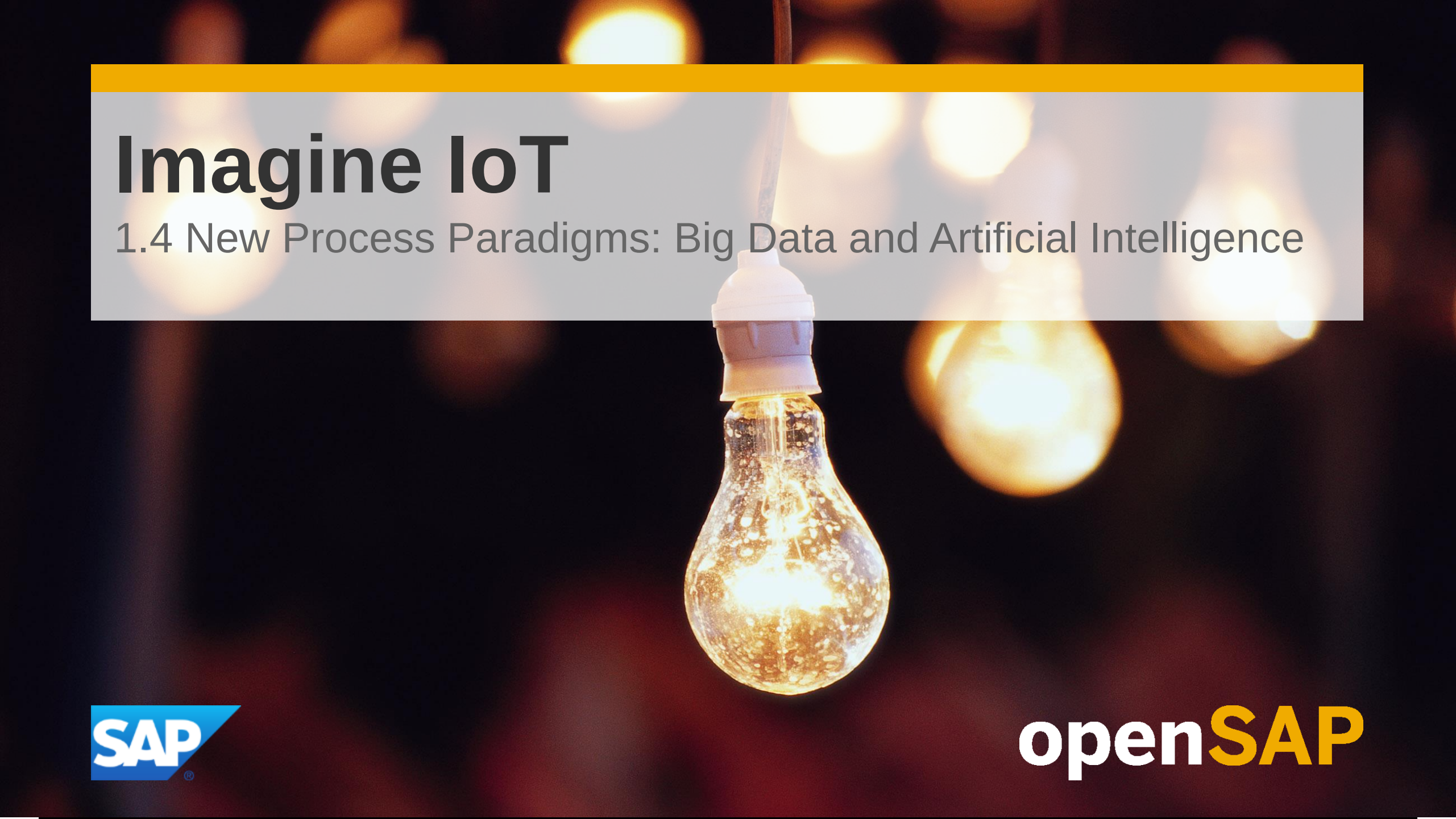


Imagine IoT

1.4 New Process Paradigms: Big Data and Artificial Intelligence

SAP

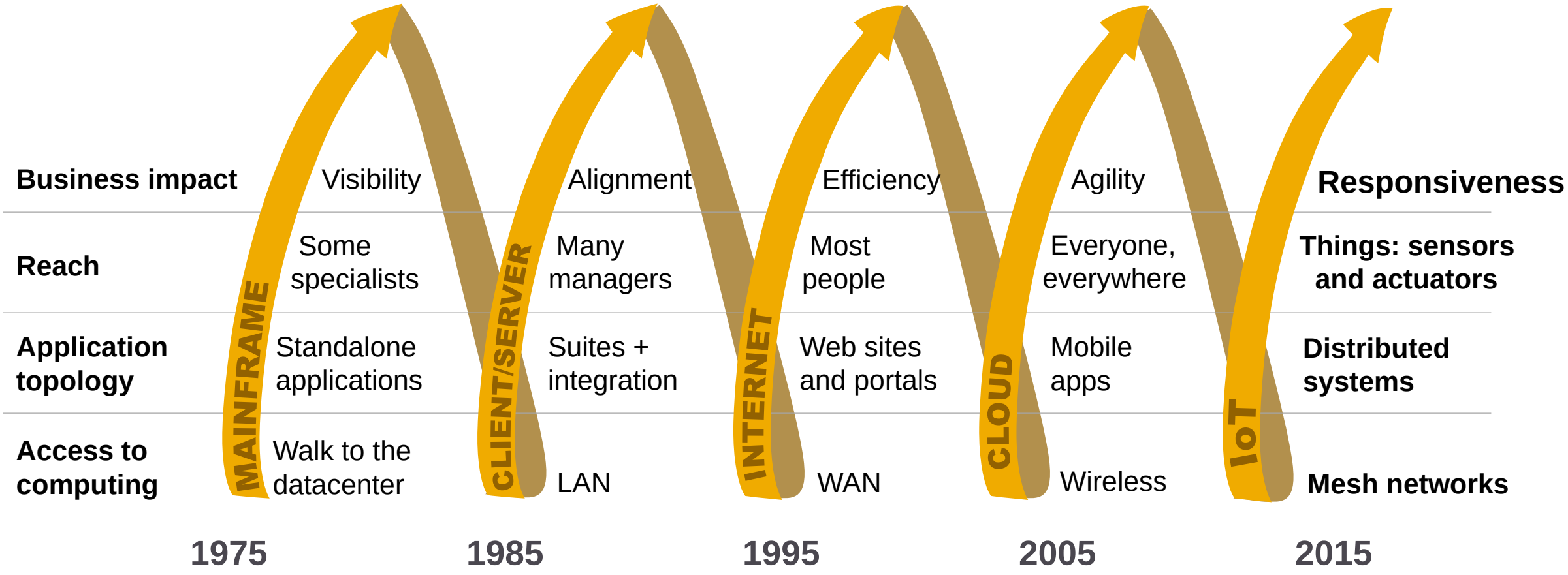
openSAP

How will IoT change business processes

...and what is the new paradigm?

