

Fujitsu and the Next Generation Network

Key Technology and Products for Service Providers and Web Companies



Connecting the Transport Network to the Cloud Increases the Value of Both

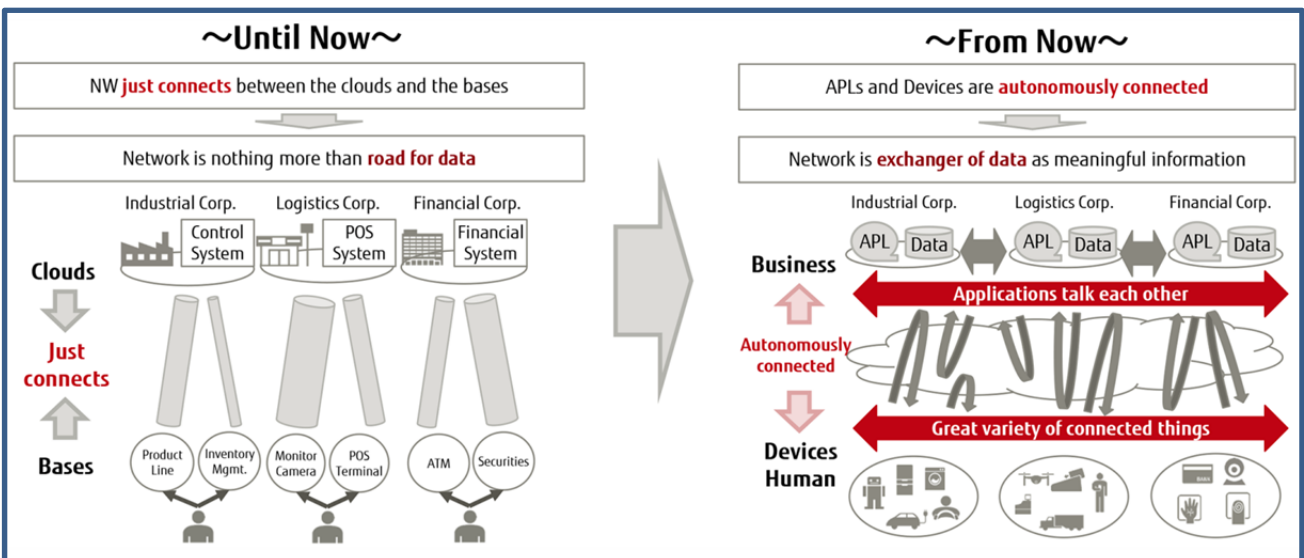
In the past, the value of the transport network was limited to moving bits of data between network elements. Often defined as “big dumb pipes,” those conduits delivered the data that powers the telecommunications infrastructure for the world’s largest economies. As the cloud has gained ubiquity and sophistication, the opportunity to go beyond transport and connect new devices, servers, and applications has emerged.

Enabling Digital Transformation

As the network and cloud computing infrastructure fuse beyond previously recognizable boundaries, Fujitsu believes that network value will ultimately rest in the exchange of meaningful information. To enable that hand-off, consumer and business Information Technology (IT) and Communications Technology (CT) must do more than co-exist; they must unite in a deeply harmonized macrocosm that delivers individualized services on-demand.

Preparing for The Internet of Things

As the Internet of Things matures and 5G adoption expands, a growing number of cloud applications will be designed to hand-off information freely and continuously between numerous end points, from mobile devices to home automation devices, to vehicles, to buildings, to manufacturing, to city infrastructure. This digital transformation requires a resilient, reliable, and affordable network that is capable of contributing to and leveraging artificial intelligence.



The Elements of the Next Generation Network

The next generation network includes three well-known groups that can be combined, rationalized, and reconciled seamlessly.

Business-oriented Networks

Business applications often have unique network requirements for public, private, and on-premise clouds, as well as network elements in the field. For example:

- The manufacturing sector and its supporting devices often require reliability and simultaneous connection capacity.
- The retailing sector needs security, scalability, and geographical coverage.
- The healthcare sector depends on tolerance and broad bandwidth.

The next generation business-oriented network must be capable of establishing a closed network that meets respective industry, or vertical, requirements.

Virtual Resource and Network Functions

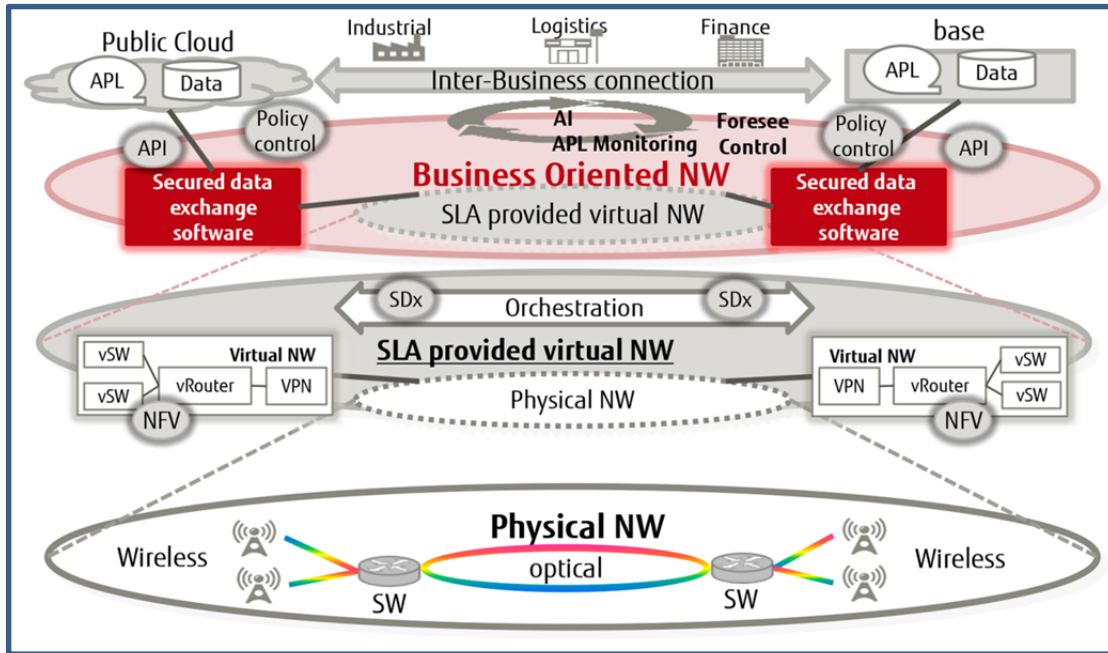
Network functions, servers, and edge compute resources can be virtualized to support automation, orchestration, and optimization.

