

A New Approach to Data Center Infrastructure Monitoring and Management (DCIMM)

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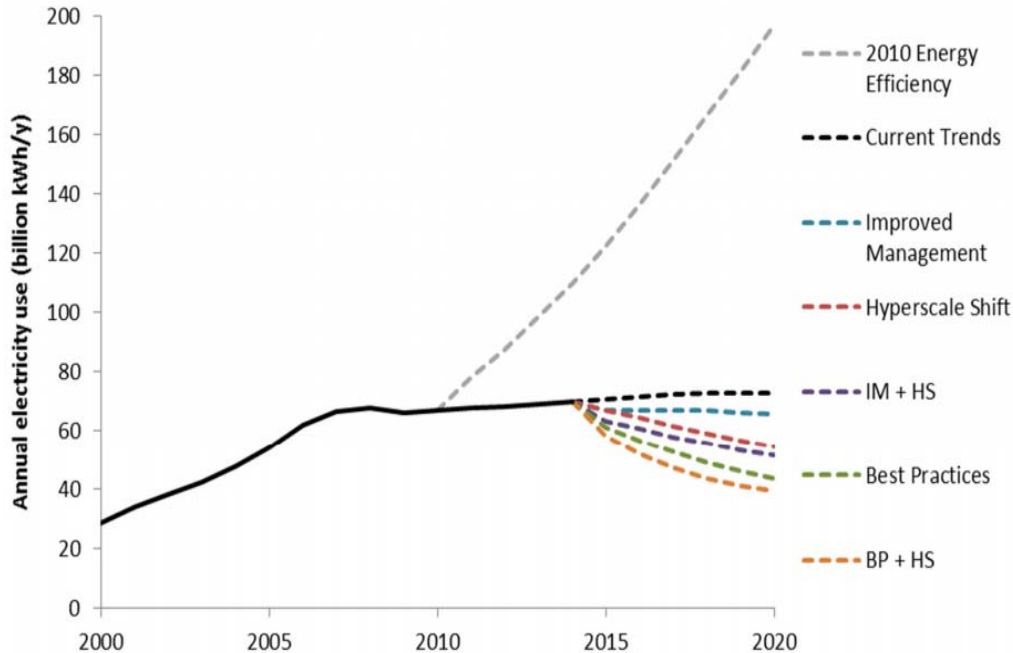
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Data Centers



Ernest Orlando Lawrence Berkeley National Laboratory
"United States Data Center Energy Usage Report", June 2016

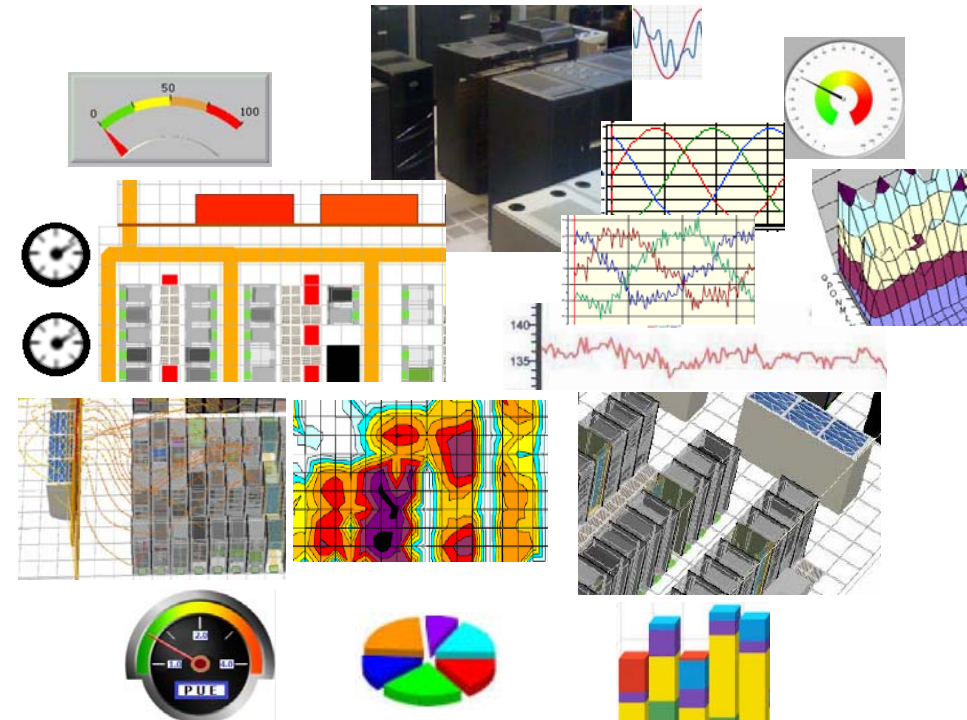
- Energy intensive
- IT equipment $\sim 1000 \text{ W/m}^2$
- U.S. $\sim 3,000,000$ Data Centers
- $\sim 1.8\%$ of total electricity consumption
- 2020: ~ 73 billion kWh
- Downtime $\sim \$ 9,000 / \text{min}$