New Process Paradigms: Big Data and Artificial Intelligence

Technology reshapes business



New Process Paradigms: Big Data and Artificial Intelligence

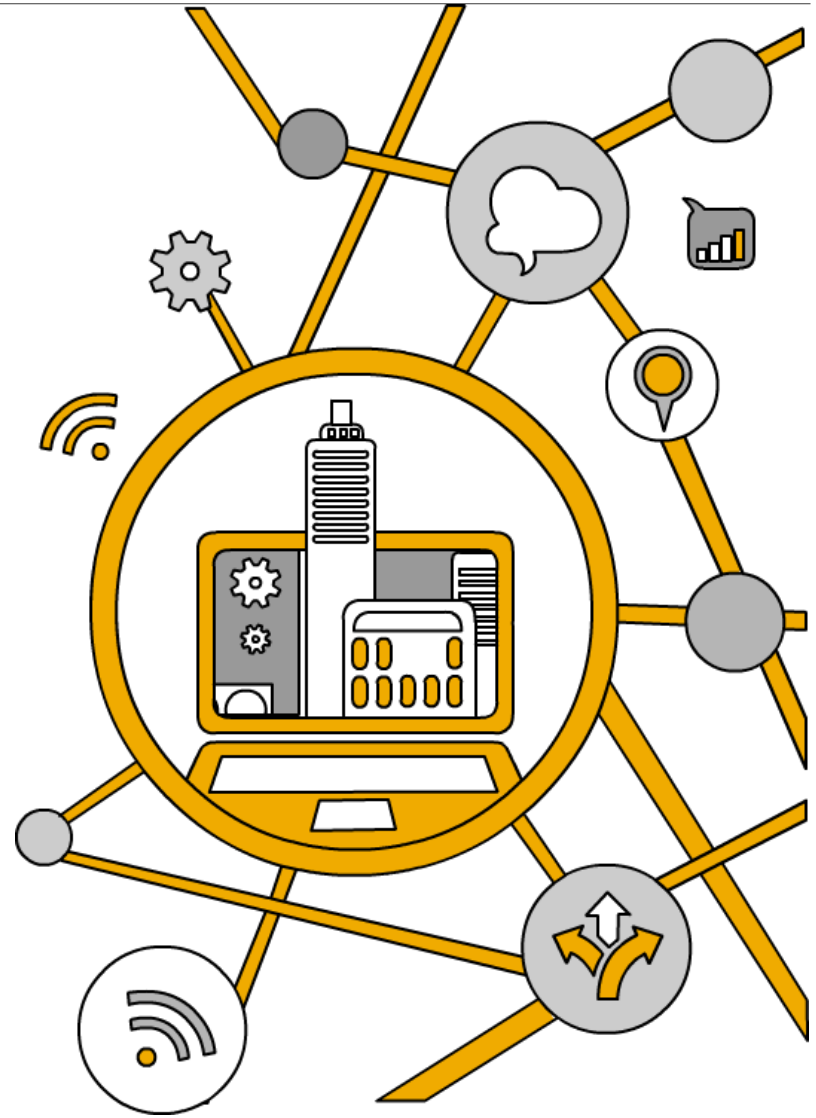
Autonomic nervous systems for organizations