- Guaranteed Service Level Agreements (SLAs) for network slices
- Optimized resource allocation
- Closed-loop feedback and analysis that uses artificial intelligence to take appropriate action and remediation.

Physical Networks

To provide end-to-end service provisioning, network automation, orchestration, and network slicing, the physical network layer must have the following characteristics:

- High scalability
- Open and standardized control plane interfaces that supports multi-vendor hardware interoperability
- Functionally disaggregated architecture for on-demand hardware additions and upgrades
- Open and standardized APIs for network slicing and network orchestration



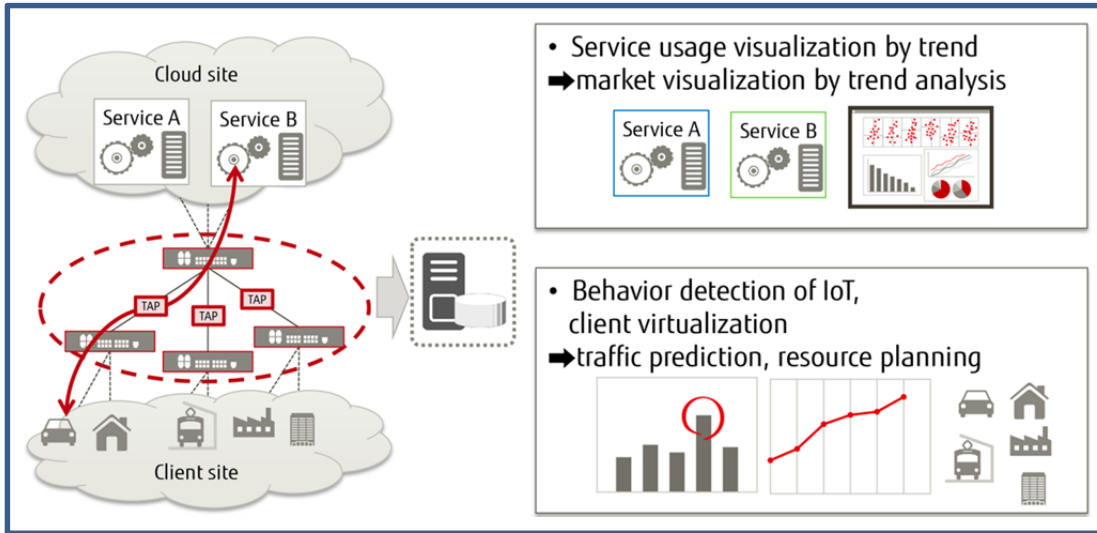
Next Generation Network Services

Next generation network services will be delivered anywhere, over any network, on-demand by network operators who are knowledgeable about the services they are provisioning, not the network or devices that deliver them.

End-to-end Network Visualization Services

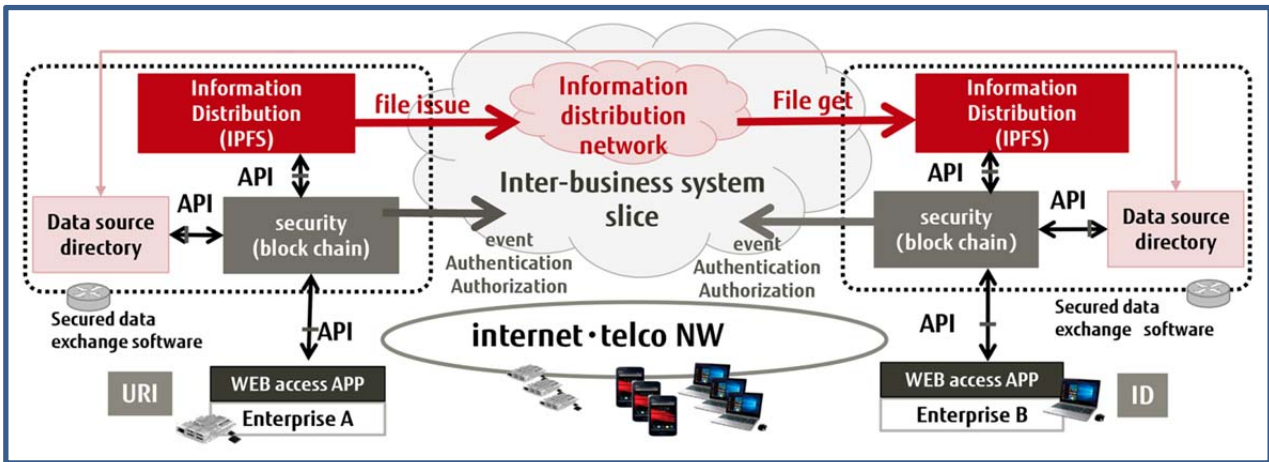
Service providers and Web companies can look forward to a flattened network that gives them a view into network usage, how to optimize usage, and how to monetize previously untapped capacity and dormant resources. End-to-end network visualization capabilities include:

- Market visualization that analyzes the various aspects of service usage
- Dynamic bandwidth control according to service usage and priority settings
- Service delivery trace and network normality proof service
- Improved traffic demand predictions and recommendations for necessary and predictive network upgrades



Virtual Exchange Services (Public and Private)

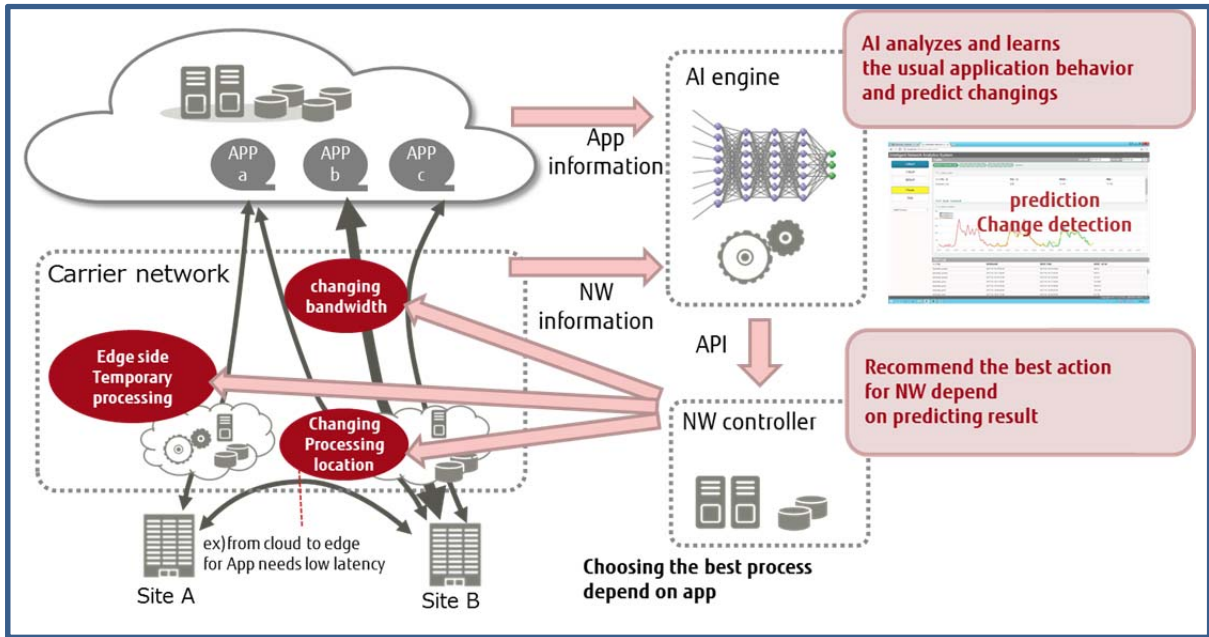
Virtual exchange services allow data services to exchange secure information within a network slice. This type of network slicing service uses Interplanetary File System (IPFS) technology to issue and retrieve files and to connect multiple tasks dynamically, across companies. Using blockchain technology event authentication, and ID access tracing, virtual exchange technology simplifies the creation of a data exchange, with little to no coding required.



Dynamic Resource Optimization Services

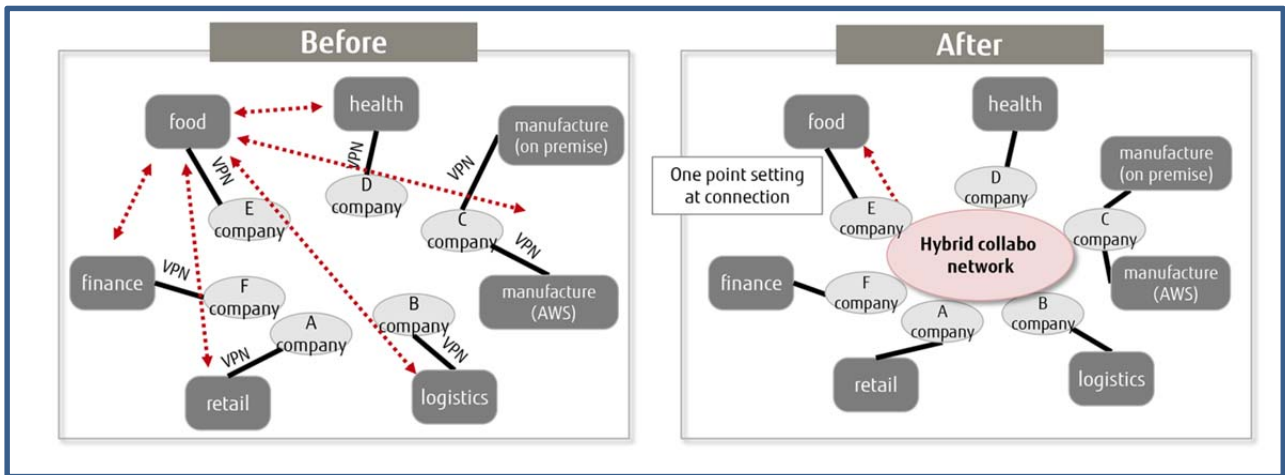
Network Artificial Intelligence can dynamically change resource allocation based on the current conditions in the network, depending on the impact to services delivered. Network monitoring and application behavior analysis can be used to predict and change:

- Bandwidth allocation required by a particular service
- Processing location from cloud to edge
- Processing location from edge to cloud



Virtual Network for Multi-cloud Connections and Services

A virtual network that is connected to multiple clouds can be dynamically provisioned using a combination of application behavior analysis and policy-based SDN control functions, including SLAs, bandwidth adjustment, protection, and router redundancy. This multi-cloud virtual core network enables end-users to add a virtual network to the core network and tear it down when the application no longer needs it.