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Data Center Infrastructure Management

- Monitor, control & management
- Availability, reliability and continuity
- Energy, capacity and performance
- Downtime and TCO
- Predictive behavior
- Facility expansion or relocation



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Standards

ANSI / BICSI 002-2014

Data Center Design and Implementation Best Practices

13 Data Center Management and Building Systems

13.1 Data Center Infrastructure Management

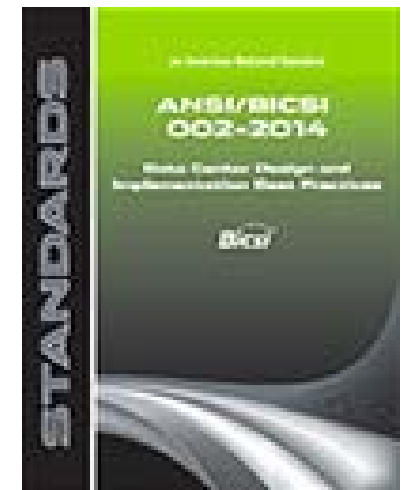
Introduction

Components

Communication Protocols, Media and Hardware

Reporting

Recommendations and Conclusion



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Standards

ISO/ IEC 18598 : 2016

Information technology - Automated infrastructure management (AIM) systems - Requirements, data exchange and applications

- 6.3 Extrinsic benefits of AIM when linked with other business information and network management systems
 - 6.3.1 General
 - 6.3.2 IT-related systems
 - 6.3.3 Building management systems
 - 6.3.4 Data centre infrastructure management (DCIM)
 - 6.3.5 Configuration management database (CMDB) applications

AIM systems:
manage structured
cabling systems.

U.S. Legislation (Federal DCs)

The Energy Efficiency Improvement Act of 2014 (H.R. 2126)

> energy efficiency
Develop best practices

Data Center Optimization Initiative (2016)

By 2018: < Power usage effectiveness
Automated DCIM tools

Energy Efficient Government Technology Act (H.R. 306)

Energy efficient technology
Optimization asset usage
Develop new metrics

January 2017
passed by the House

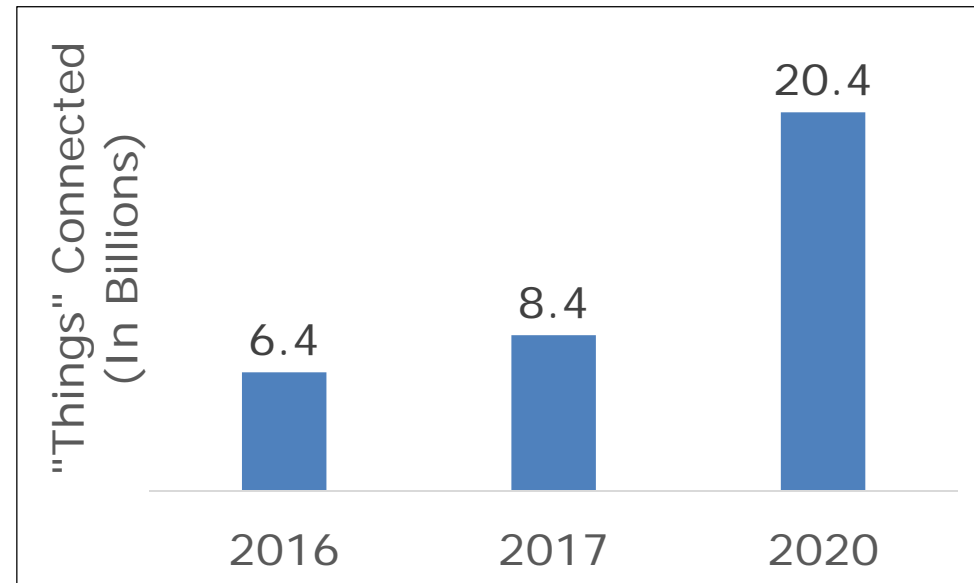
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Internet of Things

