Web/App based operational monitoring and control

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Outline

Cloud-Computing

Mobile Computing

Combining Mobile & Cloud-Computing -> Mobile Cloud-Computing

Approaches

Issues

Cloud

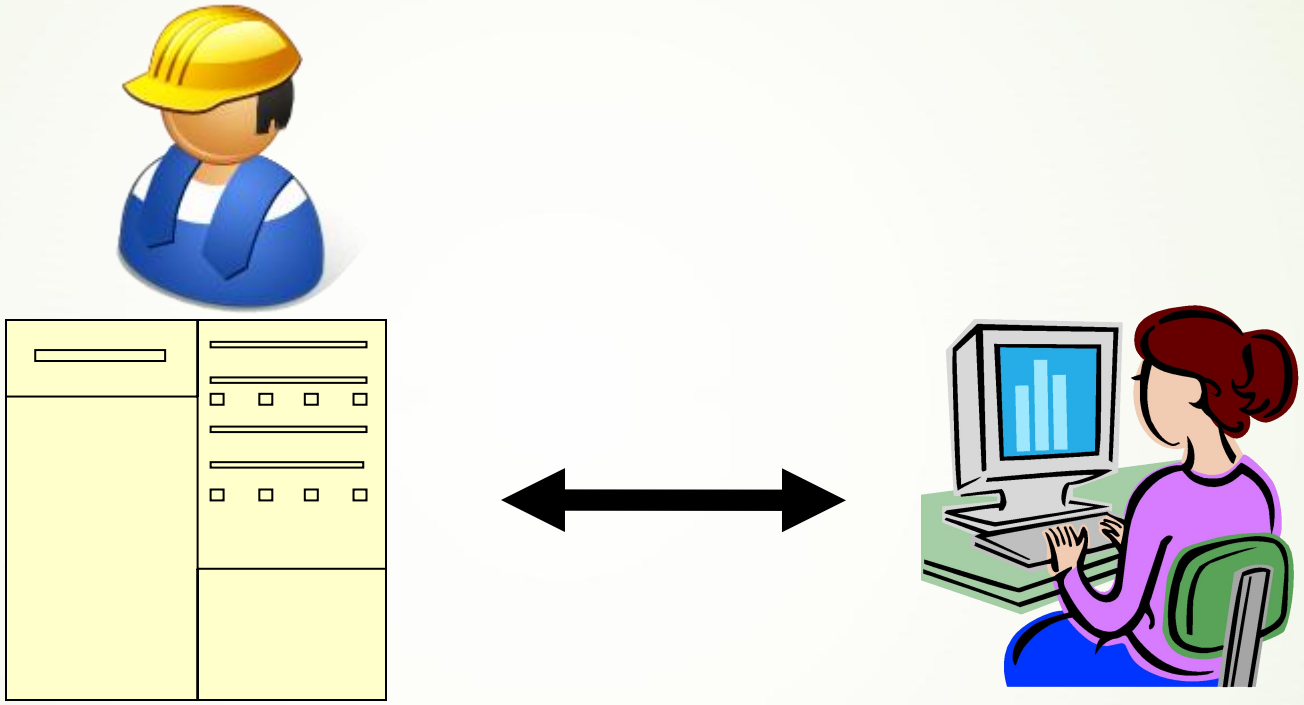
Big Switch – Nicholas Carr

2003 *Harvard Business Review* article "IT Doesn't Matter"

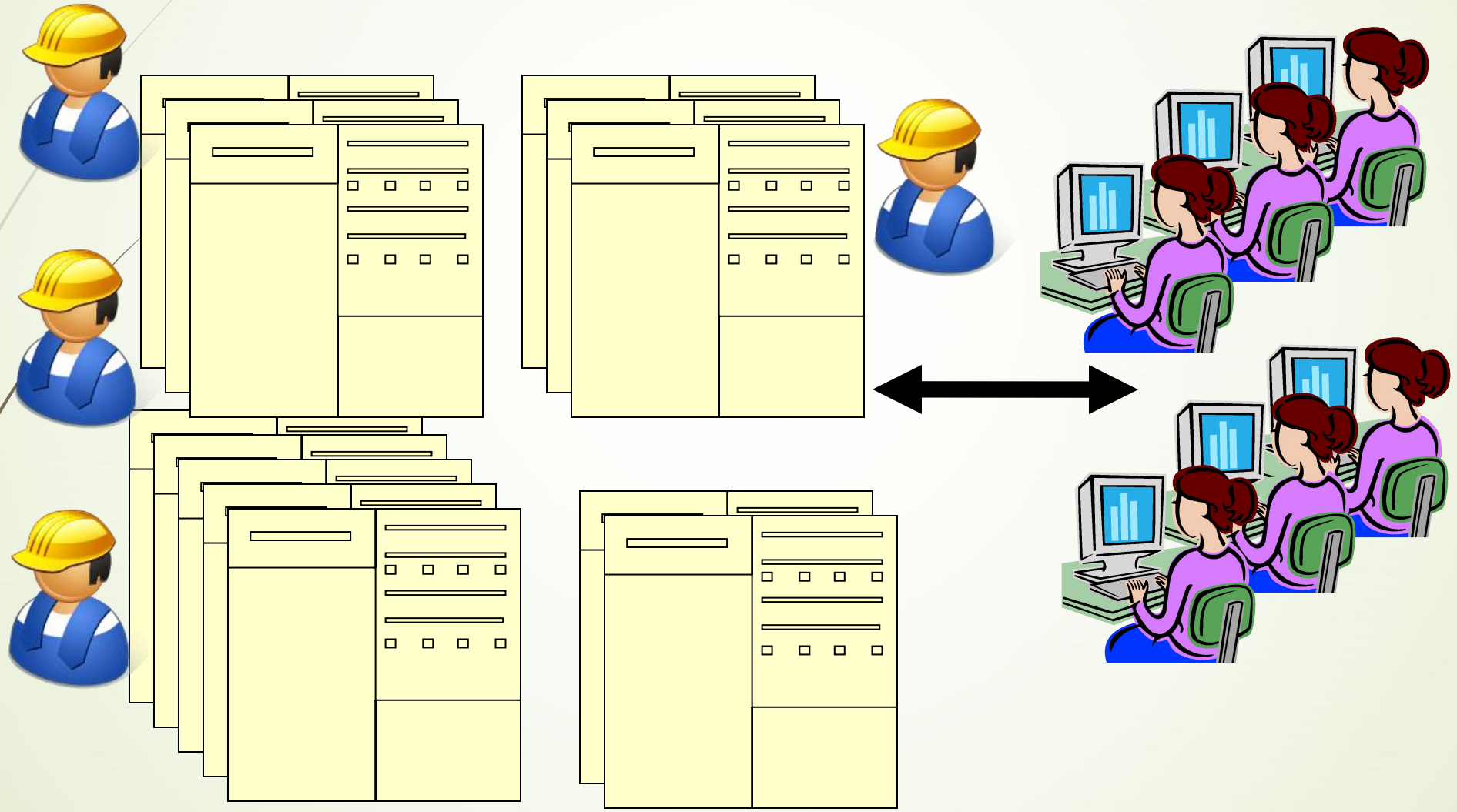
2004: The End of Corporate Computing" in the *MIT Sloan Management Review*