Fujitsu and Open Source Technology

Service providers and internet content providers require agile deployment of higher network functions, efficient and economical network upgrades, and drastic reductions in operating costs. Open source technology can help with all three requirements; industry watchers believe that the importance of open source will only grow.

Open Networking Organizations



Key Drivers of Open Source

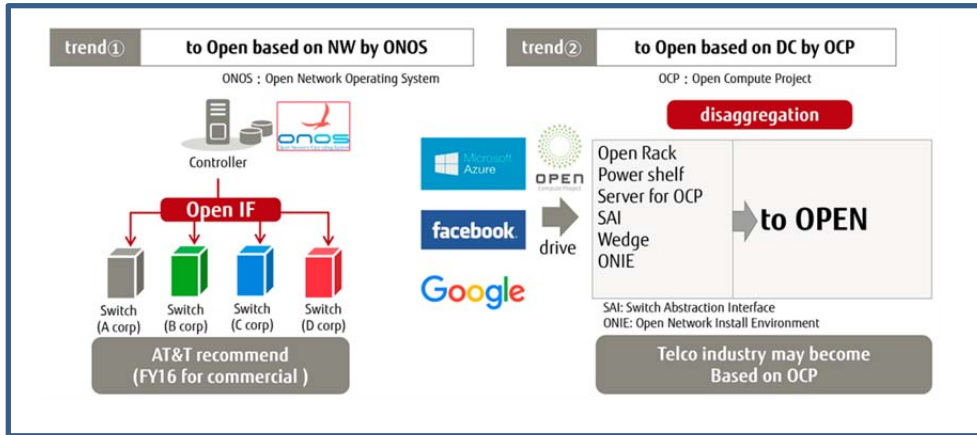
There are two primary drivers of open source technology for service providers: software-defined networking (SDN) and network function virtualization (NFV.) There are more than twenty SDN/NFV private standardization groups and foundations.

Practical applications of these open-source projects include SDN control (ONOS and OpenDaylight), NFV/VNF management and orchestration, as well as Central Office Re-Architected as Datacenter (CORD) related initiatives that are more OSS/BSS centric. While SDN and NFV are all about network automation, the CORD concept provides a blueprint for using commodity access hardware with all the benefits of scale-out expandability in the datacenter. All of this requires multi-vendor connectivity and functional disaggregation of the transport network and is dependent on open APIs for software and hardware.

Another practical application of open source is the Open Compute Project that focuses on using standard data center hardware (server/rack/power module/switch/network) to capture power savings and increase knowledge sharing.

In addition to open source public projects, there are service providers and Web companies who are developing SDN/NFV solutions in house for their competitive advantage. For example:

- Google (B4:SD-WAN, Andromeda: high-speed NFV, Jupitar: DCI, Espresso: SDN for dynamic peering point selection),
- AWS (shifting to serverless computing by integrating micro-services)
- AT&T (Network 3.0 Indigo: data-powered optimization)

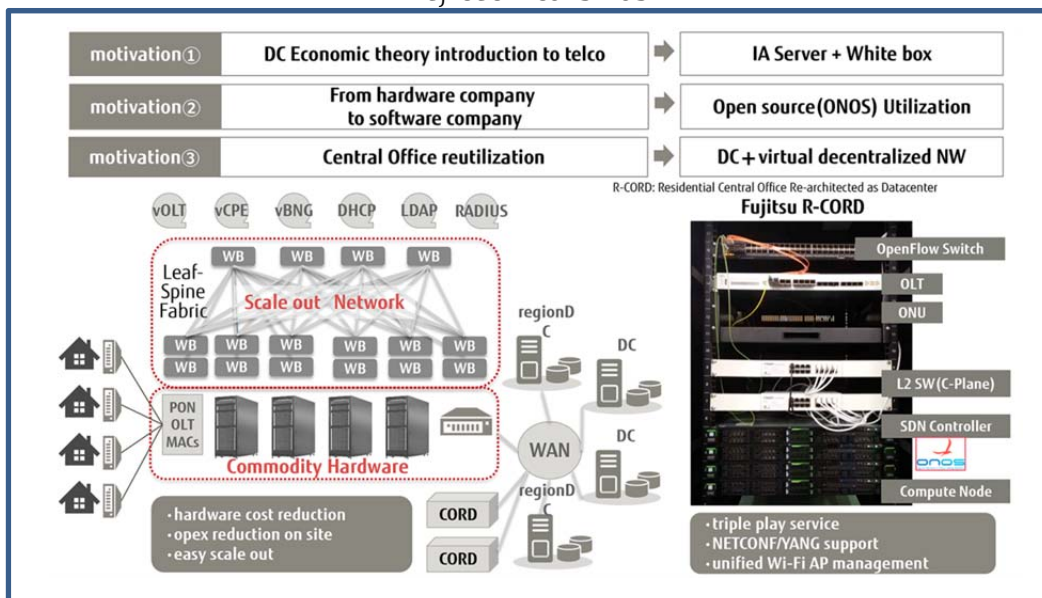


Fujitsu and Open Source Technologies

To be competitive in the new digital business economy, service providers need to dedicate more budget and resources to service innovation. However, multi-layer/multi-vendor network design necessitates that a significant portion of any service provider's budget goes to the network itself. At Fujitsu, we are changing that: we are working with our customers to architect an entirely 'open' new system: disaggregated, flattened, and virtual.

