Technology Lifecycles
and
Emerging Innovations

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The Road Ahead

Positioning case study (autonomic computing!)

Revitalizing old technologies
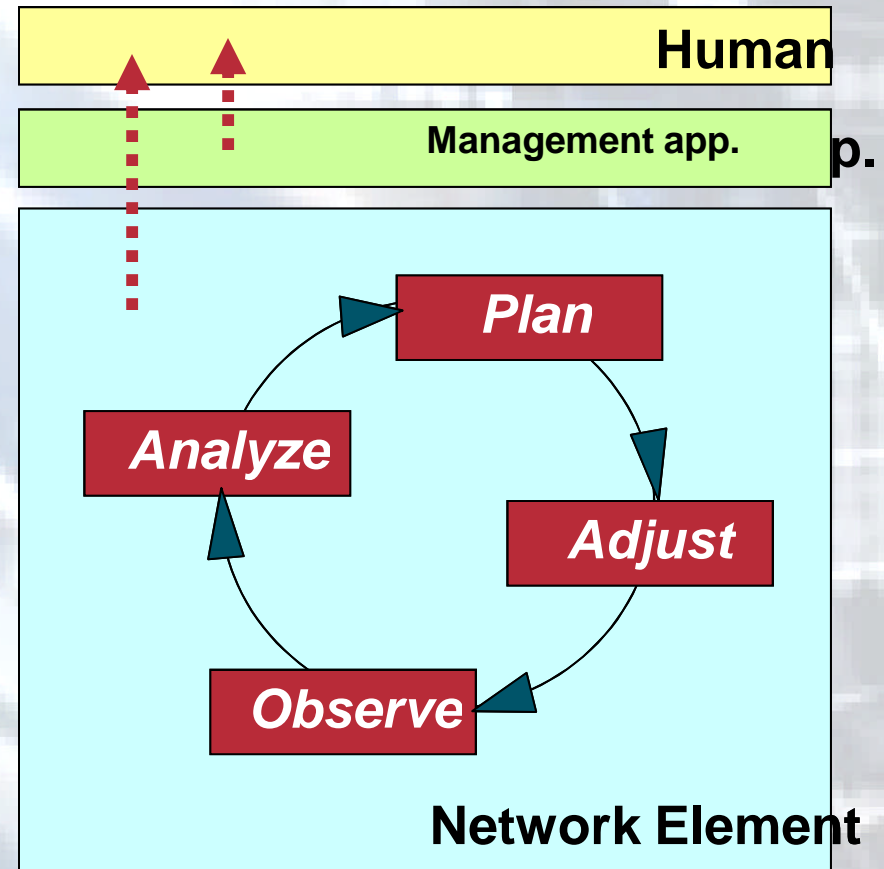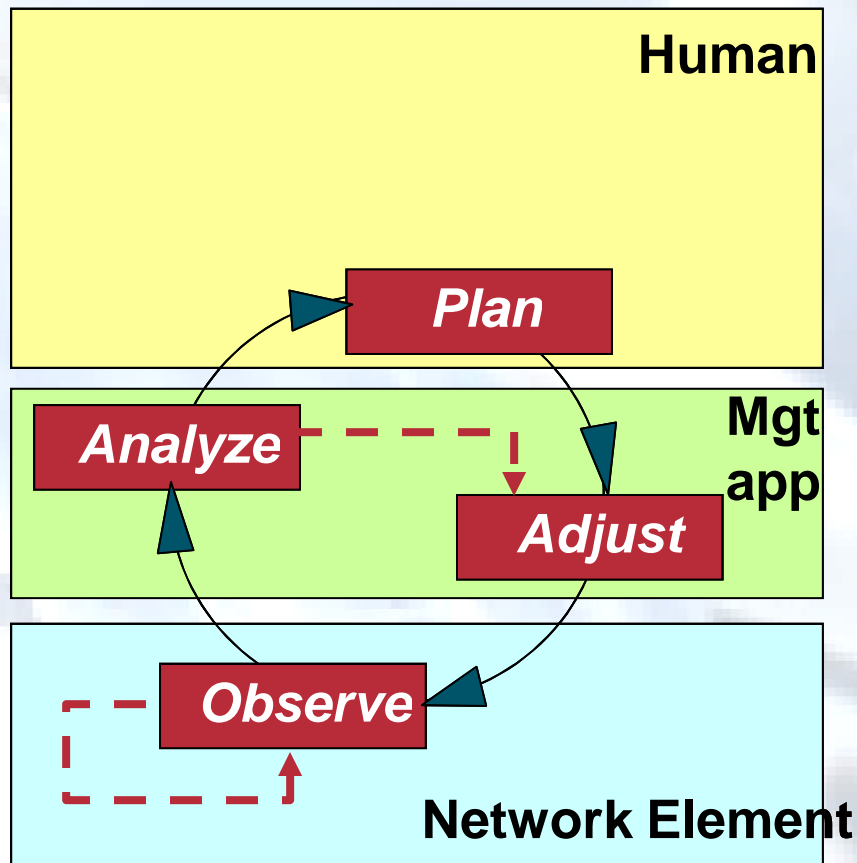
Technology barriers