- Interconnecting physical and virtual "things"
- Based on interoperable information and communication technologies

Recommendation ITU-T Y.2060, 2012



Gartner

<http://www.gartner.com/newsroom/id/3598917>

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Challenges

Solutions specifically designed for Data Centers

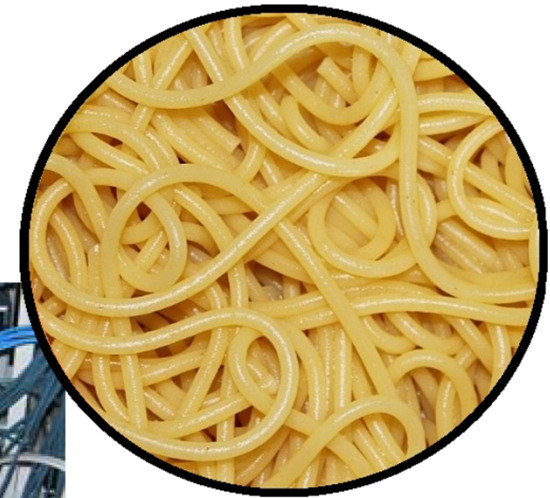
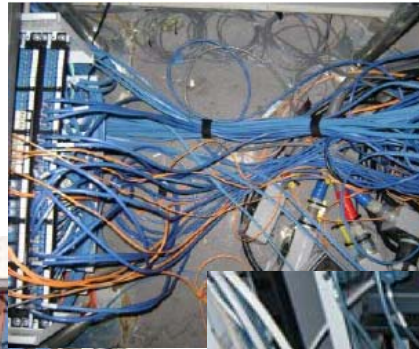
Lack of adequate instrumentation