Nothing goes away

- Reports
- Dashboards
- Transactions
- Applications
- Web sites
- Mobile apps

Something is added

- Ability to **sense** and **respond** to changes in the environment
- Meeting **customer needs** as soon as—or even before—they are noticed by people
- **Reactive** *and* **proactive**



New Process Paradigms: Big Data and Artificial Intelligence

Example of an autonomic business process

1. Cooling unit shows subtle pattern of vibrations
2. IoT system predicts refrigeration failure in hours
3. Message to driver re-routes truck to transfer depot
4. Message to another driver brings another truck to pick up payload
5. Parts for repair automatically ordered, sent to maintenance yard
6. Load transfers, truck is routed to maintenance yard and removed from service
7. Near-future deliveries scheduled for this truck are re-planned to other trucks

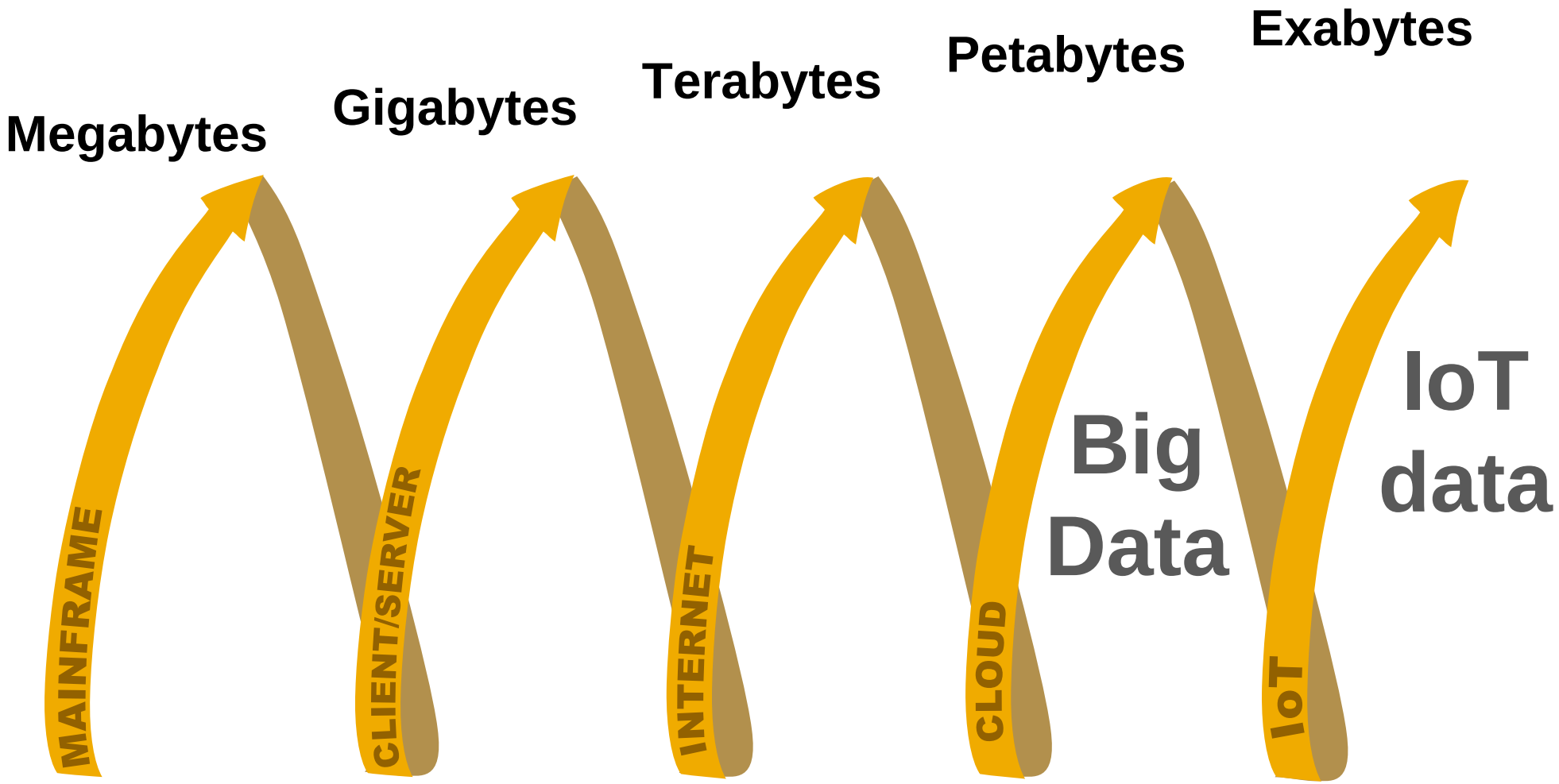
All done automatically

What is Big Data

...and how does it compare to IoT data?

