Smart Campus Implementation
based on Internet-by-Design

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“Strategic use of Cloud & DC”

1. Facility on the Net (Cloud)
2. Computers into the Net (Cloud/DC)
3. Eco-System by Design
IoT (Internet of Things)
IP for Everything

IP for Everyone
HVAC  Lights  General Outlets

Vertical Lock-on

HVAC  Lights  General Outlets

Horizontal Cooperation
for “Open-Data”

1. User can **to access and to use** the lawful data, **with the same way**.
2. User can **connect/put the sensor**, that does not harm the network, **with their choice, with the same way**.
3. User can **provide service** using the open-data.
IEEE1888 System Architecture

GW, Storage, APP Binding (Management Plane)

Registry

AAA

TCP/IP Network

HTTP and XML

Virtualization of Input/Output

GW

BACnet

Lonworks

Modbus

ZigBee

Field-Bus

Proprietary Circuits

CSV Files, ...

User Interface

Reporting

Data Analysis

Command Submission

Data Archive

Rendezvous Point for GWs, APPs

APP

APP

APP

Storage

Storage

83x472
IEEE 1888 System Architecture

- User Interface
- Reporting
- Data Analysis
- Command Submission
- Data Archive
- Rendezvous Point for GWs, APPs

- Virtualization of Input/Output
- GW, Storage, APP Binding (Management Plane)
- TCP/IP Network
- HTTP and XML
- Proprietary Circuits
- CSV Files, ...

- Independency of SW players from HW, i.e., SDN
- Data Centric for
  1. Transparency
  2. BigData

- Integration and Interoperability via GW for legacy and {new} unique systems
# Energy Saving at The University of Tokyo in Summer of 2011

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<tr>
<td><strong>Major 5 campus</strong></td>
<td>66 MW ($60M/yr)</td>
<td>69% (△31%)</td>
<td>75%-78% (22%-25%)</td>
<td>less than 1 month</td>
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<tr>
<td><strong>Eng. No2 Bldg.</strong></td>
<td>1 MW ($1M/yr)</td>
<td>56% (△44%)</td>
<td>69% (△31%)</td>
<td>2 yrs</td>
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【Contributions】
1. Multi-Vender for sustainability
2. Global Standards for procurement
System overview Eng.No.2 Building in Hongo Campus, Tokyo, Japan

Legacy system + common I/F gateway
System overview Eng.No.2 Building in Hongo Campus, Tokyo, Japan

Data Integration among legacy sub-systems

Visualization of data

Action and Control

Legacy system + common I/F gateway

Additional system
Smart Meter

With Smart Phone

Smart Kiosk

Smart Tap

Receiver

Smart Tap

Smart Lights

Smart HVAC

SmartTap
Tokyo Institute of Technology, Green Hills, No.1 Bldg

HQ, Otsuka Corp.

Chiba Univ.
Agriculture plant

Hitachi Info & Tele Eng Ltd.
Nakai Development Center

SEIKO Solutions
Factory in Thailand

✓ R&D campus
✓ Office
✓ Factory
✓ Agriculture
✓ CEMS (City)
“Strategic use of Cloud & DC”

1. Facility on the Net (Cloud)
2. Computers into the Net (Cloud/DC)
3. Eco-System by Design
Strategic Energy Saving in Tokyo?

1. Move and accommodate servers in the offices into iDC, hosting service, will lead to 15% energy saving.

2. Vitalize the servers and integrate into a single physical machine, i.e., cloud computing, will lead to 40% energy saving.

CO₂ Emission

-15% with legacy hosting

-40% with cloud hosting
Strategic Energy Saving in Tokyo?

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Energy “Consumer” ↓

to “Saving”, i.e., “Nega-watt” by Data Center
What happened on Tokyo Local Government officer?

1. Initial (Spring 2008)
   i. **“Hate”** Data Center, because of huge power consumption and continuous increase.

2. Beginning 2010
   i. Data Center is **”good”** for reduce the power consumption

3. Now
   i. Include the **”exception”** for iDC into the **“regulation”** on the CO₂ carbon footprint reduction
   ii. **”Promoting”** to use iDC and cloud platform
Best Current Practice for Commercial Building

1. Facility management control by IEEE1888
2. Servers go to Data Center = No server room in the bldg
“Strategic use of Cloud & DC”

1. Facility on the Net (Cloud)
2. Computers into the Net (Cloud/DC)
3. Eco-System by Design
Anti-air-polution in 1960s

• Real Objective & Goal
  Large and high quality outputs (== TQC)

• Improvement of Environment
  It was a “gift” (== by-product)
【Cost-saving & QoE】
1. Initial cost for computer room
2. During use of office
3. Move out cost for restoration

【BCP】
a. Protection of Intellectual property
b. Remote office capability for handicapped employees or for female with kids and seniors
New Implication of Data Center?

1. Could change from consumer to supplier
   - Possibility of DC power supply
2. 72 hour operation, after electric black-out
3. Power-generator function, including Hydrogen and heat.

- Critical Infrastructure for IT/ICT
- De-centralized energy source
- {short-term} “energy security”
東京23区の清掃工場一覧

清掃工場施設一覧

<Co-Location>
✓ Power Generator
✓ H₂ Generator (for FCV)
✓ Hospital
✓ Senior Apartment
✓ Data Center
✓ Disaster evacuation site
“Green” Eco System

TQC → Internet By Design → BCP
“Green” Eco System

Energy Save

Internet By Design

TQC

Innovation

BCP

Profitability
Internet by Design

1. Global and unique network
2. Provision of “Alternatives”
3. Believe in “Running code”
4. Best effort service
5. Transparency and End-to-End
6. Social System
7. Autonomous System
Building Automation WG in 2003 at Collaboration with Tokyo Gov. since 2004
Established FNIC in 2006 (Facility Network Interoperability)

In 2008 Beijing Olympic
In 2008 China-Japan Green IT Project funded by MIC in 2009

IIT Hyderabad w/ IITH & IMD
FIAP in 2009 (Live E! architecture)

Global Standardization (cross domain)

Since 2005 (7th at Kyoto)

Smart Disaster Mitigation

Smart Energy Management

KU+KUS with MIC+JGN2 in 2005
DUMBO2006 with AIT in 2006

Since 2005

KU+KUS with MIC+JGN2 in 2005

JTC1 SC6 WP7

Established FNIC in 2006 (Facility Network Interoperability)

IEEE 1888 in Feb. 2011