Real-time data collection is not a trivial task

Right data vs. Collecting more data



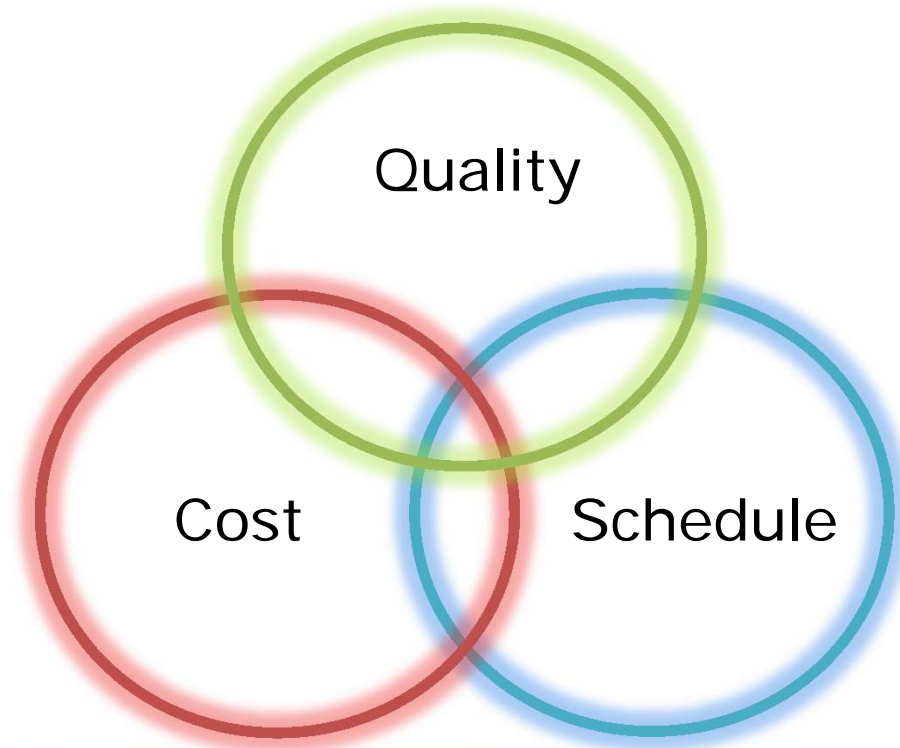
Cabling Challenges



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Project Management

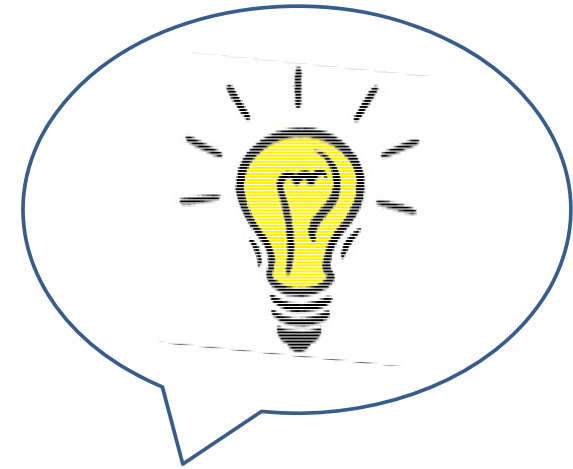


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Challenges



New approaches for
real-time data collection



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What can we find in a Data Center ?

Power Delivery

UPS

Switchgear

Electrical panel

Generator

PDU

RPP

Power Consumption

IT equipment

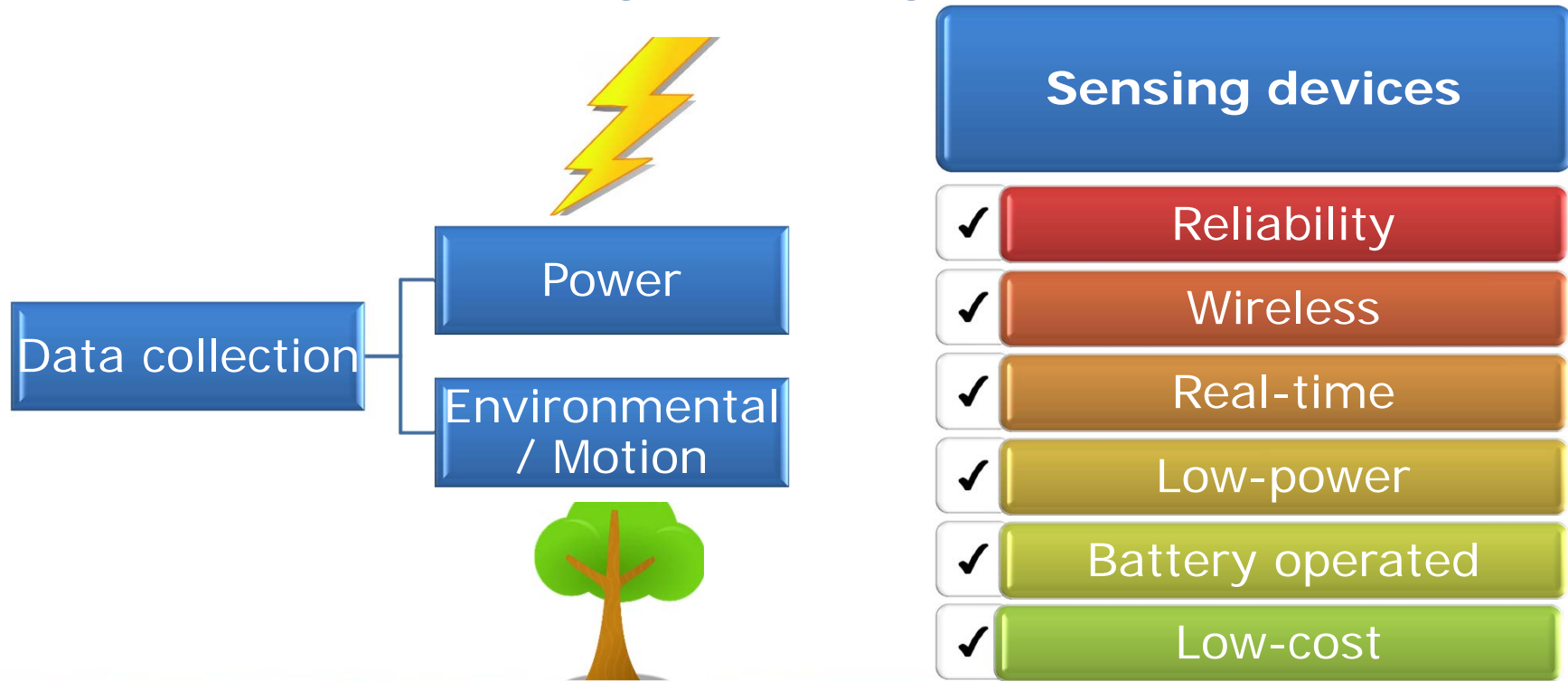
HVAC

Lighting

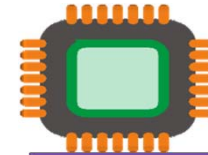
Fire system

Automation

Concept of Operations



Measurements



Power

- Non-invasive methods
- Real-time data: Communication interfaces (e.g. SNMP over TCP/IP)