New Process Paradigms: Big Data and Artificial Intelligence

Dataset sizes



New Process Paradigms: Big Data and Artificial Intelligence

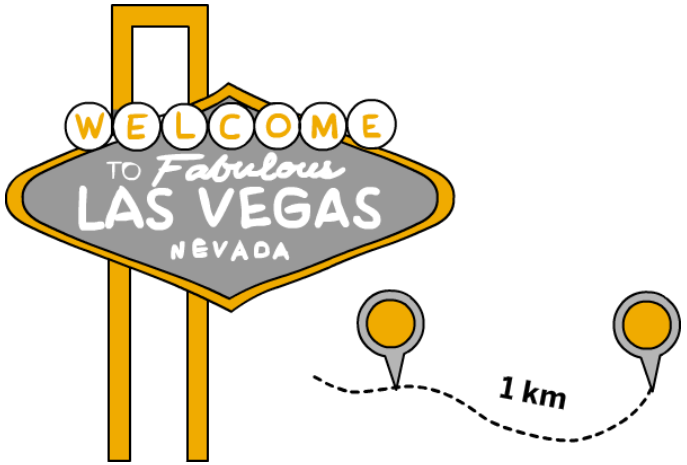
How much bigger is IoT data?

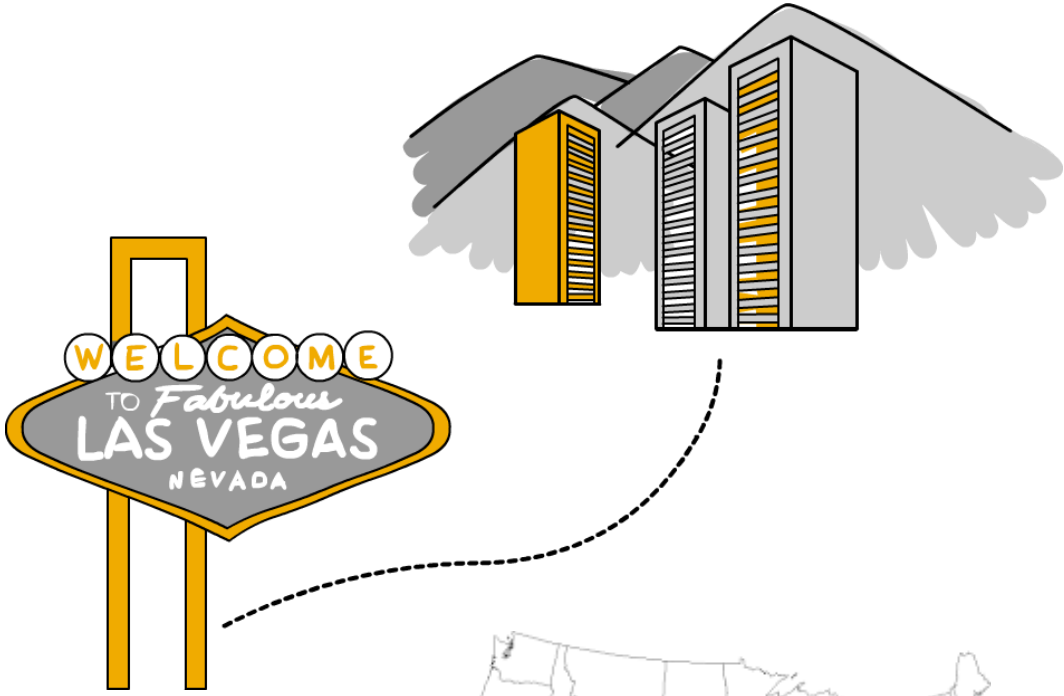
Type of data	Recommended SAP data management solution	Size range	Expressed numerically
Transactional data	SAP HANA – in-memory	Terabytes (TB)	10^{12}
Traditional analytics (OLAP)	SAP IQ or SAP HANA dynamic tiering – disk-based	10s to 100s of terabytes	$10^{13\text{-}14}$
Big Data	Hadoop with SAP HANA Vora – both in-memory & disk-based	Petabytes (PB)	10^{15}
IoT data	SAP SQL Anywhere distributed as an edge database	Exabytes (EB)	10^{18}

New Process Paradigms: Big Data and Artificial Intelligence

How big is an exabyte?

Size range	Analogy to distance	How far you would have to walk
Terabyte (10^{12})	1 meter	Walk 2 steps
Petabyte (10^{15})	1 kilometer	Walk half the length of the Las Vegas strip
Exabyte (10^{18})	1000 kilometers	Walk from Las Vegas to Denver, Colorado





New Process Paradigms: Big Data and Artificial Intelligence

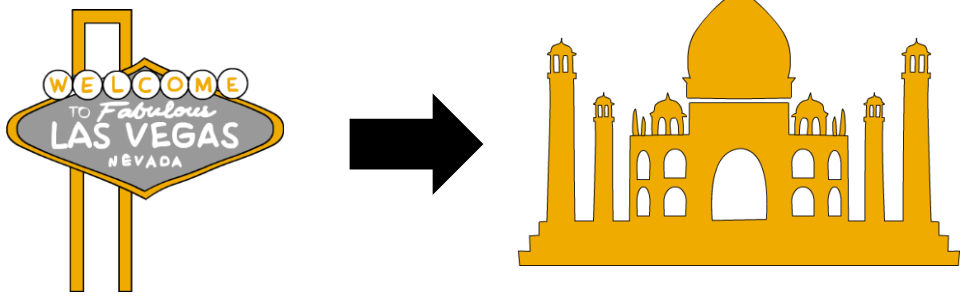
Will IoT datasets really get this big?