2008: The Big Switch: Rewiring the World, From Edison to Google

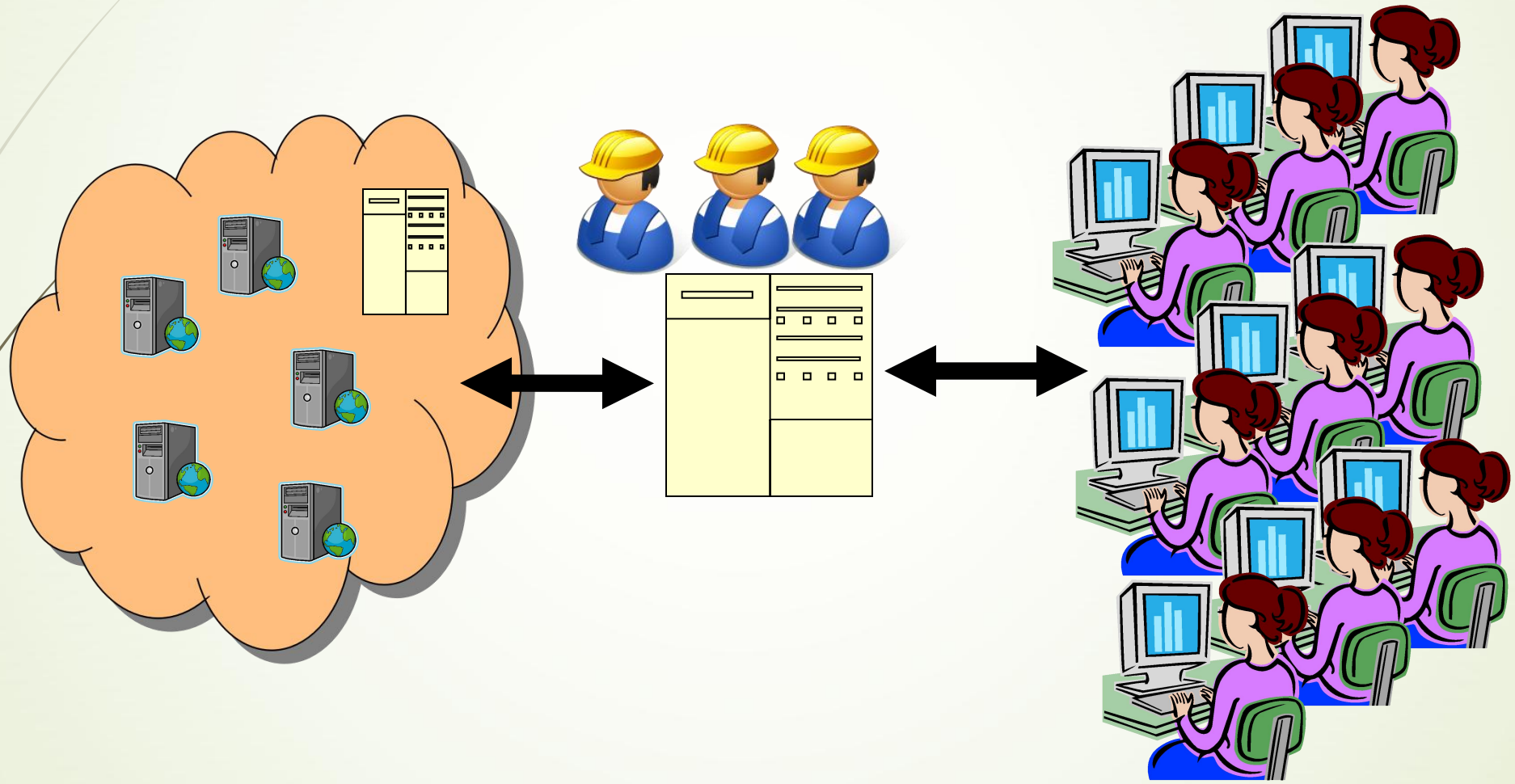
Need for IT People & HW/SW



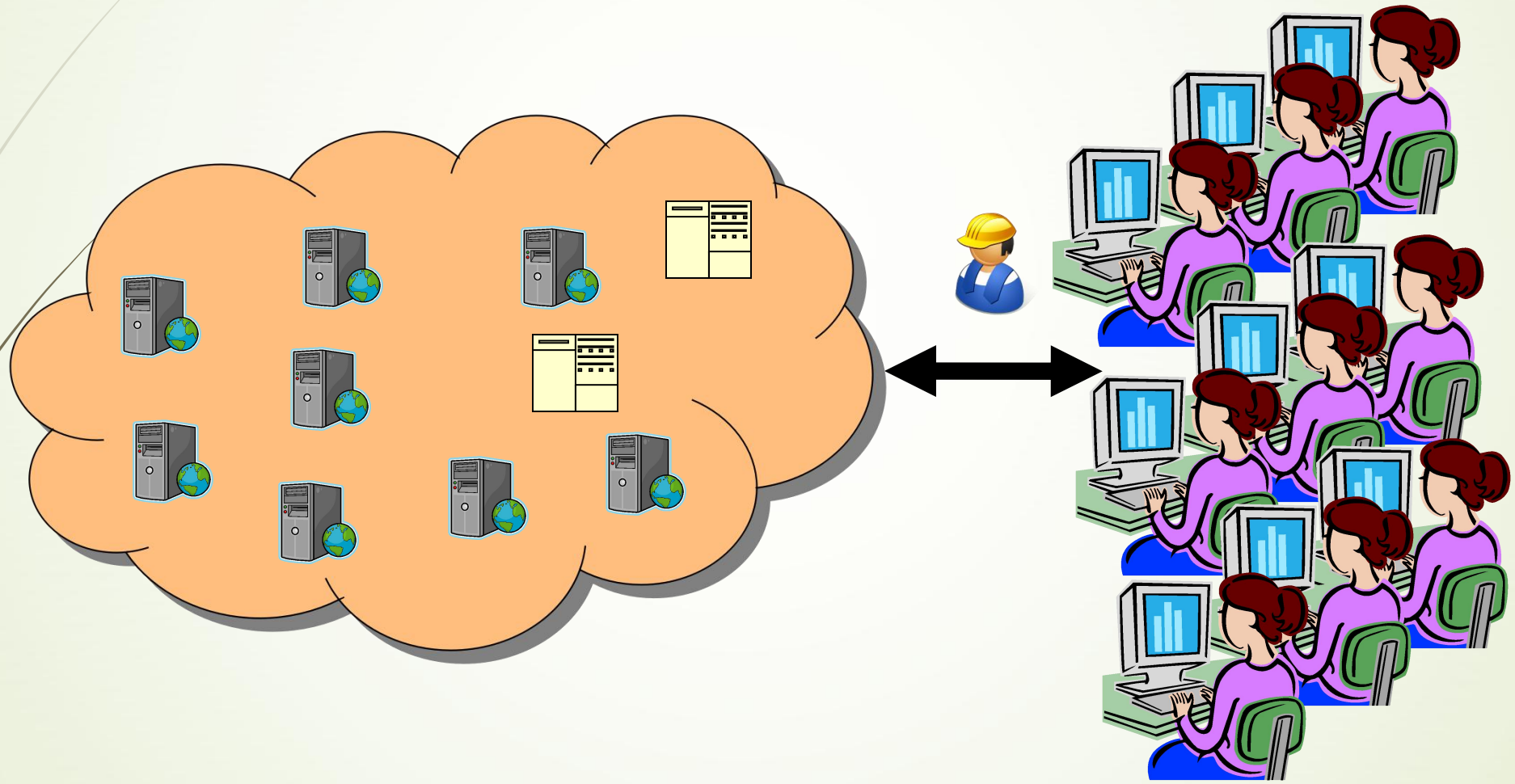
Need more IT Resources ?



Renting Resources to cover peak loads



Do you really need your own IT?



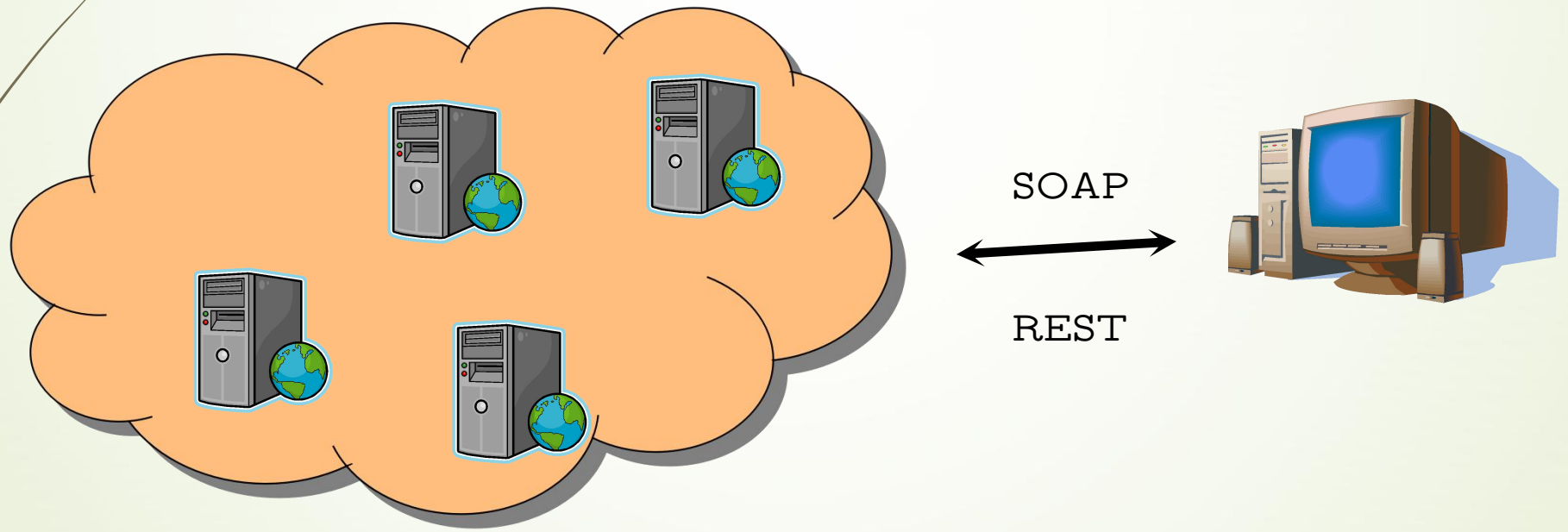
Cloud Computing – Economy of Scale

Outsourcing many/all/parts of computing

Use of virtualized components

Focus on services

Pay as you go



Cloud Types

Infrastructure as a Service (IaaS)

- EC2, Google Compute Engine, Rackspace, Slicehost ….