Trends
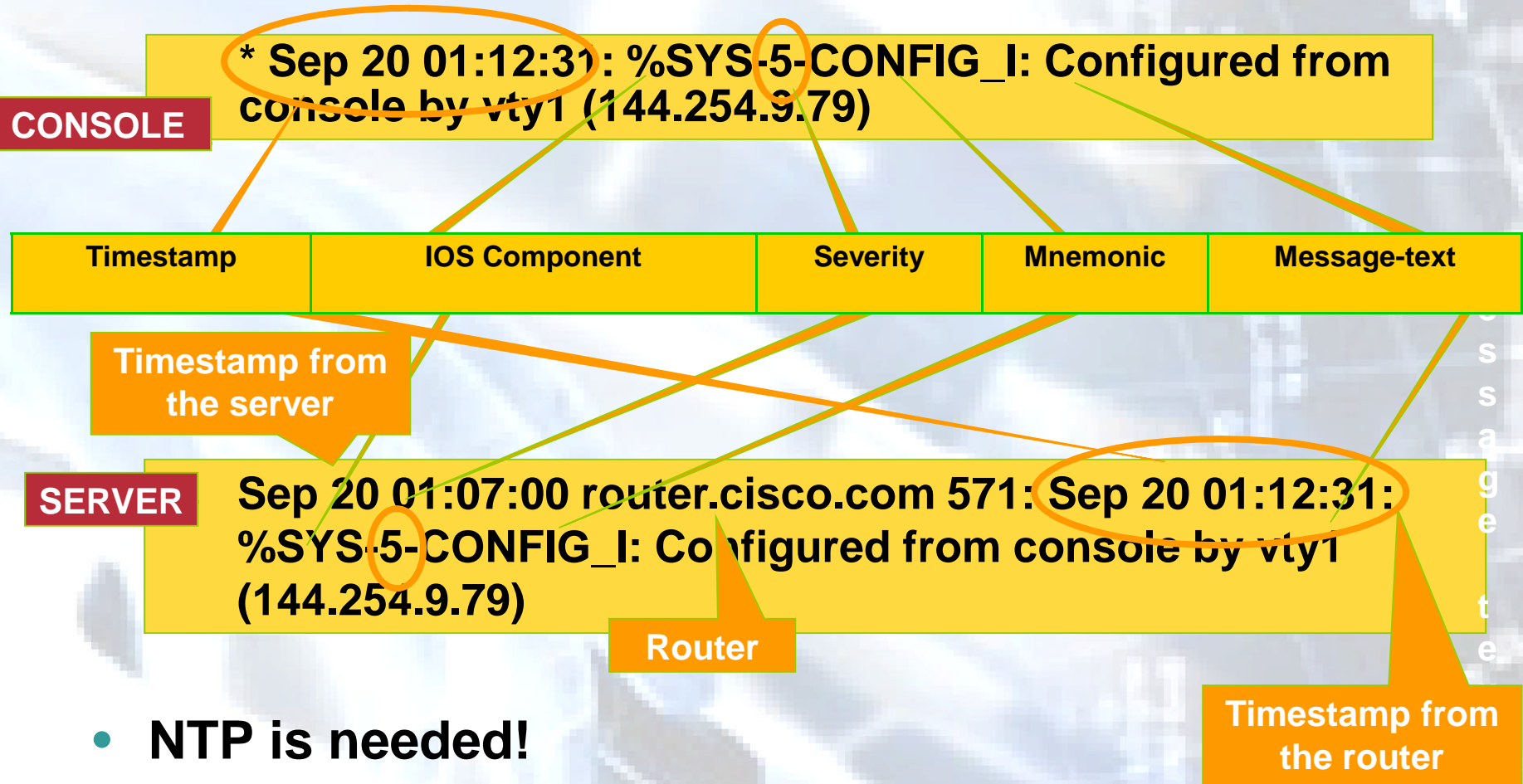
Technology Lifecycles

Autonomic computing

- **Case study**

Autonomic Computing

(a) Typical management control loop

(b) Closed management control loop in autonomous network

Syslog Message "Body" Format in the IOS

CONSOLE

* Sep 20 01:12:31: %SYS-5-CONFIG_I: Configured from console by vty1 (144.254.9.79)

Timestamp	IOS Component	Severity	Mnemonic	Message-text

Timestamp from the server

SERVER

Sep 20 01:07:00 router.cisco.com 571: Sep 20 01:12:31: %SYS-5-CONFIG_I: Configured from console by vty1 (144.254.9.79)

Router

Timestamp from the router

- ## NTP is needed!

- ## Header:level can be different than Body:severity

Semantic Issues

- ## Naming

- ## Context-defined

- ## Smart events

business objective

performance objective

NM Systems CUSTOMERS

Intermediate Processing MIDDLEWARE

Syslog events

Network Devices VENDOR

	HOW?	Syslog message

- How to instruct intermediate processing to filter special instructions?

- How to convey special instructions to the intermediate processing components?
- How to consider vendor instructions in setting business objective?

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6

Revitalizing old technologies

- **Human ear recognition (biometrics)**

- **Tape storage (vs. online digital)**

Ear Biometrics

http://www.cse.msu.edu/~cse891/Sect601/textbook/13.pdf

1880: Alphonse Bettillon, Police, France: anthropometry (all body parts)

1906: R. Imhofer, Physician, Check Republic, 500 ears-> four features

1960: C. Fields et al.: 206 sets of ears of newborn babies

1948-1962: Alfred Iannarelli, 12,000 individuals, 12 different geometric measurements of the ear based on crus and helix (1964)

→2D + 3D (richer than 2D)

→(Computer, November 2011, p. 79)

Tape storage (vs. online digital)

- **Storage strategies**

- **Long-term storage**

- **Offsite storage**

- **Regular backups**

- ## Case study

- **Google: lost Gmail information in the Spring of 2011
  ! Multiple copies of data in data centers; software bugs affected them, all
  ! Tapes are offline; no software bugs**

- **? Anything that si dick-base and based on replication, including cloud-based storage, requires that the data be transferred to another disk.**