Large car manufacturer – numbers provided by customer

- 100 million cars (10-year lifespan) x 4 messages/day x 25-kilobyte messages
  = 10 terabytes/day = 3½ petabytes/year x 10 years of data = 3% of 1 exabyte
- Could grow to 200 messages/day x 50-kilobyte messages → **3½ exabytes**

Gartner estimate: 50 billion connected devices by 2020

- Conservative assumption: average 500-byte message per minute per device
- 50 billion devices x ½ million minutes/year x ½ kilobyte = **12½ exabytes/year**
  = like walking from Las Vegas to Delhi*!*



What is the edge

...and why is it so important for IoT?

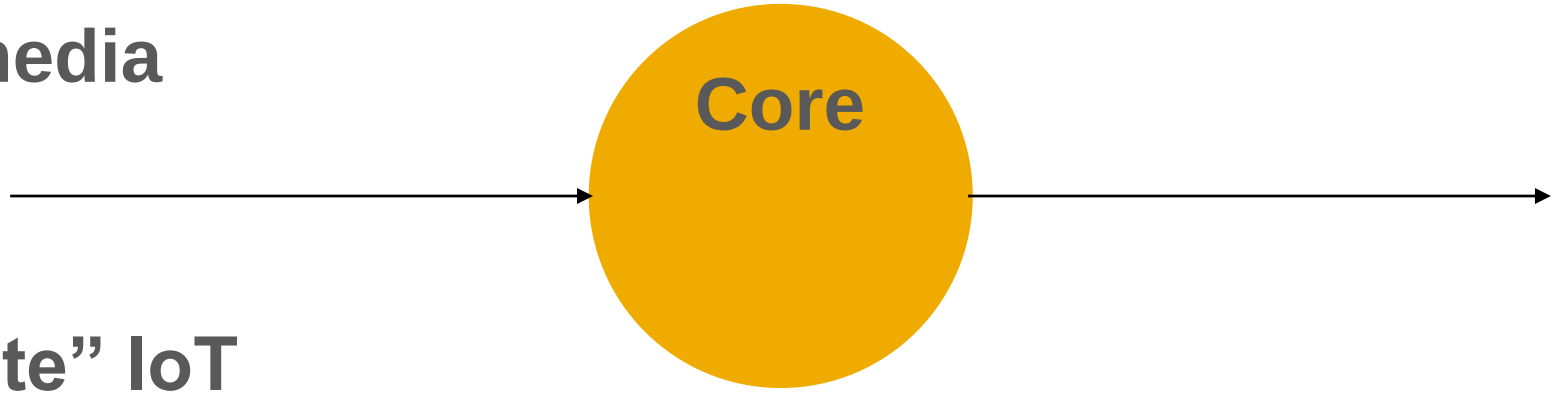
New Process Paradigms: Big Data and Artificial Intelligence

Where will IoT data reside and how will it flow? (1)

“Light Content”
(info, news, marketing)

Commerce

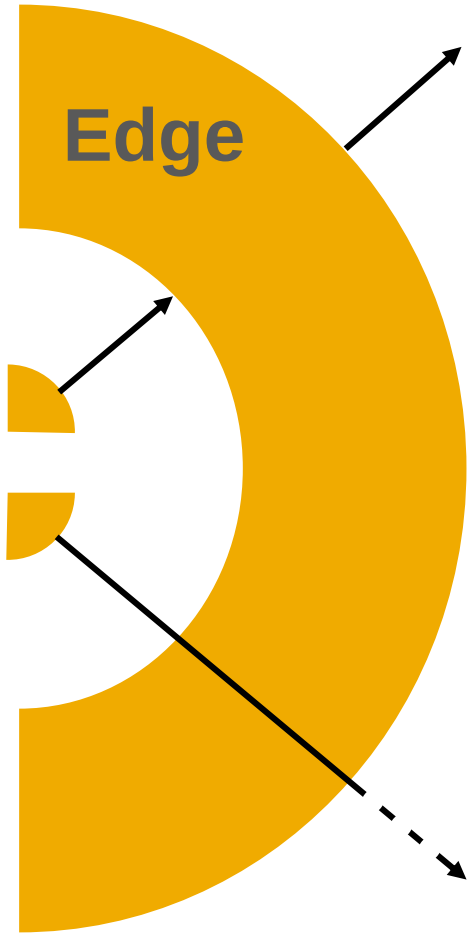
Social media



“Moderate” IoT
(petabyte-sized)