Platform as a Service (PaaS)

- Azure, Google App Engine, ….

Software as a Service (SaaS)

- S3 (storage)

Core Management SW in the Cloud

Fault

Access

Configuration

Performance

State

Account

….

Mobile

CEO Satya Nadella: Mobile First & Cloud First

Bold Ambition & Our Core, http://news.microsoft.com/ceo/index.html

Worldwide Devices Shipments by Device Type, 2015-2018 (Millions of Units)

Device Type	2015	2016	2017	2018
Traditional PCs (Desk-Based and Notebook)	246	232	226	219
Ultramobiles (Premium)	45	55	74	92
PC Market	**290**	**287**	**299**	**312**
Ultramobiles (Basic and Utility)	196	195	196	198
Computing Devices Market	**486**	**482**	**495**	**510**
Mobile Phones	1,910	1,959	1,983	2,034
Total Devices Market	**2,396**	**2,441**	**2,478**	**2,545**

Ranjit Atwal - http://www.gartner.com/analyst/14371

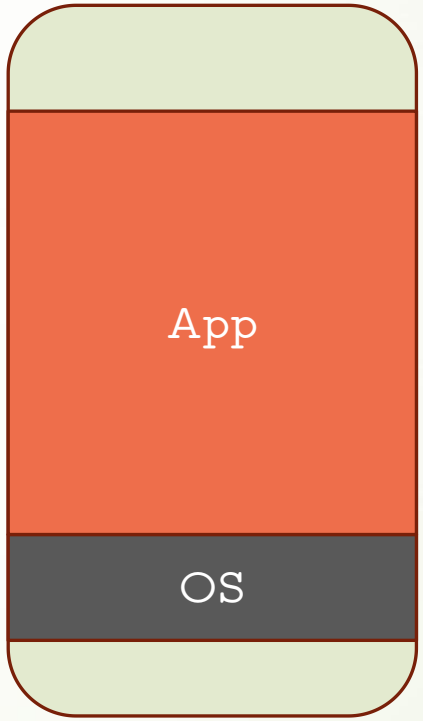
Native Apps

Program device specific

Able to utilize resources better

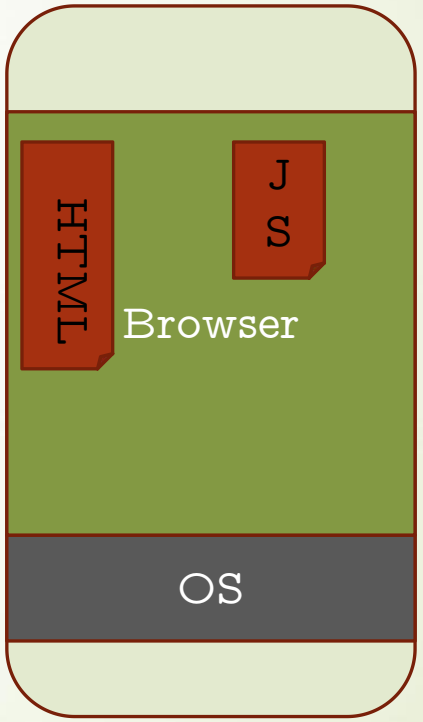
Better user experience

Complexity? Time?



Mobile Web

- Mobile Web
  - Focus on using browser as the environment
  - Leverage web-technologies / web-standards
  - Simpler development process
  - Offline?
  - How to use device features?

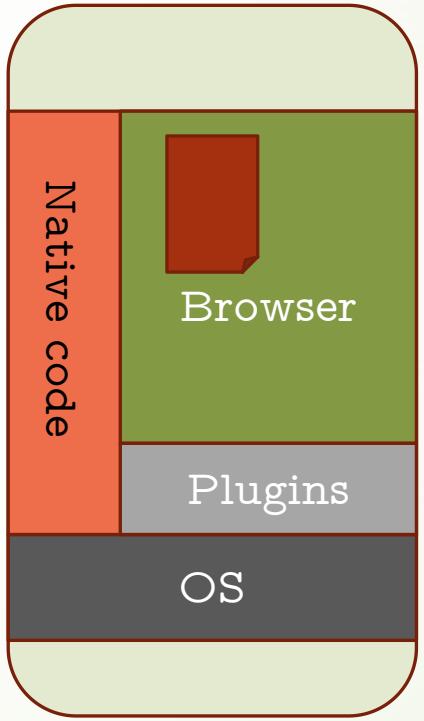


Hybrid Apps

Combine native & mobile web

Build native apps

Use browser



So ….

3 basic approaches to develop apps

- Native / cross-compiler
  - Xamarin
- Mobile Web
  - Dreamweaver
- Hybrid
  - Phonegap + JQM

Key issues:

- Platforms to be supported
- Off-Line operation
- **Integration with Backend**

Mobile Computing + Cloud Computing = MCC

- Mark Beccue 2009, ABI research -> Mobile Cloud-Computing
  - Use cloud to help mobile devices overcome resource constraints

- Basic Approaches
  - Offloading
  - Mobile device as cloud service consumer
  - Edge & fog computing

Mobile Devices as Service Consumer

Most often used MCC pattern

Backend in cloud

- Integration challenge

Use mobile device to access some functions

- REST

To overcome network issues apps keep some data local

- Apps become less dependent on cloud

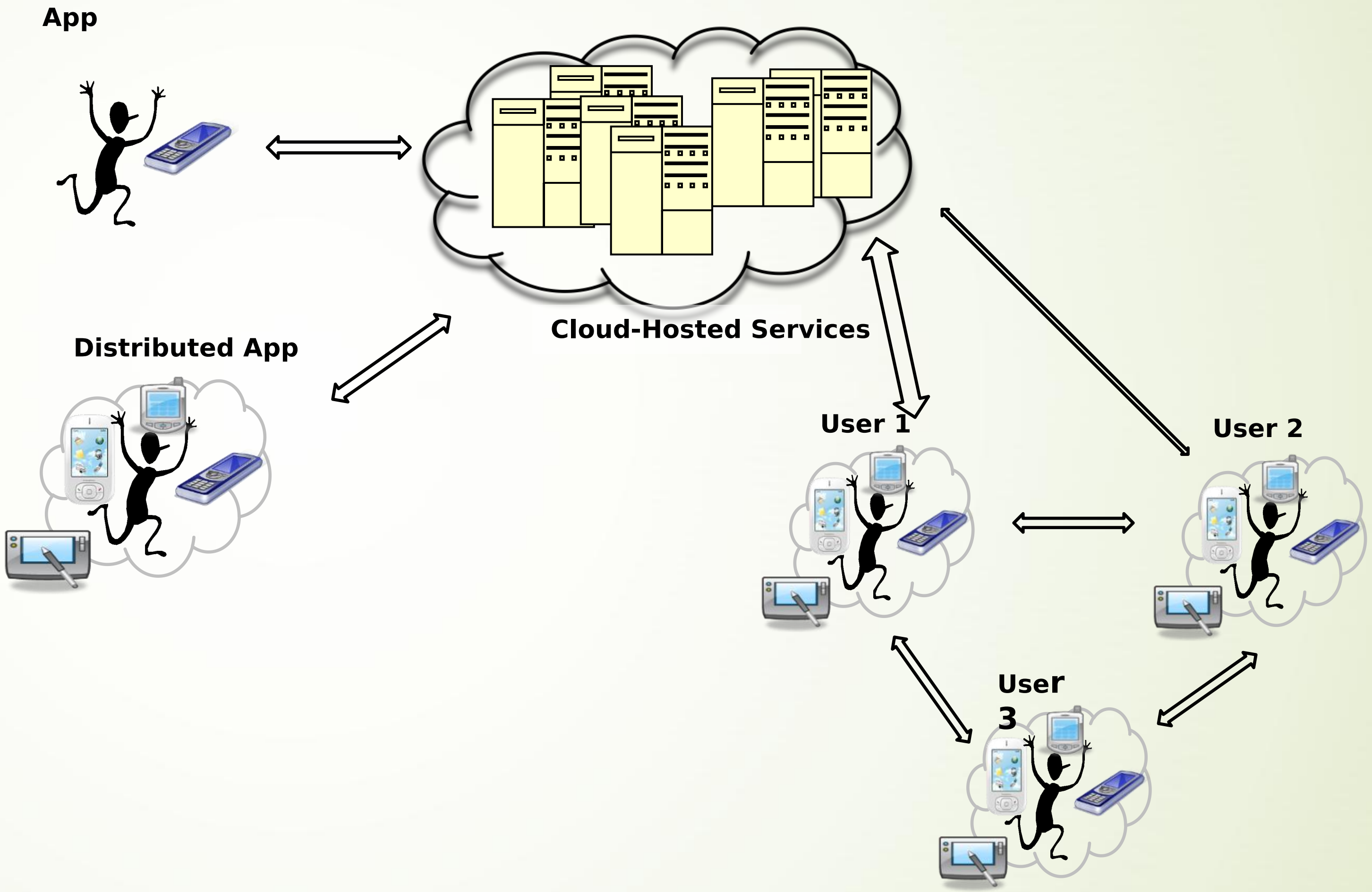
Mobile Cloud-Computing (MCC)