- **PC, October 2011, vol. 9, Iss. 10, pctoday.com**

Technology barriers

- **Nanoscale limits**

- **Computation resources**

Nanoscale limits

- ## Nanotechnology
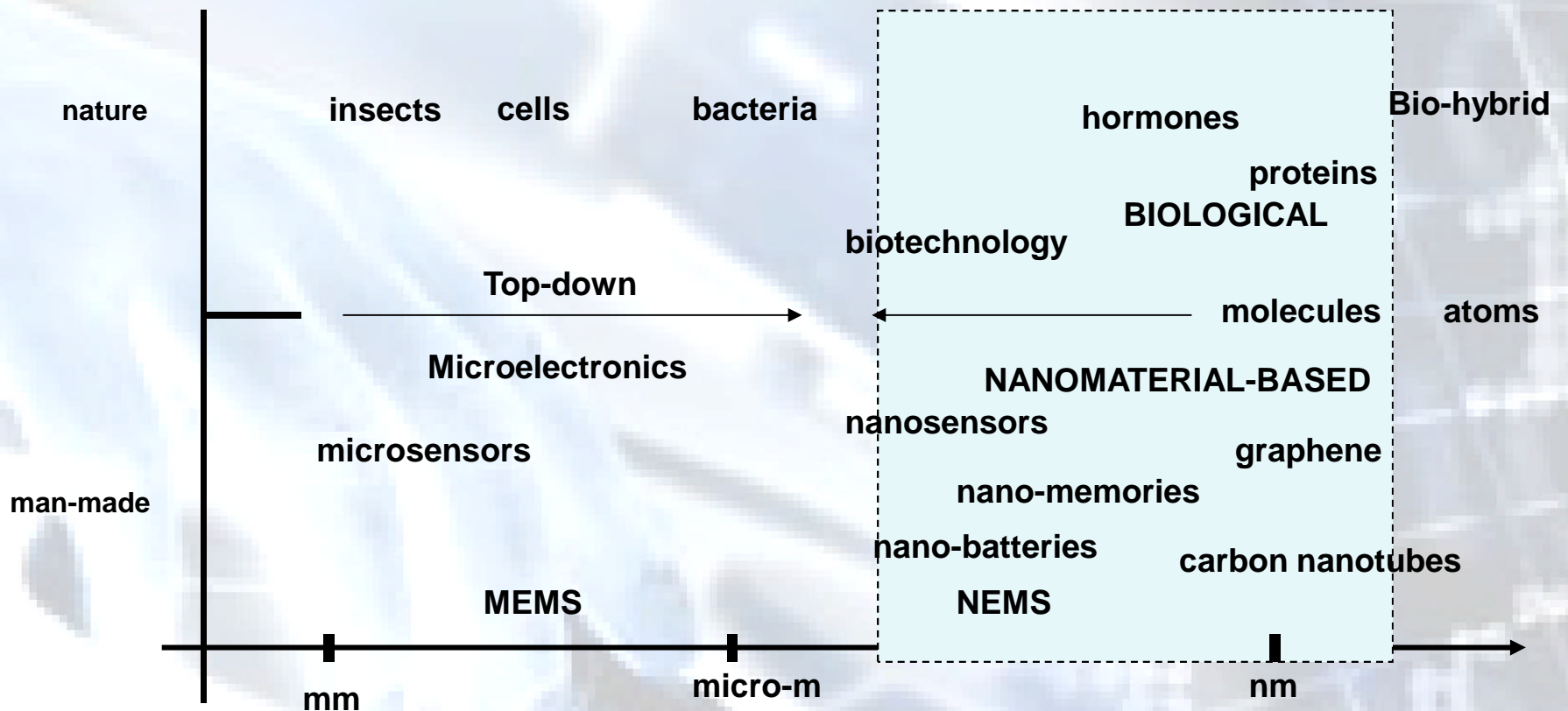
from: Nanonetworks: A New Frontier in Communications by Ian F. Akyildiz, Josep Miquel Jornet, and Massimiliano Peirobon
Communications of the ACM, 11/2011, Vol. 54, no. 11, p. 84

Computation resources

- **Chaotic Planet**

- **Extreme-weather prediction: new weather models + modeling technologies**

- **Currently: Central prediction models**

- **Tendency: Ensembles of (slightly different) models**

- **Quotes: Steve Koch**

- **NOAA: "We don't have one gigantic model that solves all the problems"**

- **"Getting to the point where s are able to produce 60-minute warnings for extreme weather will be a major undertaking that require enough computing power to run fine-scale ensemble models at an operational level"**

from: Modeling Chaotic Storms, by Kirk Kroeker
Communications of the ACM, 11/2011, Vol. 54, no. 11, p. 14

Trends

- **Data analytics**
- **Computational journalism**
- **Social networks**
- **Deep Web**
- **Distributed Artificial Intelligence**
- **Brain-computer interfaces**
- **Natural-search interfaces**
- **Organic displays**
- **Anonymity versus cyber-threats**
- **....**