New Process Paradigms: Big Data and Artificial Intelligence

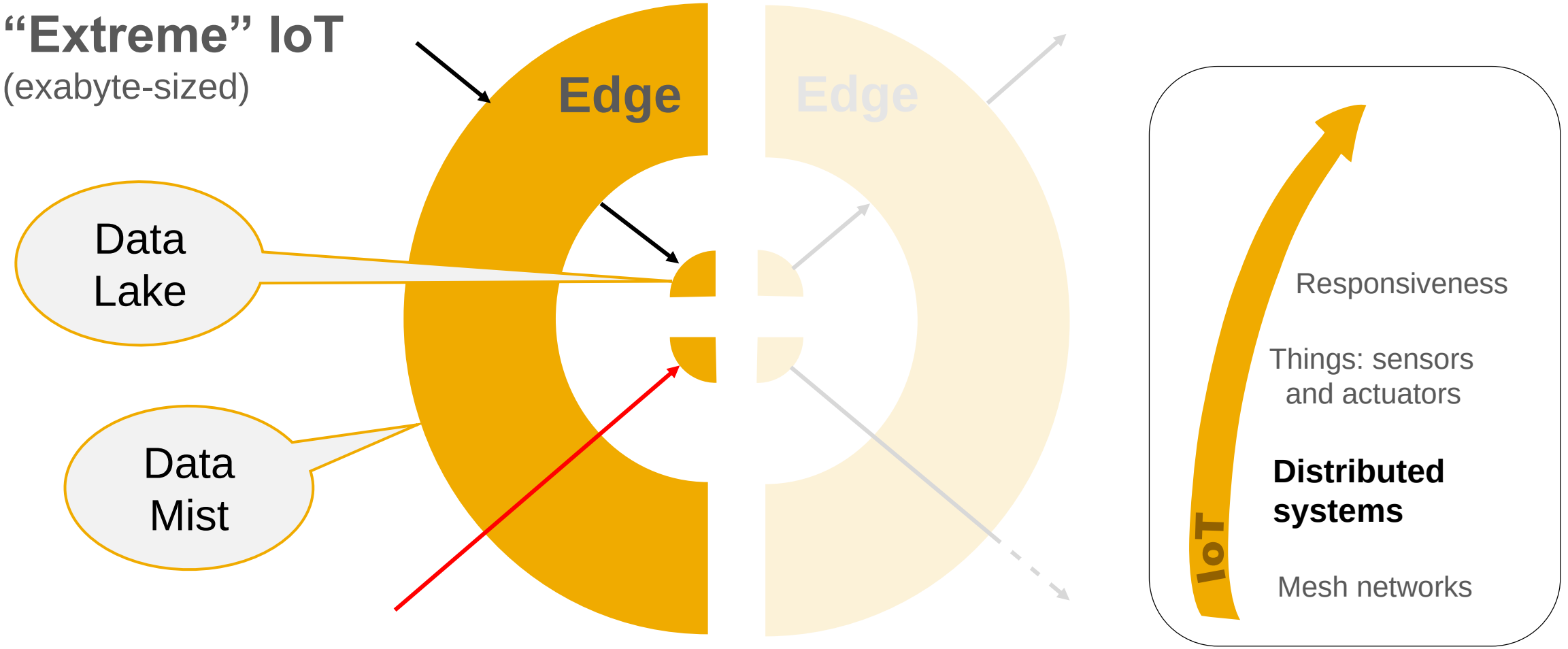
Where will IoT data reside and how will it flow? (2)



Video

New Process Paradigms: Big Data and Artificial Intelligence

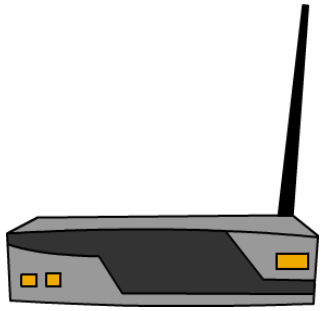
Where will IoT data reside and how will it flow? (3)



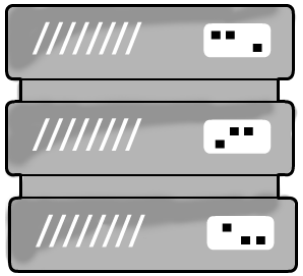
New Process Paradigms: Big Data and Artificial Intelligence

What does the “edge” look like?