MCC

- Baccue 2009

User : Device

- 1:1
- 1:N
- **M:N**

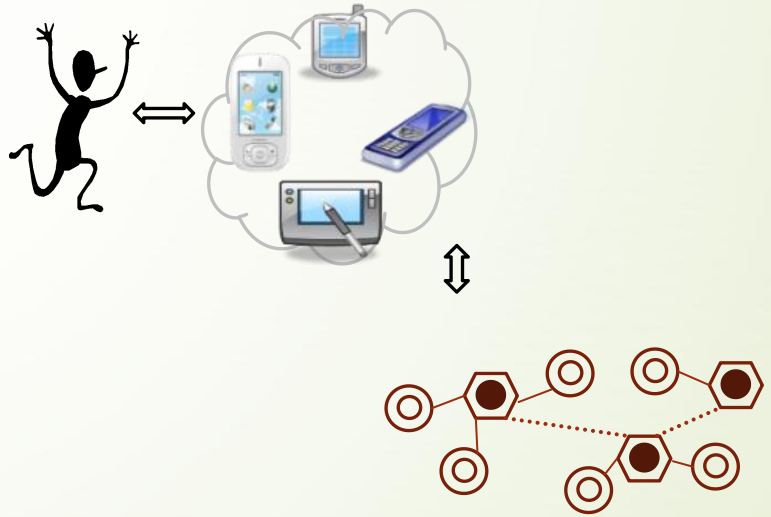


Linking Device Clouds with IoT

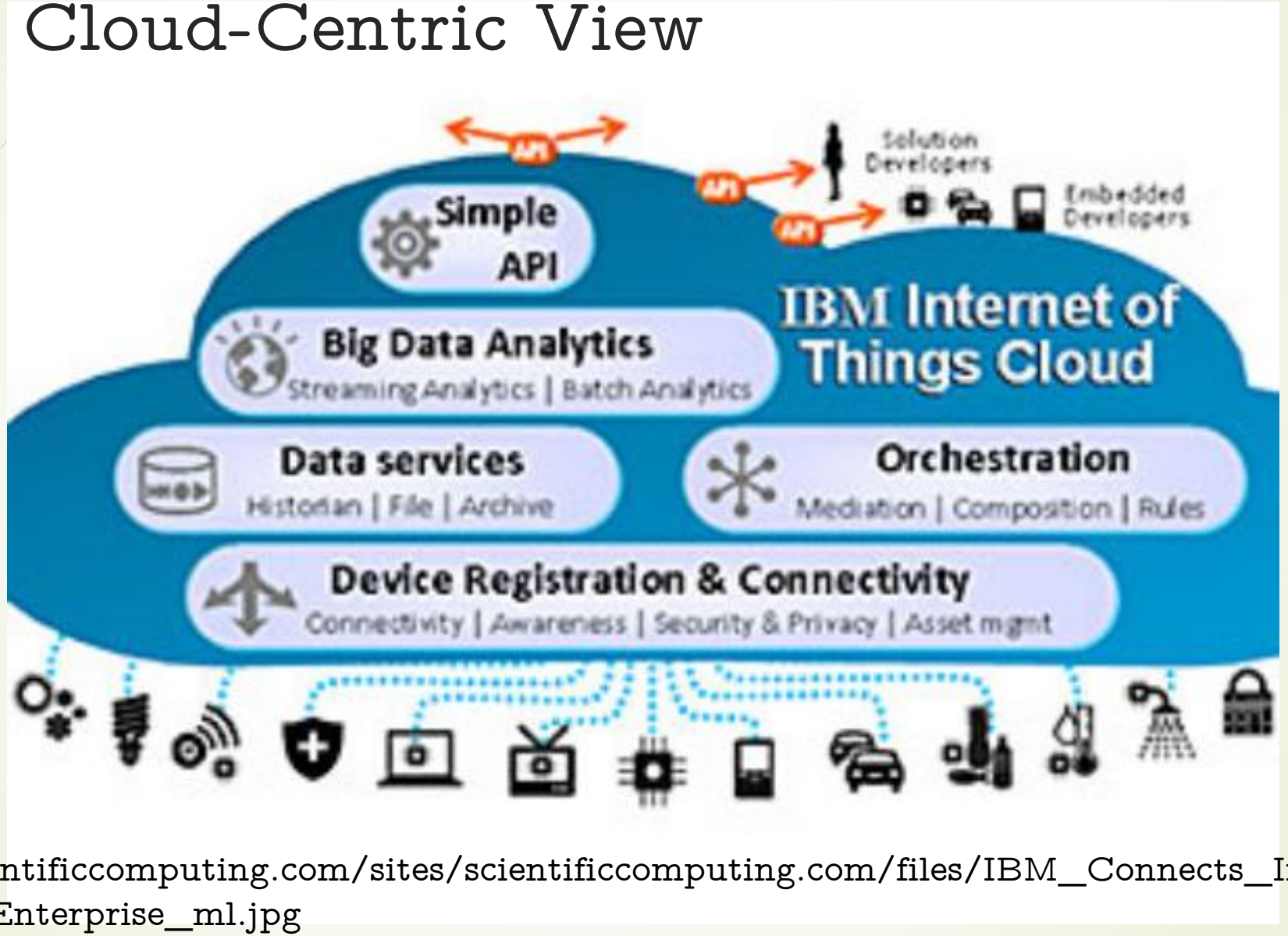
M User: N Devices

Using N devices to access cloud-hosted representations

- Bandwidth
- Only reads?