Environmental

- Real-time data
- Sensors: Temperature, Humidity, Airflow, Water, Security, Vibration, Differential air pressure, Light, Fire systems ...

Processor

- Directly access measurements
- Comparison of measurements to help decision-making
- Critical task interference ?

Processor Measurements

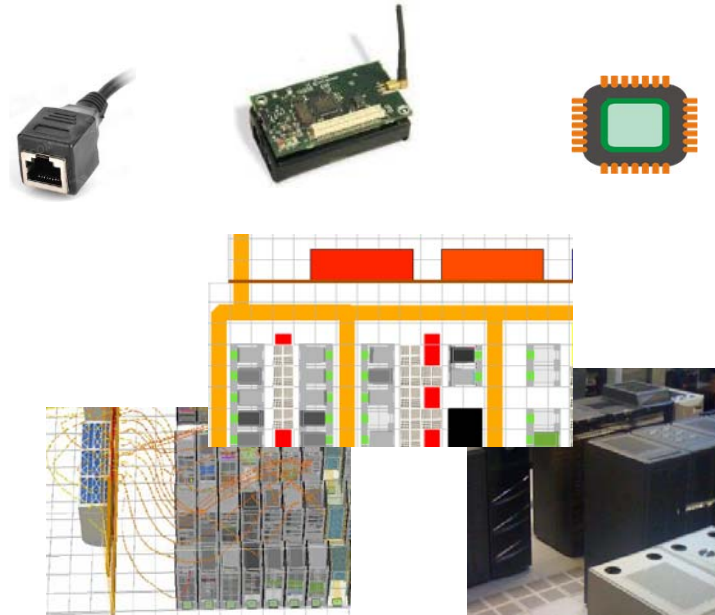


- Air inlet temperature
- Airflow
- Outlet temperature
- Power utilization
- CPU utilization
- Memory utilization
- I/O utilization

*Maybe NOT available
for all IT equipment*

Data Collection and Transmission

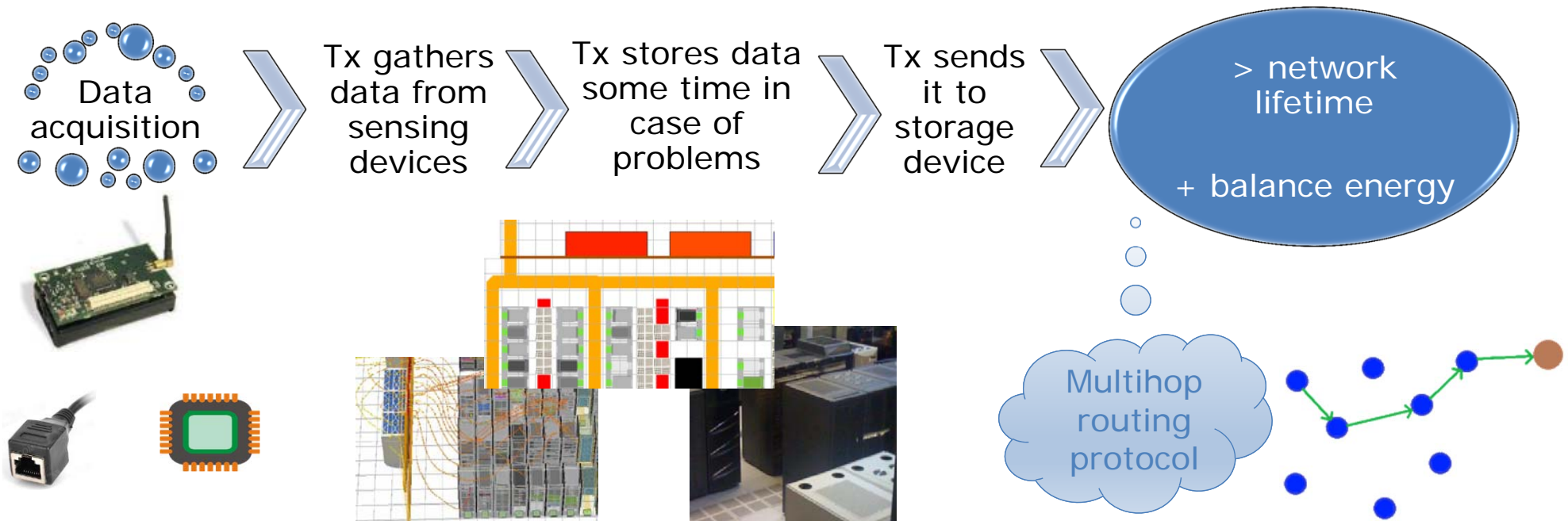
- Device location
- Relocation
- Failure diagnostics
- New devices
- Redundancy