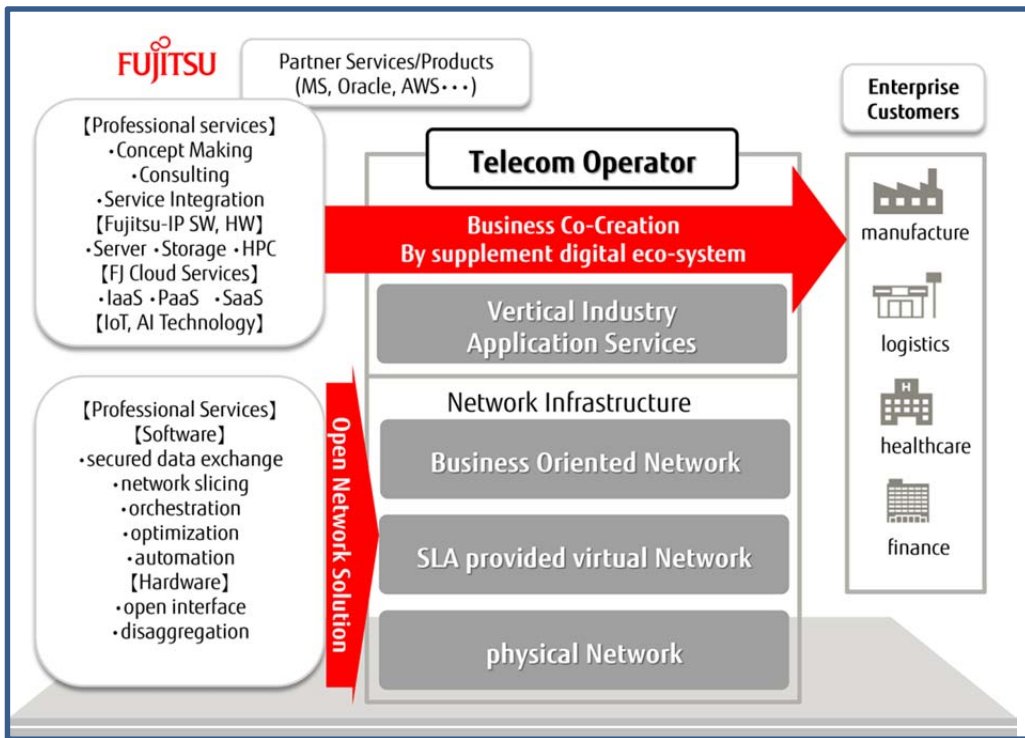
Fujitsu joins more than 40 service providers and ICT vendors as a proud member of ONAP, an open source network service orchestration software. Fujitsu is also an ONOS board member and has been actively contributing to its northbound API designing/coding initiative. Finally, Fujitsu has participated in the residential CORD project of ON.Lab by providing first R-CORD POD, including an IA server, white box switch, OLT, and SDN controller.

Fujitsu's R-CORD POD



Fujitsu's Value Proposition to Service Providers and Web Companies

Fujitsu's value proposition stems from its unique history as both an Information Technology (IT) provider, and a Communications Technology (CT) provider.



Co-creating Business Applications and Services

The Fujitsu eco-system supports our customer's business development with enterprise business knowledge and expertise, as well as best-in-breed technology.

Professional Services: Design, Thinking, & Facilitation

Digital transformation design

Service integration and migration

Digital services/IT systems automation and optimization

Managed services

Business process outsourcing

Software as a Service

Platform as a Service

Infrastructure as a Service

Zinrai

Zinrai Deep Learning APIs

IOT

Application software, middleware, IOT devices

Servers: PRIMERGY series (IA), SPARC M10 (UNIX), Mainframe, HPC

Storage: ETERNUS (SAN, NAS)

Open Network Solutions for Infrastructure

The trends and technology point toward a communications industry that is software centric, with commoditized hardware, driven by content and applications, over a converged IT and telecom network. Open software, standardized interfaces, and standardized data models simplify service creation and allow for full automation. Fujitsu is utilizing these technologies to develop products like 1FINITY and Virtuora that realize the value of open technology.

Professional Services

- Consulting, designing, integration/optimization of open network life-cycle management
- Network operations outsourcing

Hardware and Software Solutions

- Virtuora SDN and NFV software solutions and services
- 1Finity optical network hardware
- Wireless network including mobile front-haul, BTS, and RRH

Fujitsu's Key Transport Network Products: 1FINITY & Virtuora

Fujitsu sees the possibilities of hybrid IT and is creating an innovation platform for our customers. The MetaArc, Virtuora, and 1Finity vision bring together telecom, enterprise, and consumers to create a tightly integrated world.

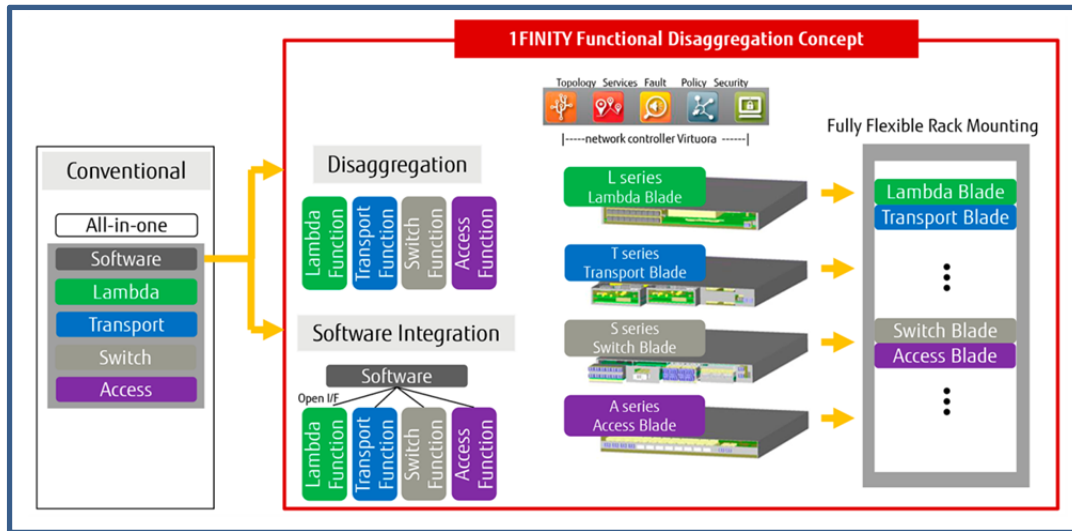
The underlying technology sectors required to make this vision a reality include: SDN, NFV, 5G Mobility, and Programmable ROADM.