Technology Lifecycles

- **FSM, FA TL TLA, Process Algebra →**

- **Reactive/proactive/adaptive/predictive/bio-… →**
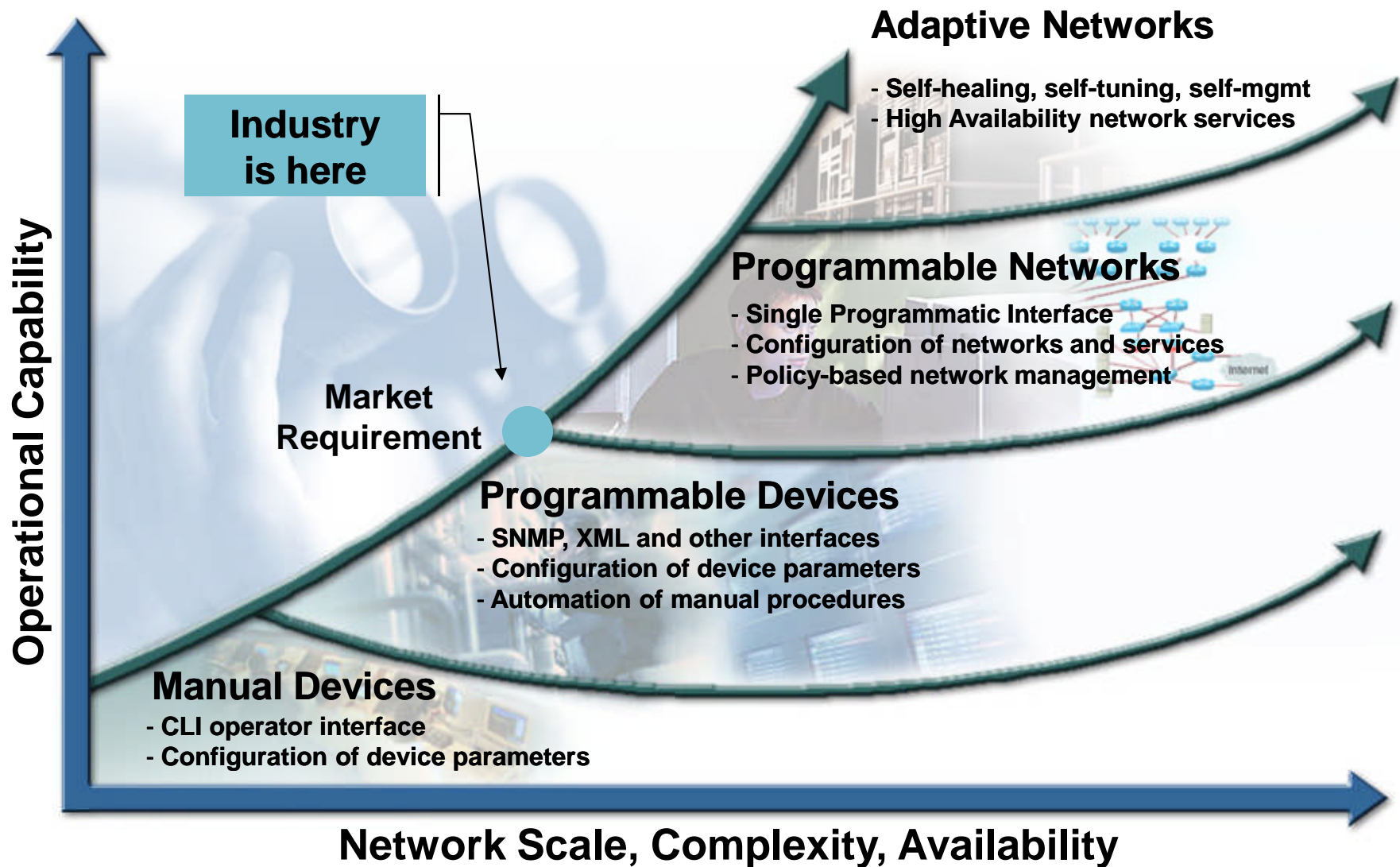
- **Social/semantic/analytics →**