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Data Collection and Transmission



Redundancy

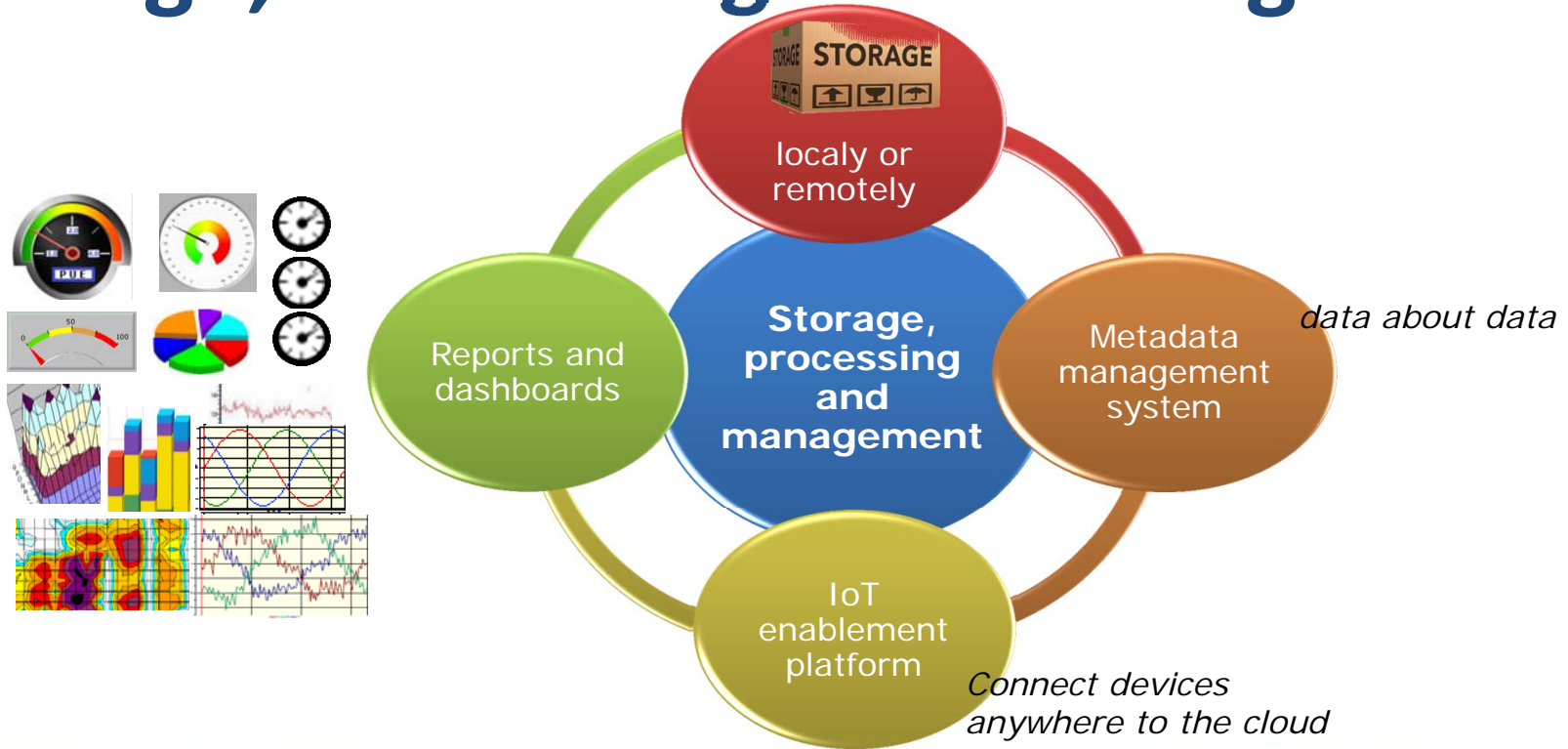
Why? Sensitive data loss

How? Decision based on Data Center reliability and redundancy level

$N+1$, $2N$, $2N+1$...