All of this is in preparation for The Internet of Things: a deluge of appliances, devices, and equipment that will be networked and communicating all the time.

1FINITY: Functionally Disaggregated Open Networking Blades

The revolutionary Fujitsu 1FINITY platform launches a new category of network equipment, spanning access, packet optical, and more.

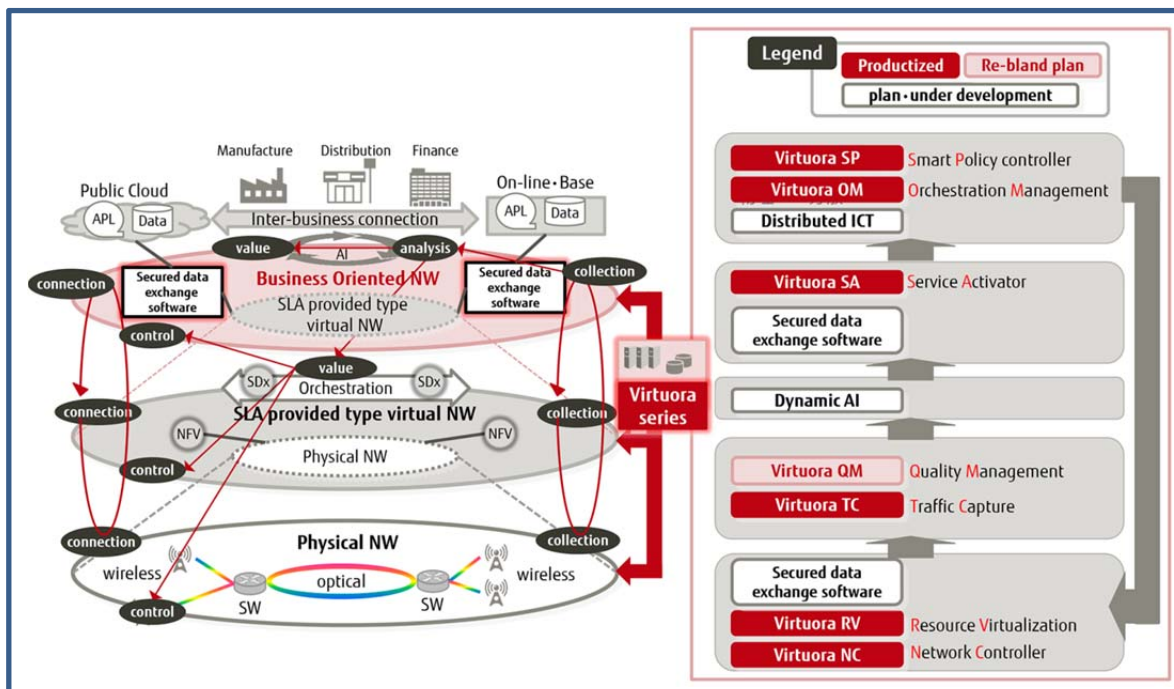
The 1FINITY platform leverages functionally disaggregated hardware components and re-aggregates their functionality through enhanced software. The blade-centric 1FINITY architecture delivers unprecedented flexibility, scalability, and efficiency, providing a pay-as-you grow approach and evergreen technology design, supporting open pluggable optics, open APIs and open-standard protocols.



Virtuora: SDN, NFV, Service Orchestration and Automation

The Virtuora Product Suite is a comprehensive, adaptable, modular suite of software products that enables network architects to build and grow a virtualized, programmable network.

The suite encompasses software-defined network (SDN) control, Network Functions Virtualization (NFV) orchestration and infrastructure management, in addition to network planning, design, management, service fulfillment and performance assurance functions.



Virtuora software solutions enable end-to-end operational automation, service orchestration, and network programmability. The suite provides a foundation for resilient networks that make full use of resources, perform self-repair procedures, and responds to moment-by-moment to customer needs.

Fujitsu's IoT Solution: UBIQUITOUSWARE

IoT is a core enabler for the future hyper connected business and a key driver of digital transformation and business innovation. Hyper connectivity will see the connection of people, information and things in ways that fundamentally change business and society. Fujitsu aims to create an environment to support innovation on a proven IoT platform, powering digital transformation with IoT solutions and services for the transformative enterprise. Our strong portfolio of our own intellectual property is combined with a broad ecosystem of partners. Our IoT solutions range from enterprise wearable devices, middleware software, cloud platforms to standardized business solutions for customer verticals. They leverage both our own, and partners, expertise in analytics and AI.

The advantages of UBIQUITOUSWARE

- Immediate On-site use**
 As a comprehensive solution, from sensors to software, UBIQUITOUSWARE can be used wherever the customer is located.
- Use only what you need**
 UBIQUITOUSWARE can be provided as whole stack including the cloud or as partial incorporation in your products – whatever best meets your needs.
- Highly accurate algorithms**
 Over 68 rich algorithms can be used to detect the behavior of humans and objects in a highly accurate way. More than 49 patents* have been obtained after proving accurate human centered analysis of falls, heat stress and worker wellbeing etc.

*As of July 2017

Solutions

Worker Safety
 Helps to provide safer working environments by remotely monitoring the health and safety of workers and issuing alerts when accidents occur.

Driver Safety
 Monitoring the driver's drowsiness via sensor can be used for driver self management and enable to allow fleet managers to perform route optimization planning.

