Hyperconnected Cloud for Digital Co-Creation

Shigeru Sasaki
CEO
FUJITSU LABORATORIES LTD.
What is Fujitsu?
Fujitsu’s Business Portfolio

Device Solutions
US$ 5.0 billion

Ubiquitous Solutions
US$ 8.6 billion

Technology Solutions
US$ 27.3 billion

Others
US$560 million

FY2015 Revenue*: US$ 39.4 billion

Note: Consolidated Revenue by Business Segment, Including Intersegment Revenue, US$1=120yen, the approximate closing rate on March 31, 2016. FY 2015 is fiscal year ended March 31, 2016.
International Evaluation of Fujitsu

Fortune World’s Most Admired Companies
“323 companies worldwide, 15 companies in Japan”
“From ICT companies in Japan, Fujitsu was the only one which was selected”
> Selected for 5 consecutive years (2013 - 2017)

Dow Jones Sustainability World Index
Fujitsu selected “Software & Services” Group Leaders:
Industry Group Leaders: 24 companies worldwide
> Selected 17 times in total (1999-2010, 2012-2017)

RobecoSAM Sustainability Award
“Gold: 77 companies, Silver: 72 companies”
Fujitsu received the Gold Class:
“IT services & Internet Software and Services”
Number of Patent Registration Ranking 2016

5th in Japan: 2,570 granted patents

1(8) Panasonic IP... 4546
2(2) Canon KK 4345
3(3) Mitsubishi Electric 4252
4(1) Toyota Motor Corp 3461
5(5) Fujitsu Ltd 2570
6(6) SEIKO EPSON Corp 2449
7(7) Ricoh Co Ltd 2211
8(11) DENSO 2262
9(10) Honda Motor Co Ltd 2186
10(21) JFE Steei Corp 1907

17th in the U.S.: 1,568 granted patents

1(1) IBM 5518
2(2) Samsung Electronics 3665
3(3) Canon KK 2897
4(4) Qualcomm Inc 2835
5(5) Google Inc 2784
6(9) Intel Corp 2428
7(8) LG Electronics Inc 2398
8(10) Microsoft Corp 2288
9(13) TSMC 2181
10(7) Sony Corp 2102
11(11) Apple Inc 2023
12(12) Samsung Display Co Ltd 1954
13(6) Toshiba Corp 1662
14(26) Amazon tech Inc 1647
15(16) Seiko Epson Corp 1646
16(14) General Electric Co 1568
17(19) Fujitsu Ltd 1552
18(20) L M Ericsson 1524
19(24) Ford Global Tech LLC 1417

Source: http://ipforce.jp/Data/index/y/2016 [Ranking based on published unexamined patent application and publication of application in 2016]

Digital Transformation
Digital Business

Digital World

IoT
Analytics
AI (Algorithm)
Robotics

Sense
Understand
Decide
Act

Cloud
Social
Mobile

Digital Business Platform

Physical World
FUJITSU Cloud Service K5

SoE (Big Data, SNS, Mobile, etc.)
Speed / Flexibility / Cutting-Edge Technology

SoR (CRM, ERP, email, etc.)
Quality / Productivity / Connection with Existing Environment

Fujitsu’s Know-How

Fujitsu’s Know-how Development / Operation
Using in-house Systems within the Company Group

Open Technology

OpenStack
Cloud Foundry
With K5 you can

Do incredible things with FUJITSU Cloud Service K5.

FUJITSU Digital Business Platform

MetaArc

Fujitsu’s Know-how
Development / Operation

Using in-house Systems within the Company Group

Fujitsu’s Know-how

Speed / Flexibility / Cutting-Edge Technology

SoE (Big Data, SNS, Mobile etc.)

Quality / Productivity / Connection with Existing Environment

ERP, email etc.)

Productivity / Connection

Human Centric AI

Zinrai
Fujitsu Laboratories: Overview
Fujitsu Labs’ Mission

Driving the Fujitsu Group growth with leading-edge technologies
Fujitsu Labs' Innovation

- **1968** LSI-based computer
  
  *World’s fastest at the time*

- **1974** Ladder-type SAW filter
  
  *World’s smallest high-performance*

- **1992** LSI-based computer
  
  *World’s fastest at the time*

- **1998** Palm vein authentication
  
  *World’s first*

- **1998** High Electron Mobility Transistor
  
  *(HEMT: World’s first)*

- **2003** Single-photon emission from quantum dots
  
  *(World’s first, joint R&D with University of Tokyo)*

- **2005** Petascale computing
  
  *(World’s fastest supercomputer)*

- **2006** 1 Tbps-wavelength division multiplex photonic transmission

- **2006** Digital picture encoding and Transmission system
  
  *(Industry’s first)*

- **2011-2014** Petascale computing
  
  *(World’s fastest supercomputer)*

- **2017** Human Centric Innovation

- **2017** Single-photon emission from quantum dots
  
  *(World’s first, joint R&D with University of Tokyo)*

- **2017** Fujitsu Labs was established
Fujitsu Group is expanding the businesses globally in collaboration with customers.
Technology Value Chain of R&D Themes