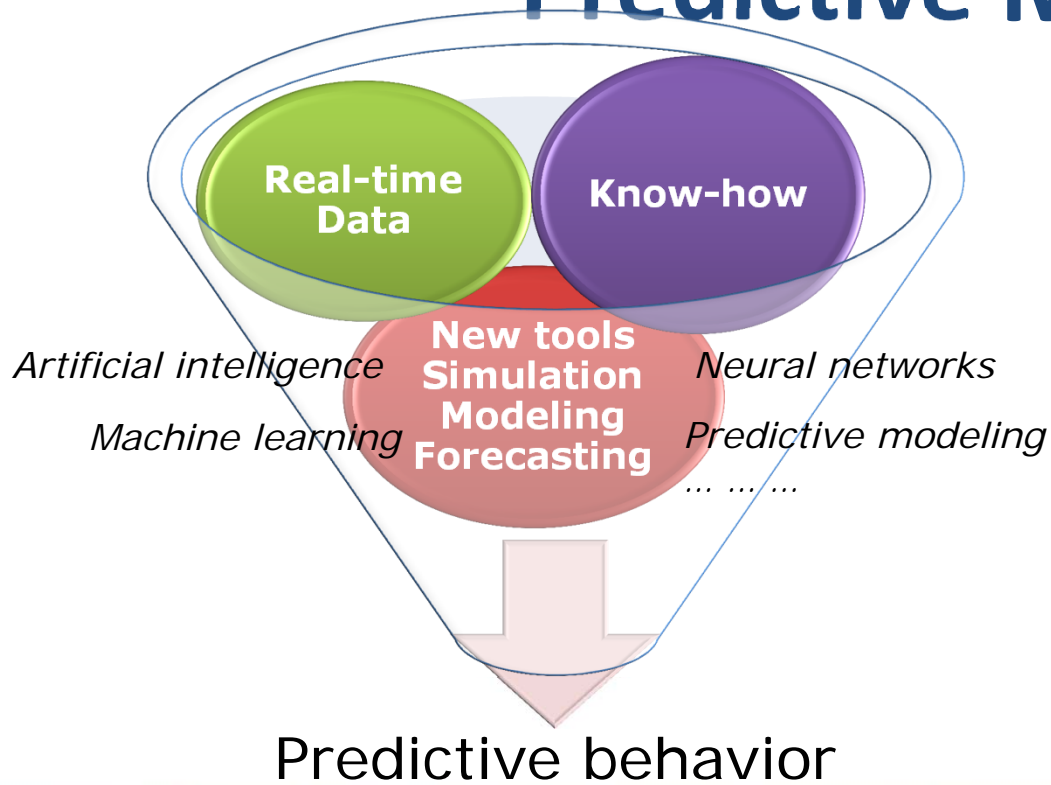
Storage, Processing and Management



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Predictive Modeling



Summary

Rapid deployment of a reliable real-time monitoring system

Battery operated, low-power wireless sensing devices

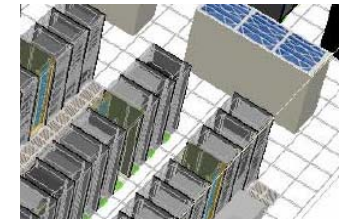
+ data retrieved from equipment



= non-invasive and non-interruptive data collection

Summary

DCIMM must include end-to-end resource management
(IT equipment + supporting infrastructure)



Opportunities for transferring data, control power and
environmental parameters.

Thank you.

Reference:

- M. Levy and J. O. Hallstrom, "A New Approach to Data Center Infrastructure Monitoring and Management (DCIMM)," *IEEE CCWC 2017. The 7th IEEE Annual Computing and Communication Workshop and Conference*. Las Vegas, NV, 2017. Best paper award.

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