Once the data moves to the cloud, can you ever get it back?
- Will IP be relegated to bridging large *opaque* entities?
- What could drive the pendulum back to a more symmetric net?
- Why are network operators and their suppliers in so much pain?

Proactive Computing

- Pieces are falling into place
- Time to enable autonomous operation, by moving to *faster than real-time* and *closing the loop*?

~~Second~~ **Third** Economy

- Second Economy creates the surplus to enable a **Third Economy**
- In the long term, US has a labor shortage
- What do we want our THIRD economy to be?
- How do we shape our limited labor resources to participate in it?