Solutions

Systems

Networks

Next-gen Devices

Advanced Materials

Software

5G
Optical Communication
SDN
Operating System
API, OSS
Validation
Compiler

Cloud
Data Centers
Domain-Specific Computers
Approximate Computers
Quantum Computers

Fujitsu’s Business Innovation

Web Services

Big Data

Artificial Intelligence

Security

Media Processing

Environment
Global Activity

- Employees: Approx. 1200 in Japan, Approx. 240 overseas
- Open Innovation: 84 Projects in Japan, 58 Projects in 11 Countries

Continuously generating R&D results that will amaze the world

Quickly deploy R&D results to Proof of Concept and Proof of Business on a global scale

Generating innovations, including new business models that resonate through global markets
Treasure-Trove of Leading-Edge Technologies
To Achieve a Digital Transformation
Challenging the Limitations of ICT
Digital Connections

- Number of connections IPv6: 340 undecillion
  ⇒ World population: Approx. 7.5 billion  Approx. 45 octillion NW connections

Human Centric Innovation
Digital Co-Creation

2017
- New Industrial Revolution

2014
- Human Centric Innovation
- Hyperconnected World

2013
- Fujitsu Technology and Service Vision Launched

2010
- Human Centric Intelligent Society

2008
- Human Centric Network Society

1999
- Everything on the Internet
# Units for Numbers

<table>
<thead>
<tr>
<th>$10^{36}$</th>
<th>undecillion</th>
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<tbody>
<tr>
<td>$10^{33}$</td>
<td>decillion</td>
</tr>
<tr>
<td>$10^{30}$</td>
<td>nonillion</td>
</tr>
<tr>
<td>$10^{27}$</td>
<td>octillion</td>
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<tr>
<td>$10^{24}$</td>
<td>septillion</td>
</tr>
<tr>
<td>$10^{21}$</td>
<td>sextillion</td>
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<table>
<thead>
<tr>
<th>$10^{18}$</th>
<th>quintillion</th>
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<tbody>
<tr>
<td>$10^{15}$</td>
<td>quadrillion</td>
</tr>
<tr>
<td>$10^{12}$</td>
<td>trillion</td>
</tr>
<tr>
<td>$10^{9}$</td>
<td>billion</td>
</tr>
<tr>
<td>$10^{6}$</td>
<td>million</td>
</tr>
<tr>
<td>$10^{3}$</td>
<td>thousand</td>
</tr>
</tbody>
</table>
Digital Connections

- Number of connections IPv6: 340 undecillion \((340 \times 10^{36})\)
  \[\Rightarrow\] World population: Approx. 7.5 billion  Approx. 45 octillion \((45 \times 10^{27})\)

Human Centric Innovation

Digital Co-Creation

- New Industrial Revolution
- Human Centric Innovation
- Hyperconnected World
- Fujitsu Technology and Service Vision Launched
- Human Centric Intelligent Society
- Human Centric Network Society
- Everything on the Internet

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Trends in the Improvement of Computing Performance

- **CPU / DRAM OS**
- **Multi-Core / GPGPU**
- **3D Package Silicon Photonics**
- **FPGA**
- **Neuromorphic Computing**
- **New Types of Nonvolatile Memory**
- **Approximate Computing**
- **Quantum Computers**
- **Nano-wire**
- **Nano-carbon Transistor**

**CMOS Miniaturization and High Integration**

**Limits of Moore’s Law**

**Application of the hottest technology**

**Social issue solution**

**Dissemination of Internet**

**Low Power • High Performance**

**Enterprise system**

**Year**

1990  2000  2010  2020
Trends in Connection Technology

100 Tbps: Input power limit with the existing optical fiber

- Non-linear optical effect
- Shannon limit
- Optical amplification band width limit

Backbone Networks
- Electric multiple TDM technology
- WDM technology
- Optical amplification technology

Digital coherent optical

Innovative Technologies
- Photonics
- Increases in the number of connections
- Latency

Connectable data amount & Transmission capacity

- Year
- 1990
- 2000
- 2010
- 2020

Wireless
- 200G/400G
- 25G
- 100G

Multi-Cast
- 5G

IoT, Sensor
- Smart-PAN, BAN
- Bluetooth Low Energy
- ZigBee
- Bluetooth
- W-CDMA
- LTE
- PDC
- Analog
- 10G

Fusion

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Trends in Data Volumes and Conversion into Knowledge

- **Data volume - Data used for AI**
  - Expert Systems
  - Data Mining
  - Agent Systems
  - Optimization

- **Databases**
  - RDB
  - NoSQL
  - DWH
  - Column DB
  - Key-Value Store

- **Storage**
  - Disk Array
  - RAID
  - In-memory DB
  - Object-Store
  - Graph DB

- **Unstructured Data**
  - IoT, M2M, SNS
  - Sensor Networks, Web Applications

- **Structured Data**
  - Business Data, Enterprise Databases

- **Data used for AI**
  - Smart Machines
  - Deep Learning
  - Machine Learning

- **Year**
  - 1990
  - 2000
  - 2010
  - 2020

- **Conversion**
  - 40 ZB (Z: 10^{21})
  - ~YB (Y: 10^{24})