Location Monitoring
 Identifies the area and switches the indoor/outdoor positioning mode automatically. Delivers various event/alert data together with location.

Remote Support / AR
 The HMD acts as a communication tool between operators and their supervisor delivering support and sharing remote imagery in real time.

Resident Monitoring
 Monitoring and analyzing live sound and movement realize resident's safety without intruding privacy and enable care givers to respond to an abnormal situation.

Fujitsu's AI Solution Zinrai: Deep Learning Technology, Products, and Services

Deep Learning is revolutionary technology that will revolutionize the AI business. Unlike conventional machine learning with human-defined characteristics, Fujitsu's AI solution automatically extracts features from learned data.

Fujitsu's Zinrai deep learning platform provides artificial intelligence for cloud-edge services and on premise systems integration of Fujitsu hardware and software.

Zinrai deep learning

World's fastest learning processing infrastructure

<features>

- GPU [NVIDIA® Tesla® P100] implementation
- Providing both Cloud ver and on-premise ver
- Easily realize edge cooperation *
- Providing time series data learning technology, automatic optimization technology of neural network

Edge

Learned model delivery

←

→

Data collection

Cloud

Parallelization tech

advanced AI tech

Extended OSS framework

Usage support

GPU

Link

On premise

Parallelization tech

advanced AI tech

Extended OSS framework

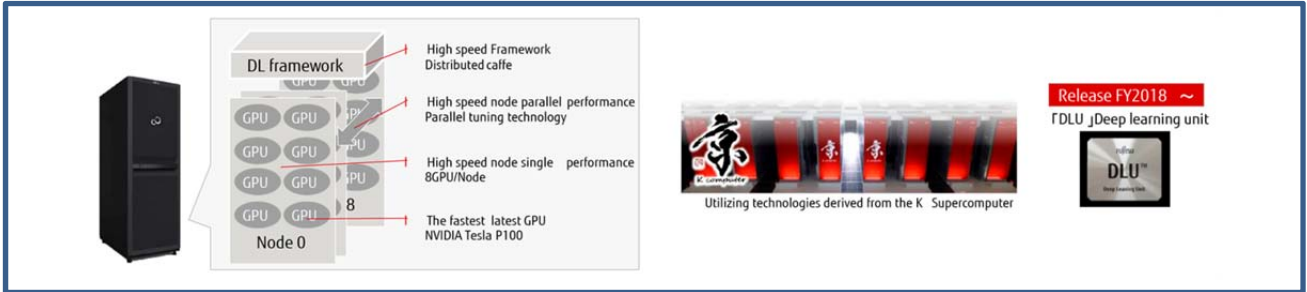
Usage support

GPU

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The Fastest Learning Processing Infrastructure

Fujitsu delivers the world's fastest learning process by NVIDIA's latest GPUs on its servers, followed by Fujitsu's deep learning dedicated CPU (DLU) that aims for hyper scalability and ten times lower power consumption per performance than standard generic GPUs.



Quantum Inspired AI

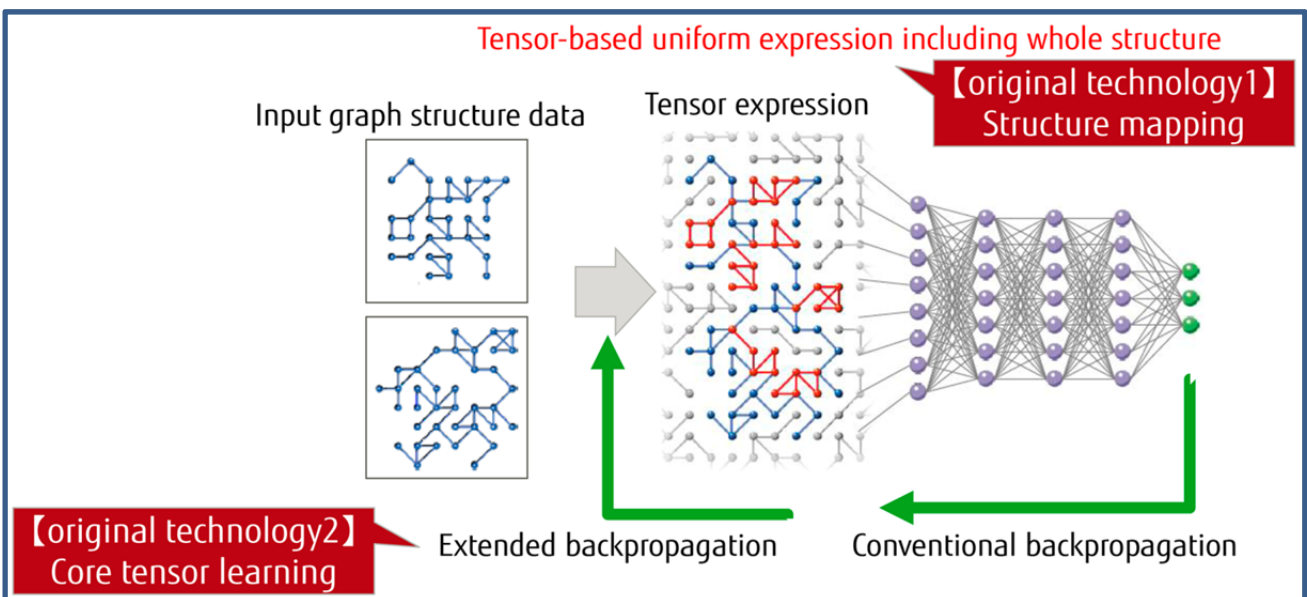
Digital Annealer is a computing architecture that solves combinatorial optimization problems quickly. This architecture is based on existing semiconductor technology that runs quantum computing application software of 1QBit Information Technologies, Inc. Digital Annealer is one of the optional services in Zinrai's deep learning cloud services.