Edge gateways

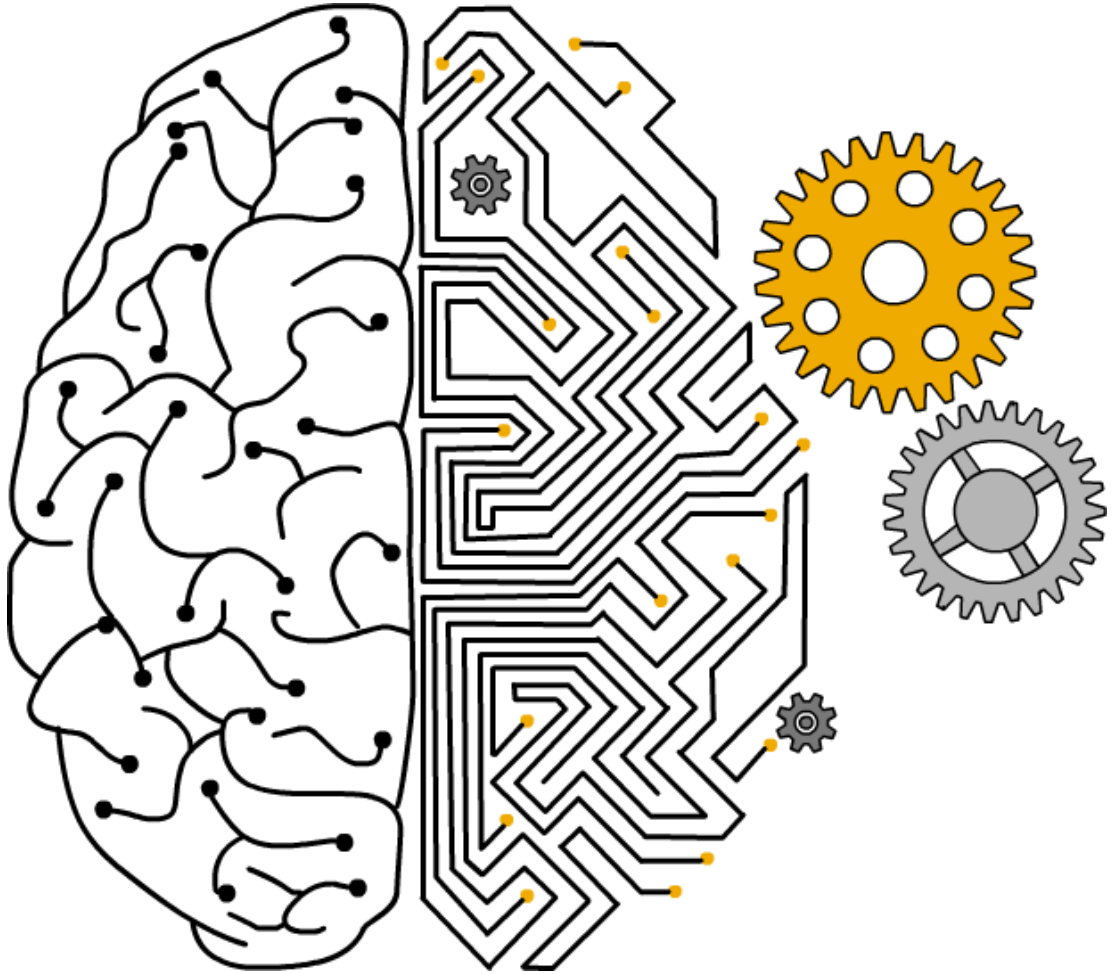


IoT gateways (Intel, Dell, Cisco…)



Remote servers

Raspberry Pi, etc.



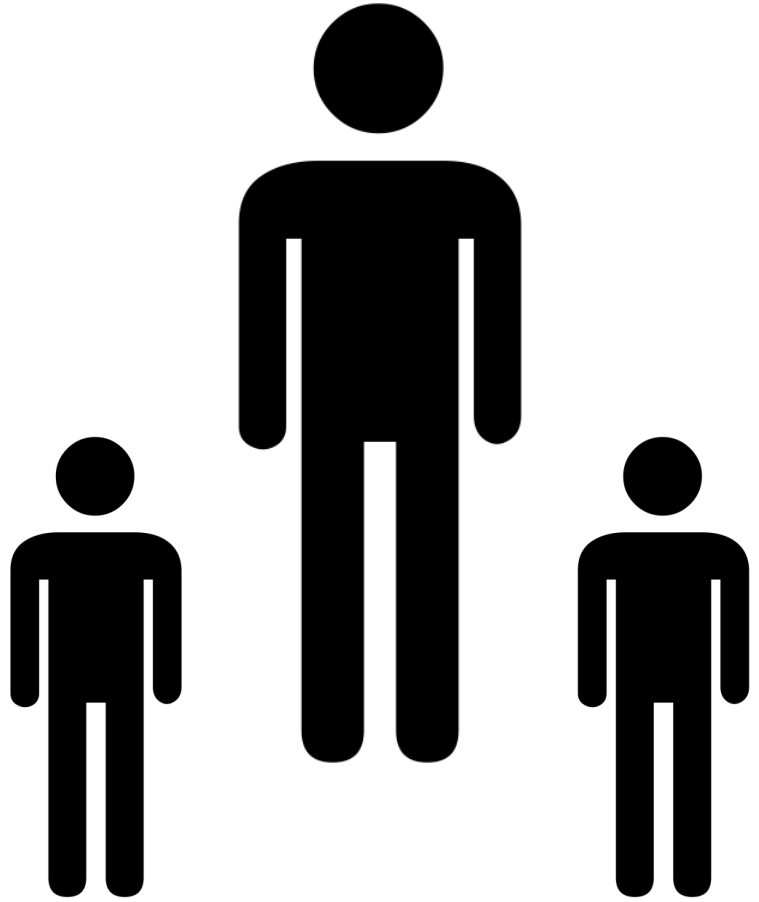
The latest trends involving automation, AI, and bots

...and how are they relevant for IoT?