- **WiFi/Mesh/P2P/LTE →**

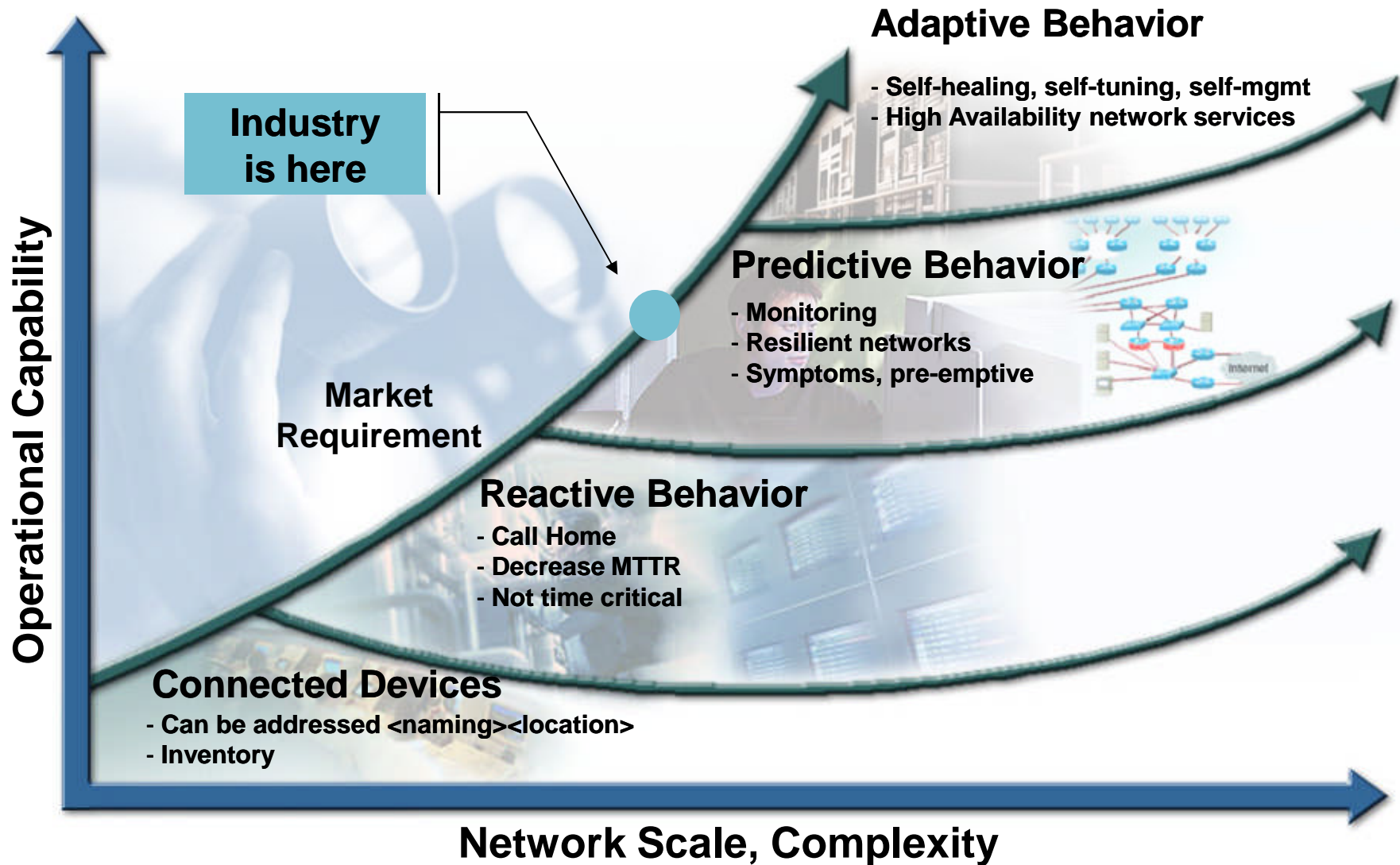- **Agents/OO/aspects/scenario →**

- **Performance/energy/unpredictability →**

Technology tendencies

Evolution of Network/System Manageability

Adaptive Networks

- Self-healing, self-tuning, self-mgmt
- High Availability network services

Industry is here

Programmable Networks

- Single Programmatic Interface
- Configuration of networks and services
- Policy-based network management

Market Requirement

Programmable Devices

- SNMP, XML and other interfaces
- Configuration of device parameters
- Automation of manual procedures

Operational Capability

Manual Devices

- CLI operator interface
- Configuration of device parameters

Network Scale, Complexity, Availability

Evolution of System Intelligence

Operational Capability (vertical axis)

Network Scale, Complexity (horizontal axis)

Adaptive Behavior
- Self-healing, self-tuning, self-mgmt
- High Availability network services