Cloud-Centric View



http://www.scientificcomputing.com/sites/scientificcomputing.com/files/IBM_Connects_Internet_of_Things_to_Enterprise_ml.jpg

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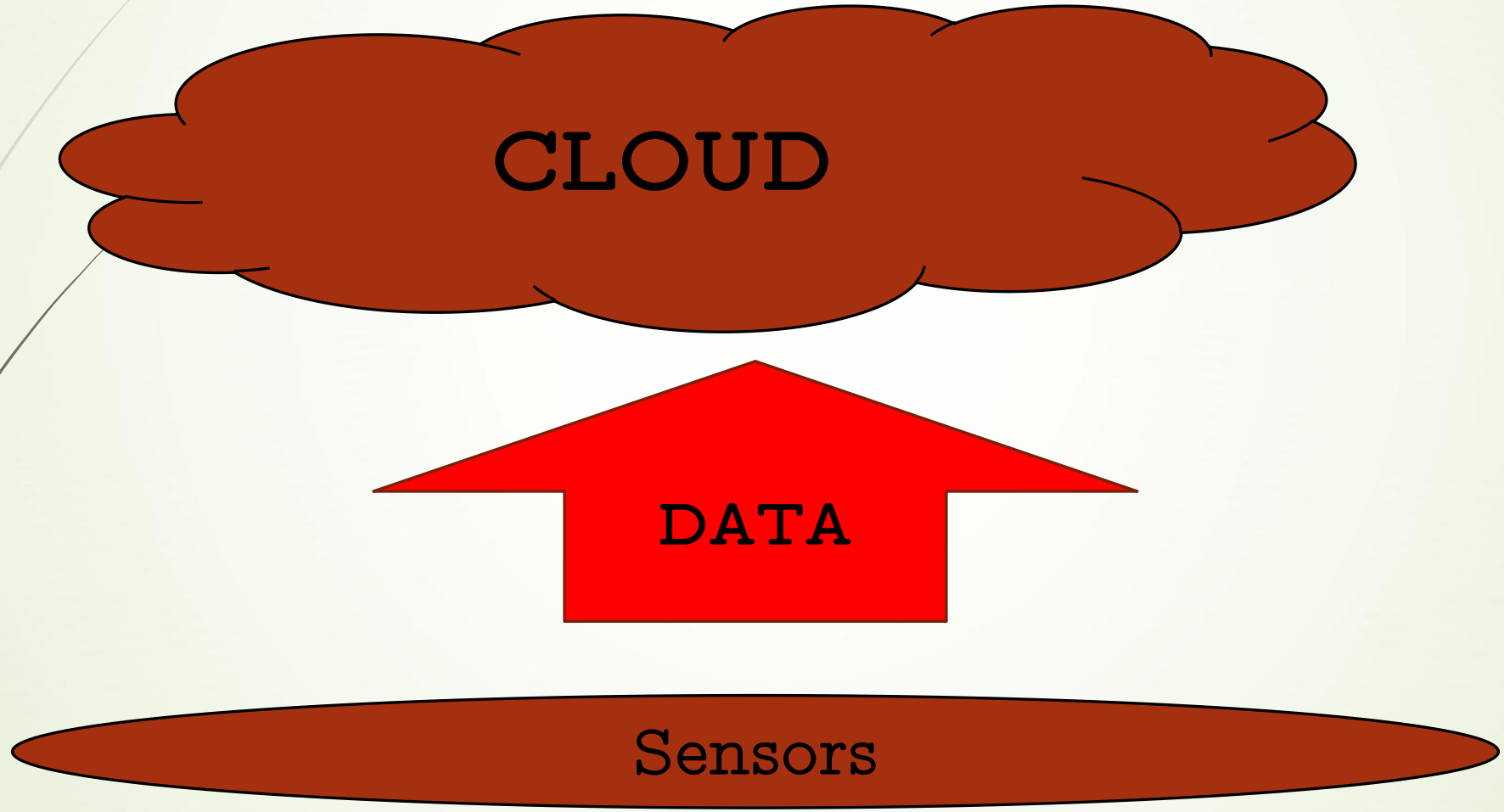

CLOUD
DATA
Sensors

Cloud-Centric

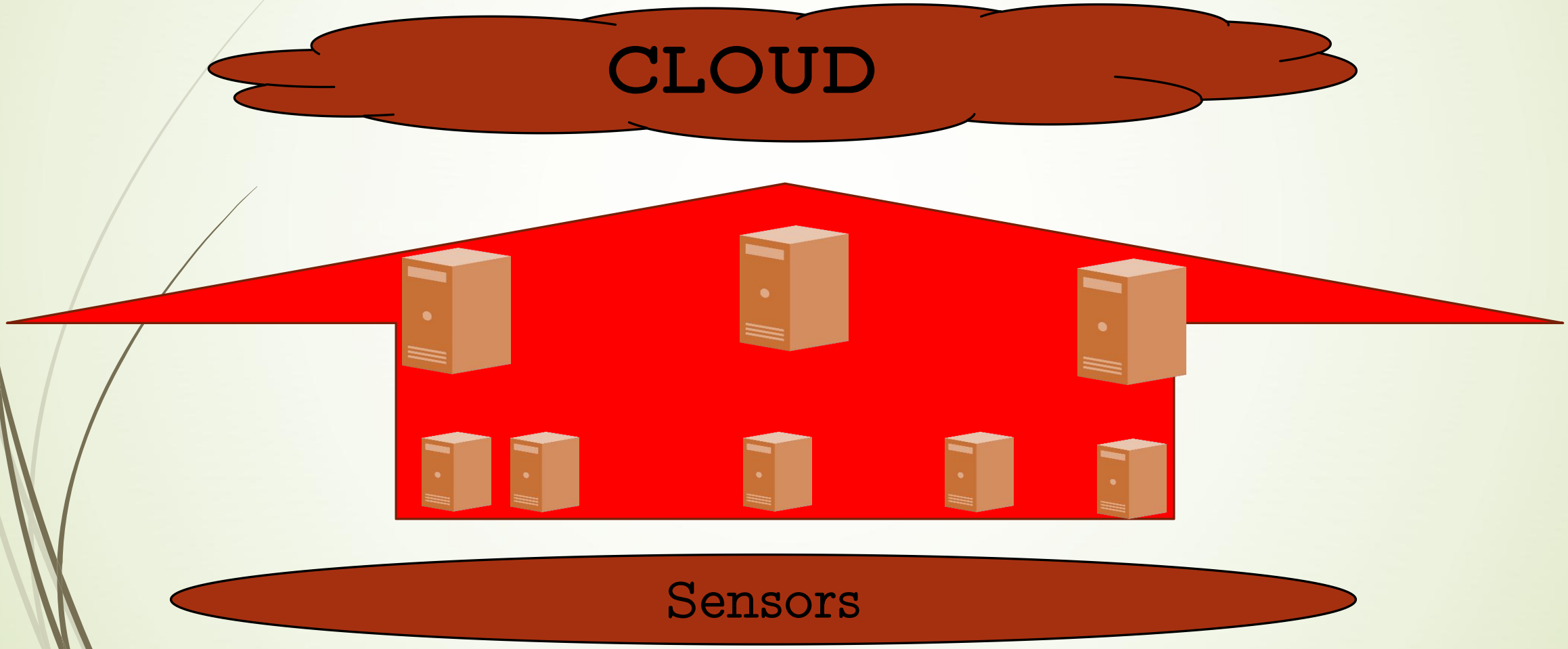
Idea:

- Data moves from devices to cloud
- Cloud stores / processes / exposes data

Questions?

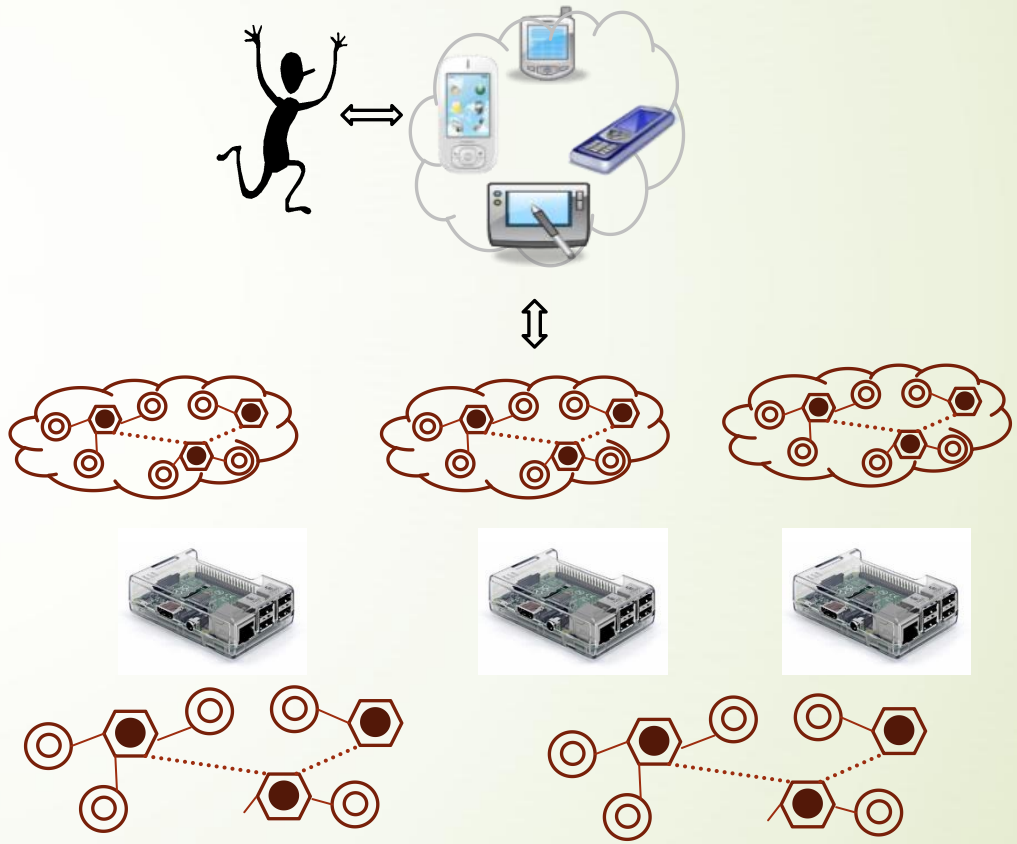
- How to upload all the data

Edge / Fog Computing Model



Linking Device Clouds with IoT Fog-Centric

- Fog computing
  - Move computing to edge
  - Distribute processing
  - Minimize traffic