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Importance of Security Technology Accompanying the Advance of ICT

- Expansion of Web
- Spread of Mobile Devices
- Cloud/Virtualized Environments
- IoT, AI, Big Data, Blockchain

New ICT Security Issues:
- Varied security solutions
- Cyber-terrorism

Borderless IoT Security

Number of Connections/Cyber attacks

Year

1990  2000  2010  2020

Computer Virus
- Anti-virus
- Spread of network viruses
- Security hole countermeasures
- Personal authentication
- Data confidentiality
- Virus epidemic due to generalization
- Targeted Cyber attack
- Malware detection
- Data confidentiality
- Anti-virus
- Personal authentication
- Cyber-terrorism

Hyperconnected World
Solutions for Global Social Problems

ICT takes important roles for solving difficult problems

- Natural disasters
- Social infrastructure
- Food/ Agriculture
- Healthcare
- Environment/ Energy
- Transportation/ Vehicles
Fujitsu Labs' R&D Vison and Strategy
R&D Vision and Strategy: Hyperconnected Cloud
R&D Vision and Strategy: Hyperconnected Cloud

Service-Oriented Connection

Core/Front Network Fusion
Emerging Technologies Lead to the Digital Future
Issues to be solved

- Social Issues: Traffic jam, Long wait time, Human Behavior Control
- Business Issues: Dynamic Mobility Control, Shortage of Transportation Capacity
Fujitsu Labs’ Vision for Future Computing

- Creating a new computer architecture toward the intelligent computing era
Developed a new computing architecture that can quickly solve combinatorial optimization problems using conventional semiconductors.

Fujitsu Labs’ Vision of AI

Structurization of existing knowledge  Acquisition of unknown knowledge

Discovery science: R&D for learning and creation of knowledge

AI that is highly acceptable to society

Utilize the vast knowledge accumulated by sensing in the real world

Utilize the vast knowledge produced by human beings around the world

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Learning of Graph Data: “Deep Tensor”

- World's first deep learning technology for graph-structured data

Knowledge fusion to assist clinical decisions

Within seconds

36,000 patients' non-clinical data

Comparison result:
Accuracy of health risk check: 80 - 97%

About one hour per patient

Spain: San Carlos Hospital

30 patients' medical histories

5 specialist clinicians (with 18 to 25 year experience)

Healthcare data processing
AI analysis engine

Patient's privacy protection
Anonymization of data/analysis result

Non-clinical data

Patient's medical history

Fujitsu Labs' Vision of IoT and Big Data

- Human Centric IoT + Emerging Data System
Research for Solving Urban Problems

- Co-creation: A*STAR and SMU
- Initial focus on the three Projects below, with further themes to be explored over the course of the partnership

- Dynamic Mobility Management
- Maritime and Port Optimization
- High-speed Large-scale Data Analysis

# Fujitsu Labs' Fundamental Concept of Security

## Authentication/Authorization

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<thead>
<tr>
<th>Guarantee</th>
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<tbody>
<tr>
<td>Personal authentication</td>
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<tr>
<td>Biometric authentication</td>
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<tr>
<td>NFC/Card authentication</td>
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</table>

## Privacy & Data Security

<table>
<thead>
<tr>
<th>Protection</th>
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<tbody>
<tr>
<td>Privacy protection</td>
</tr>
<tr>
<td>Anonymization</td>
</tr>
<tr>
<td>Concealment (Image)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management evaluation</th>
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<tbody>
<tr>
<td>Privacy risk management</td>
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<tr>
<td>Privacy influence evaluation</td>
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</tbody>
</table>

## Protect people

<table>
<thead>
<tr>
<th>Equipment authentication</th>
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<tbody>
<tr>
<td>Device authentication</td>
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<tr>
<td>HW authentication</td>
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</table>

## Protect data

<table>
<thead>
<tr>
<th>Authentication-ID linkage</th>
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</thead>
<tbody>
<tr>
<td>Authentication protocol</td>
</tr>
<tr>
<td>ID linkage</td>
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</tbody>
</table>

## Protect systems

<table>
<thead>
<tr>
<th>Data protection</th>
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</thead>
<tbody>
<tr>
<td>Encryption</td>
</tr>
</tbody>
</table>

- **Borderless IoT Security**
- **Cyber Security**

- Measures against cyberattacks
- Measures against viruses
- Measures against targeted attacks

- Measures against information leakage
- Behavioral characteristics analysis
- Information tracking

- Vulnerability monitoring
- Vulnerability evaluation
- Vulnerability reduction measures

- Anonymization
- Concealment (Image)
- Encryption

- DB protection
- Measures against targeted attacks

- Privacy by Design
- Behavioral characteristics analysis
- Information tracking

- Protection
- Management evaluation

- Cyber Security
Rapid Analysis and Measure of Unknown Attacks using AI

Malware increases over 1 million worldwide day after day!
Fujitsu America Customer Keynote

Kevin Ubert
Vice President, IT, Vitamix