Industry is here

Predictive Behavior
- Monitoring
- Resilient networks
- Symptoms, pre-emptive

Market Requirement

Reactive Behavior
- Call Home
- Decrease MTTR
- Not time critical

Connected Devices
- Can be addressed <naming><location>
- Inventory

Gartner Hype Curve 2010/2011

Figure 1 Hype Cycle for Emerging Technologies, 2010
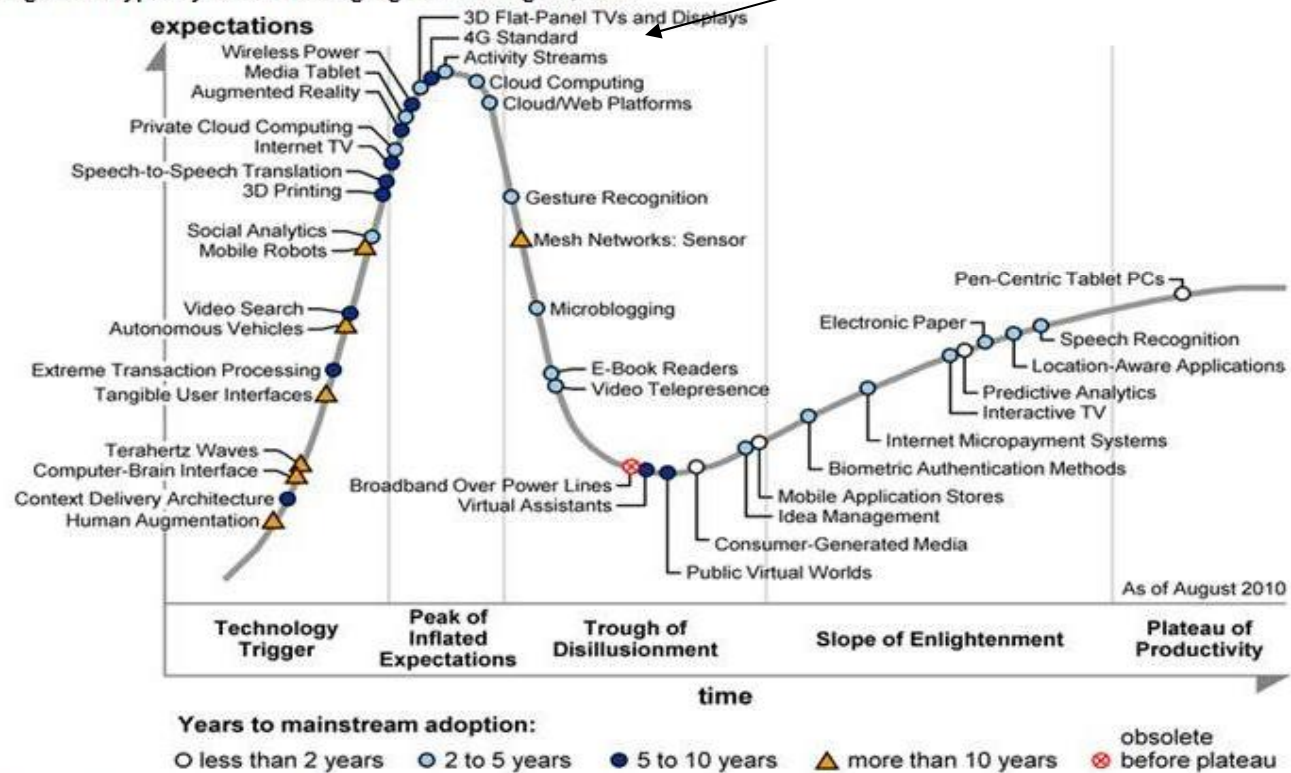
Yet to come: Grocery Club Cards as PIs

- ## Public health

  Food-borne illness outbreaks

  1987: epidemiologists / scam food purchase for culprits in food illness episodes

  Customer food history → privacy

- **Case#1 [2011]**

- Salmonella; 5 Eastern states, 42 people, hospitalization

- Shopping at Wegmans supermarket: Buying bulk Turkish pine nuts

- **Case#2 [2010]**

- E.coli O157:H7, 33 people, 33 people, 15 hospitalizations

- Shoping: raw milk Gouda cheese, produced by Bravo farms, Traver/California, usign Cotsco purchasing data

- **Case #3 [2009]**

- Salmonella: Montevideo, sicked 272 persons, 44 states,

- Shopping: Cotsco: salami from Daniele Inc.
  ! Not sausages, but the black and red peeper they were coated with the bacteria

Challenge for you / invitation for project proposals

- **Project #1**

- **Napkins notes: semantically inserted in a knowledge database**

- **Project #2**

- **Instant alerts: phone number/URL + intelligent clothes + alerts + online healthcare/medicine order/**

- *? Multi-state systems (cross-country interoperability)*

- *? Multi patient record formats (privacy, too!)*

- *? Legal barriers (much more complicated as thought!)*

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Open discussion

- ## Stage is open!

- ## ☺ Thousands of Robots for Advertising teams

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