Possible IoT Protocols

Data-Centric

- DDS (OMG)
- P2P publish-subscribe

Message-Centric

- MQTT / MQTT-S
- Message Brokers

Resource-Centric

- CoAP
- Request/Response + Observe

Data-Centric

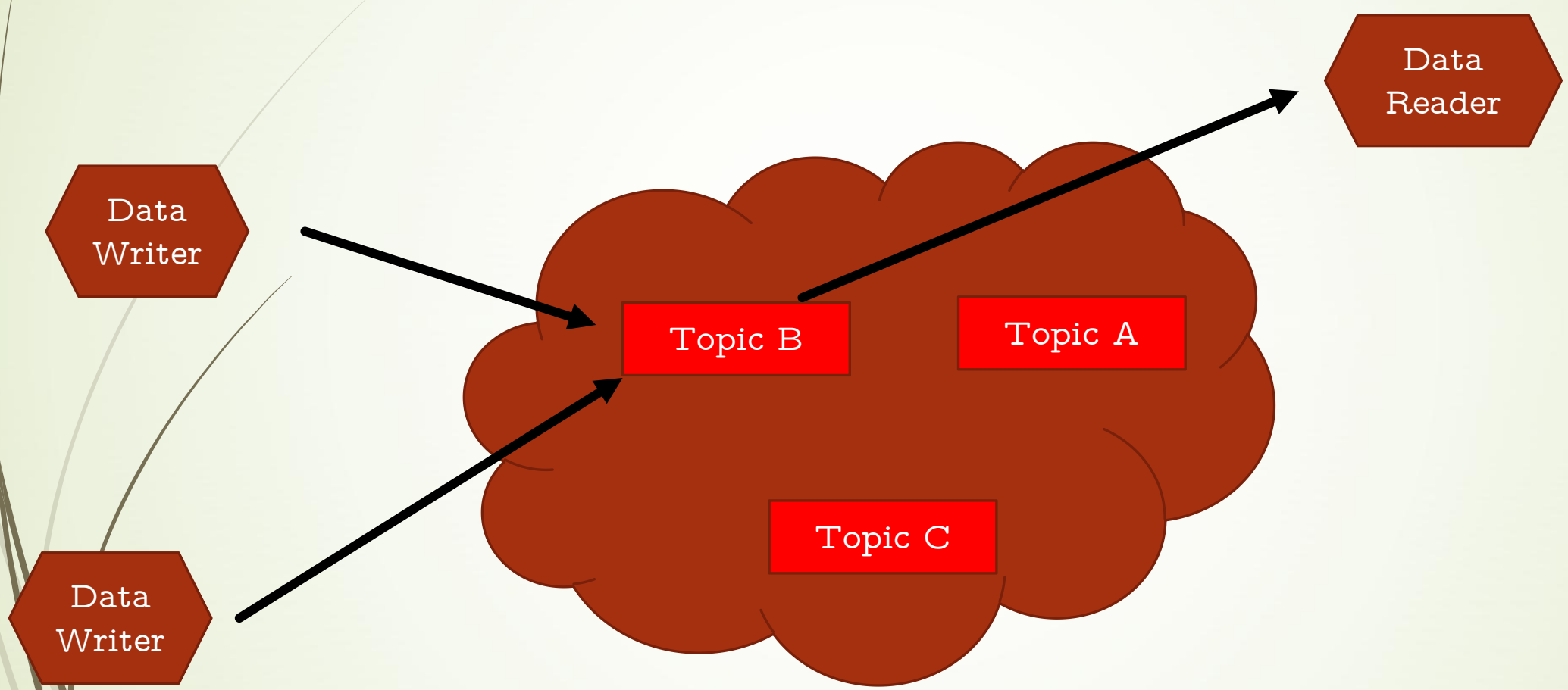
Data-Centric

- focus on data (type / structure)

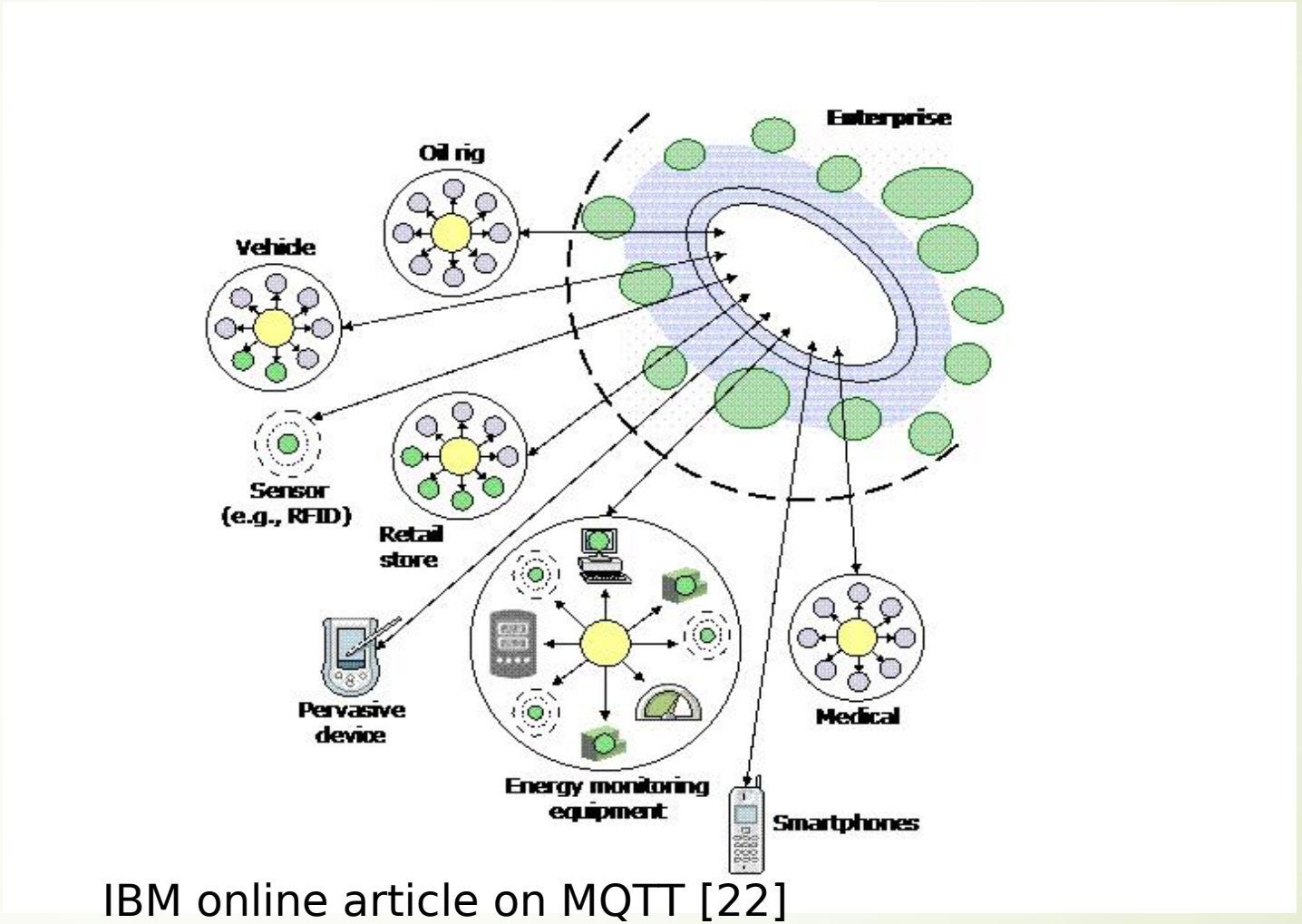
Data Distribution Service (DDS)