New Process Paradigms: Big Data and Artificial Intelligence

IoT is beyond human scale

- **Billions** of sensors
- **Millions** of edge gateways
- **Terabytes** generated every day
- **Exabyte-sized** datasets
- **Manual techniques do not work at this scale**



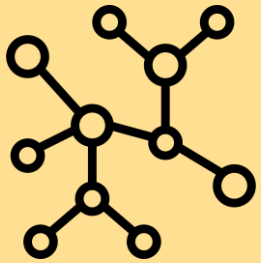
New Process Paradigms: Big Data and Artificial Intelligence

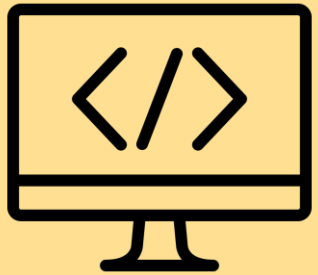
IoT is here to serve human needs

- How do we tame this **scale mismatch**?
- How do we make IoT **manageable**?

New Process Paradigms: Big Data and Artificial Intelligence

Automated delivery and governance of distributed systems





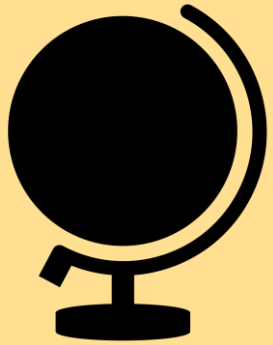
- Thousand-node clusters in the core
- Millions of gateways
- How to deploy and govern at this scale?
- DevOps – responsible for how much their code operates in real use

OpsDev

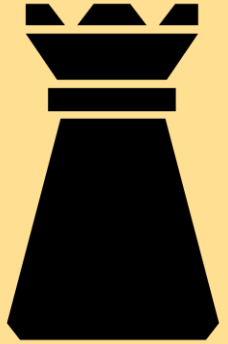
- Highly-skilled developers focused on delivery and governance
- Building semantic models to drive fully automated operation
- Zero-touch

New Process Paradigms: Big Data and Artificial Intelligence

Machine learning to extract signals from noise



- Machine learning evolves algorithms to discover patterns
- Leverage human judgment to guide evolution



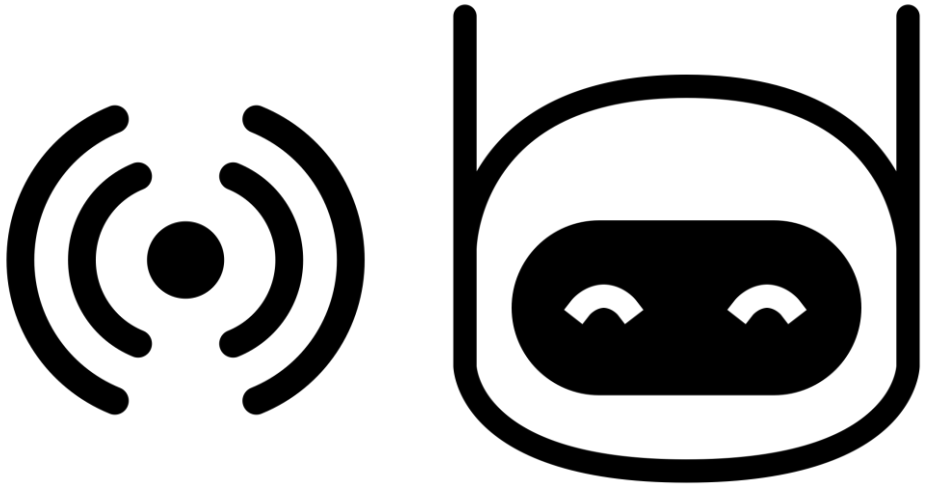
- Any smartphone can now beat a grandmaster
- Freestyle chess: People using computers versus other human-computer teams

New Process Paradigms: Big Data and Artificial Intelligence

Conversational interfaces

Bots

- Software engaging in **conversations** with users
- **Inform** you of events or predictions and **receive your commands** to react to them
- Smarter bots can explain **why** the system thinks something is about to happen



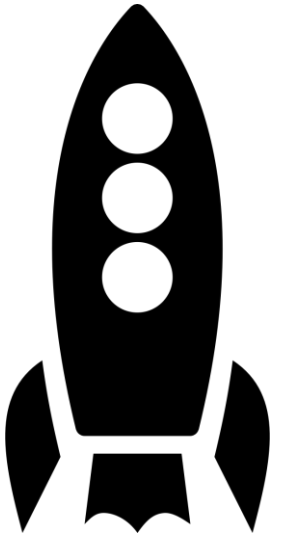
How do you balance vision and imagination

...with pragmatism and delivery of innovation?

New Process Paradigms: Big Data and Artificial Intelligence

Ready, aim, fire

- Start moderately and grow
- Design to provide **responsiveness**, not merely reports
- Plan for **scalability**—successful IoT systems will get very large
- Think in terms of **distributed** systems
- Understand the need to **automate** everything—operations, pattern discovery, generated responses—while building in ways to leverage human insight: **“freestyle”**



Thank you

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