On Premise AI

For customers who prefer to maintain their end-users sensitive personal information at their own premises, Fujitsu offers to integrate AI system on customer premises with its own hardware/software.

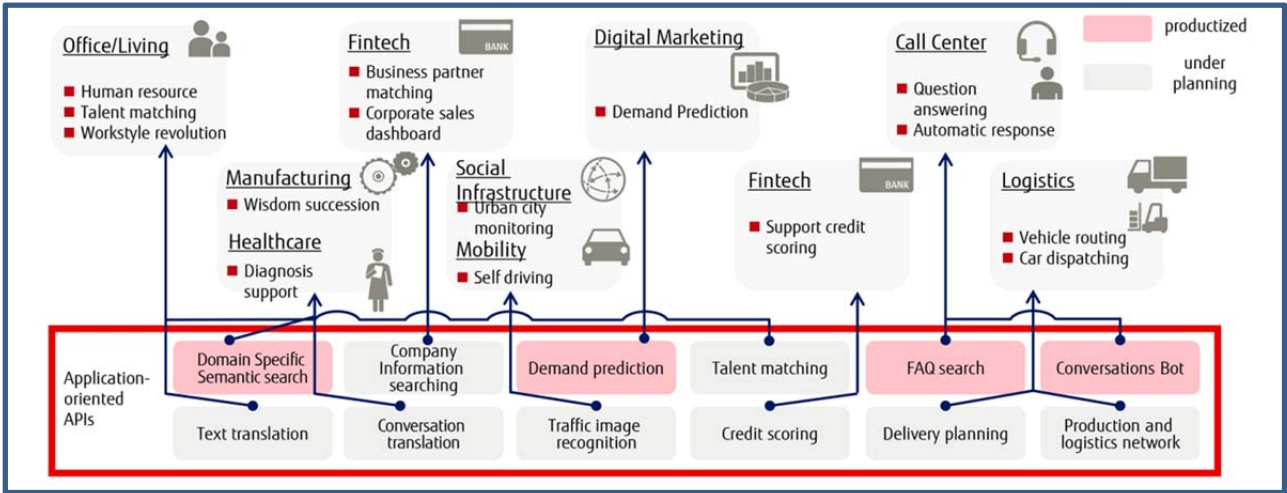
Deep Tensor

The worlds-first technology that identifies characteristics from graph data.



Smart Start

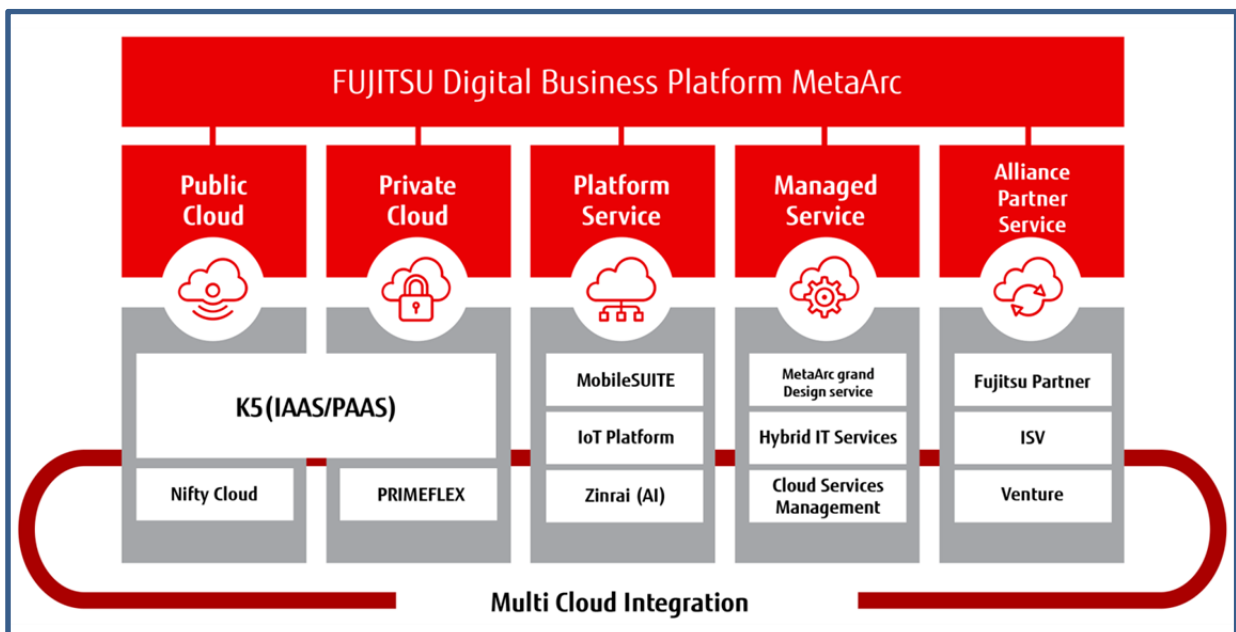
Fujitsu enables AI services “smart start” through its comprehensive menu, which includes supporting a quick collection of suitable training data, learned-model APIs, adjustments of customer’s data learning environment, and designing/integrating edge computing devices for inference processing on the field.



Fujitsu MetaArc: The Digital Business Platform of the Future

MetaArc, the Fujitsu hybrid IT solution, leverages Fujitsu’s professional and managed services offerings across infrastructure, applications, and services. This environment addresses the governance and management challenges of visibility, security and cost control when clients adopt more cloud usage, even shadow IT cloud adoption.

Fujitsu helps our customers get the right balance between supporting powerful innovation and robustly managing the associated risks, costs, and benefits of the service provider network.



For further inquiry on this paper, please contact

<https://www.fujitsu.com/global/about/resources/contact/products/network/products-sdn-nfv.html>

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