- Global Data Space
- Topics (Data types)
- Subscribers / Publishers
- Microseconds

Global Data Space



MQTT



IBM online article on MQTT [22]

CoAP

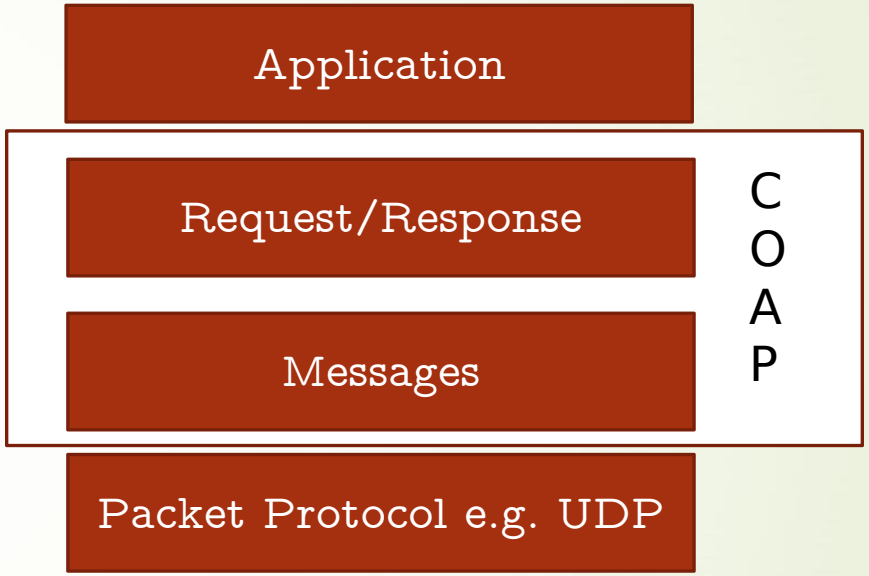
RESTful + Observe option

Supported by Cisco

Runtime discovery of resources

Sharing of computational "costs"

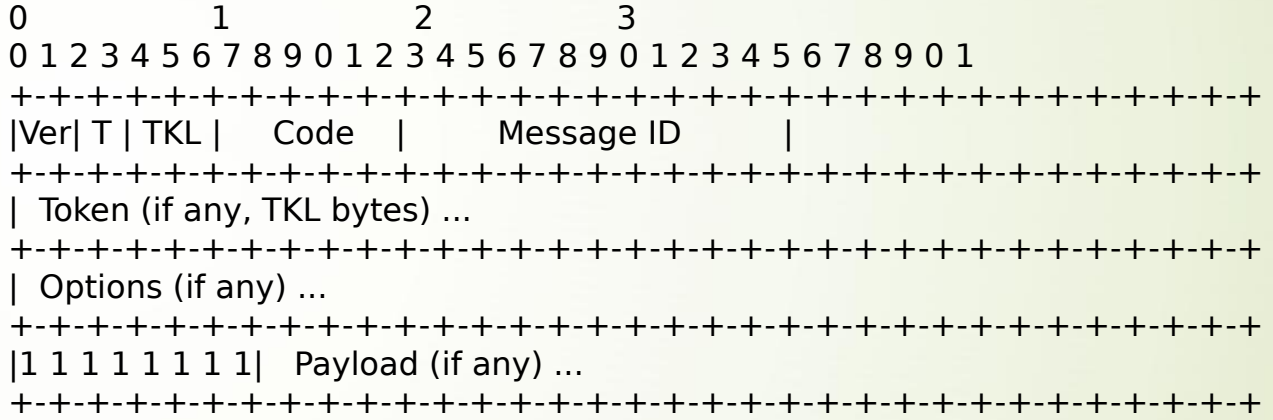
Allows web-like infrastructure




```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ver| T | TKL |     Code    |          Message ID           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Token (if any, TKL bytes) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Options (if any) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|1 1 1 1 1 1 1 1|   Payload (if any) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

CoAP

- CoAP Version
- Type of Message
  - Non/Confirmable, Acknowledge, Reset
- Token Length
- Code
  - 3 bit class + 5 bit detail
  - 0.1 = GET
  - 4.03 = forbidden
- Message ID
- Token (match request with response)
- Options / Headers
- Payload



CoAP …

Message must fit in single packet

- Default MTU 1280 bytes
- But differs in different protocols

GET, PUT, POST, DELETE

- OBSERVE

URI

- coap://box1.company.ca/sensor1
- coaps://box1.company.ca/sensor1
  - DTLS -> symmetric, key exchange challanges

Resource Discovery

.well-known/core

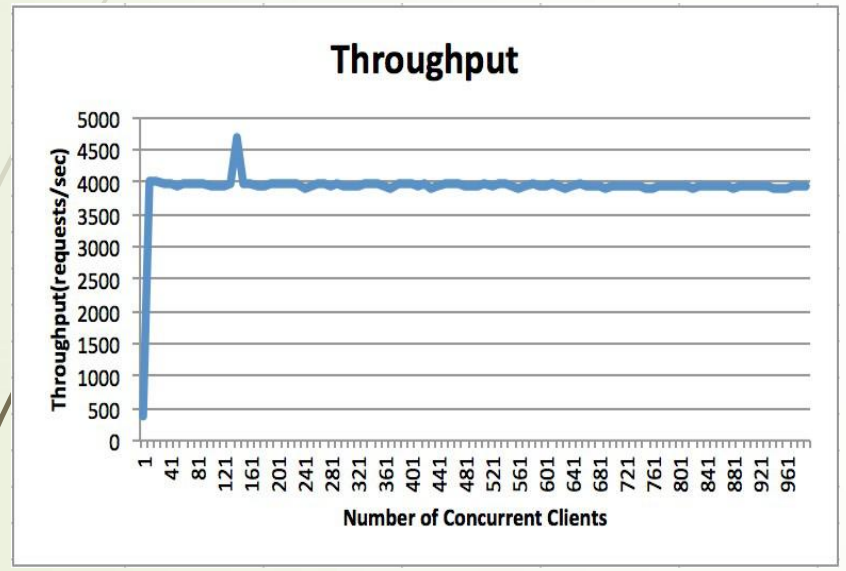
- GET to read
  - GET /.well-known/core?rt=temperature-c
- POST to add new resource

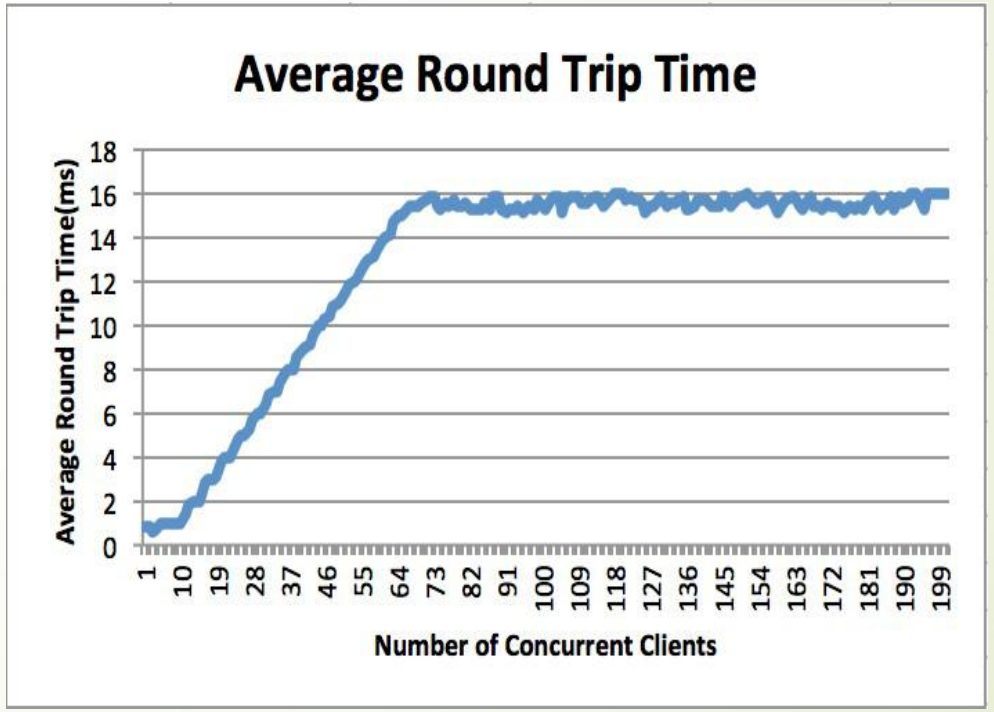
CoRE Link Format

- Defines how to describe resources

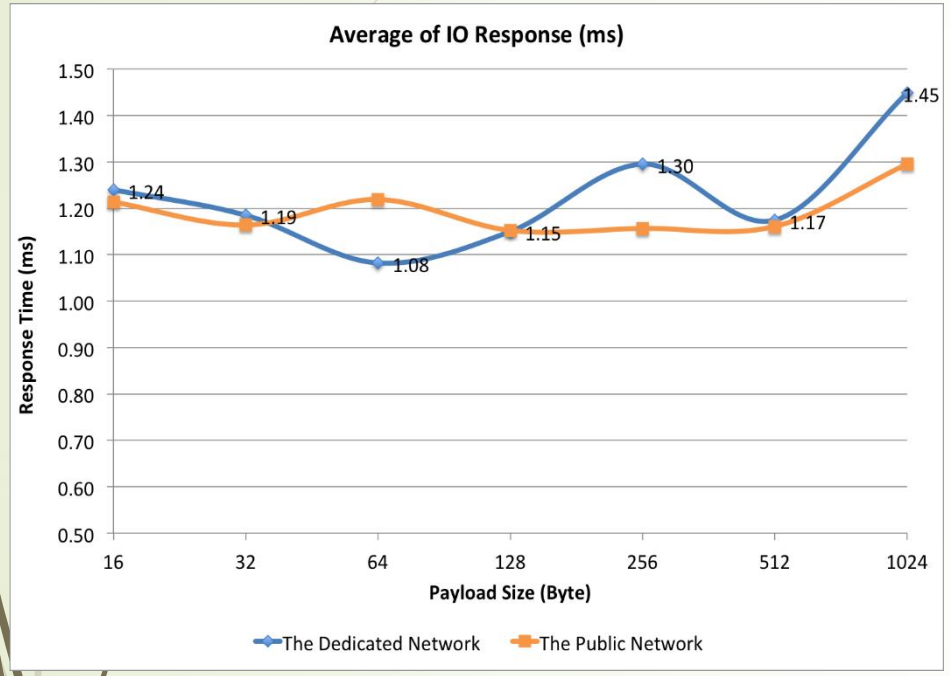
CoAP server

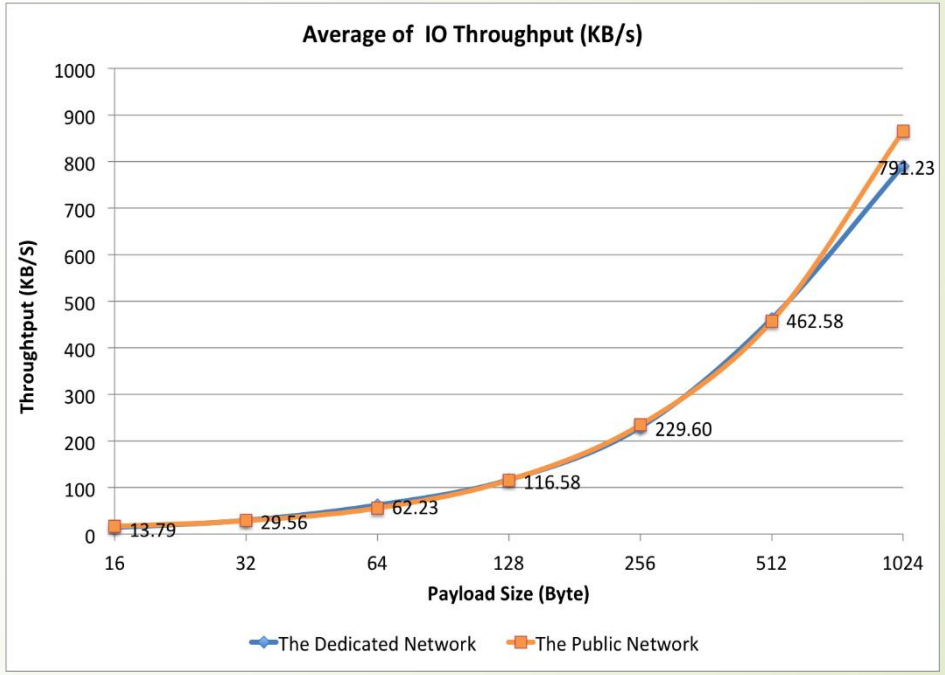
Erlang & Golang servers





CoAP Performance over WIFI





Looking at IoT

Internet of Things

1. Read (cloud-hosted) data streams

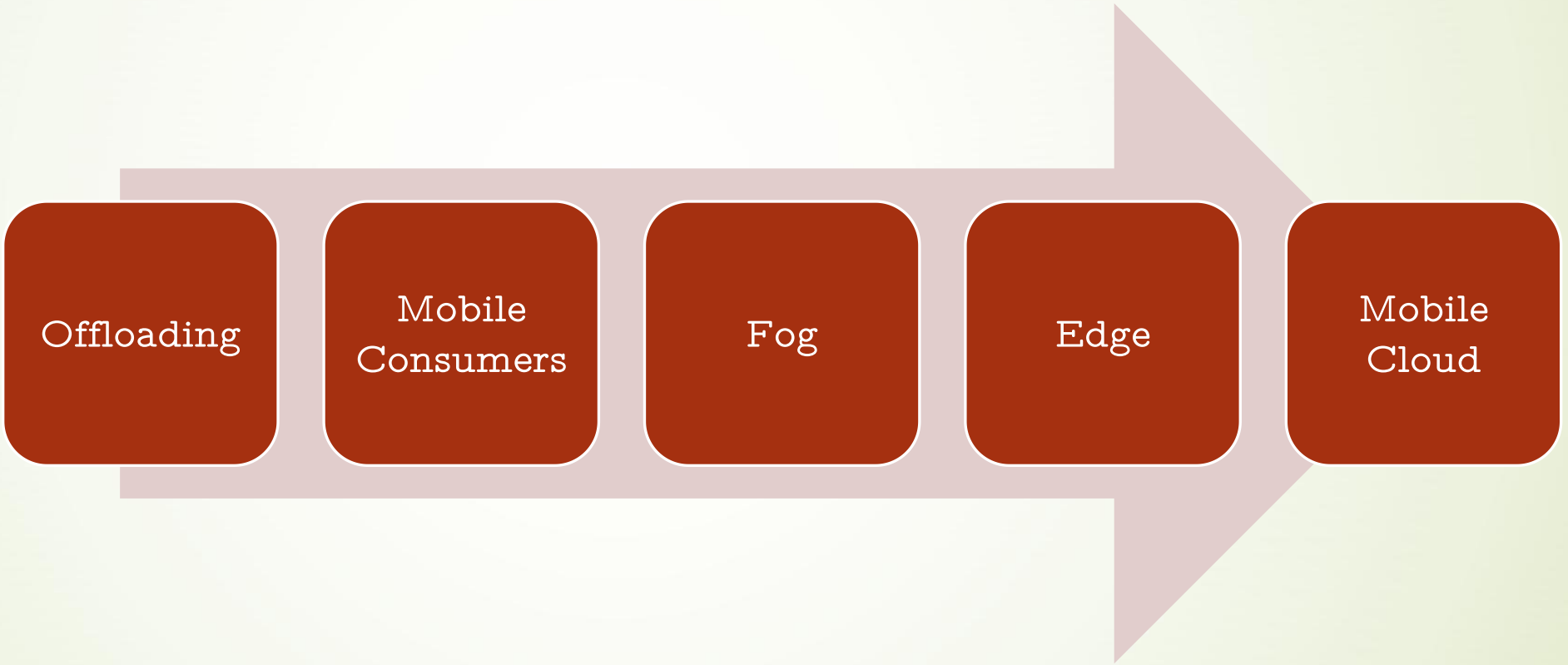
2. Allow 3rd party views on data

   Ecosystem

3. R/W settings of devices

   Access control

Moving away from the cloud



Issues

Access control (e.g. ABAC)

- Who can do reads
- Who can do writes
- Audits

Collaboration

- Integration with 3rd party apps and system

Eco-System

- Continuous development od SW & solutions

Questions

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