Traffic Management Solutions for Social Innovation Business

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OVERVIEW: The spread of smartphones in recent years has led to explosive growth in the volume of data communications traffic. The ways in which networks are being used are also becoming increasingly diverse, with not only conventional use by people but also growing machine-to-machine traffic. Meanwhile, network businesses are emerging that generate high added value by representing and analyzing these heavier and more diverse traffic volumes, and by controlling and utilizing them in the best possible ways. Drawing on its know-how and customer base that extend across both telecommunications and IT, Hitachi is supplying solutions that provide its customers with business innovations and optimized capital investment, and is working on traffic management solutions that support its Social Innovation Business, including in fields like smart information and the utilization of big data.

INTRODUCTION

WITH greater use of smartphones driving rapid growth in the use of rich content such as video, it is anticipated that data communications traffic on mobile networks will grow fifty-fold over the next five years. Traffic characteristics are also becoming more diverse, with applications for mobile networks expanding from use by people to also encompass machine-to-machine (M2M) communications. Given these heavier and more diverse traffic volumes consisting mainly of mobile data, there is a need for appropriate ways of managing and controlling this communication.

This article describes Hitachi's work on traffic management solutions (TMSs) based around the collection, analysis, and control of traffic data.

HITACHI'S TMS CONCEPT

Information and communication technology (ICT) covers both information technology (IT) and telecommunications. In terms of its role in managing the rapidly growing volumes of data communications traffic, ICT is being called on to satisfy the following two requirements.

(1) Optimization of investment: expanding data communications traffic and data storage capacity at low cost.

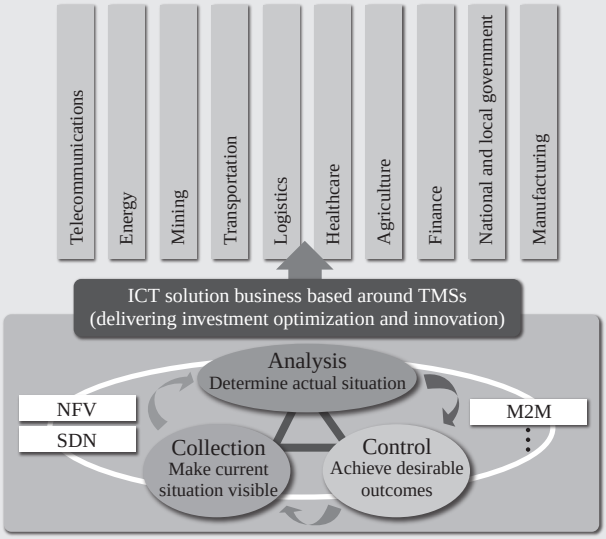
(2) Innovation: promoting business innovation and helping establish and expand new businesses.

A TMS is a solution for collecting information on the traffic between people, machines, and systems, and for performing analysis and control based on specific objectives. With the TMS playing a core role, Hitachi uses ICT solutions that incorporate a variety of technologies to implement features such as network virtualization, and to deliver innovation and optimize investment in user ICT systems belonging to telecommunications operators or to transportation, distribution, local government, or other service providers. These technologies include software-defined networks (SDN), network functions virtualization (NFV), and M2M (see Fig. 1).

In the case of telecommunications operators, for example, for whom dealing with the growth in traffic volumes is an urgent issue, Hitachi can optimize investment in telecommunications equipment by using a TMS to provide fine-grained and realtime bandwidth control for each user, and techniques for making effective use of available bandwidth, such as data offloading and data compression. Hitachi also brings innovations to telecommunications operators' ICT systems by, for example, helping them identify changes in user needs, provide new services, and establish new business models through the analysis of realtime traffic data along with their customer and other stored data.

ICT SOLUTION BUSINESS WITH CORE ROLE FOR TMS

This section describes how Hitachi is working on an ICT solution business in which TMSs play a core role, supporting its Social Innovation Business in fields such as smart information and the utilization of big data.



ICT: information and communication technology
TMS: traffic management solution
NFV: network functions virtualization
SDN: software defined network M2M: machine to machine

Fig. 1—ICT Solution Based around TMS.
The TMS collects a variety of traffic status data and then performs analysis and control based on specific objectives. ICT solutions based around TMSs deliver investment optimization and innovation.

Utilization of Big Data

(1) TMSs

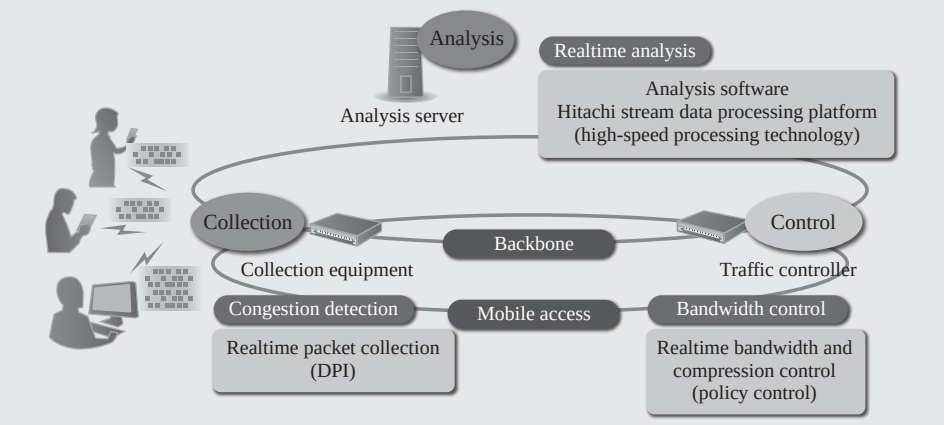
In the past, users of telecommunications services have experienced stress in data communications such as the intermittent degradation of communication quality due to bursts in traffic. Meanwhile, telecommunications operators have needed to make sufficient capital investment to ensure that they have the base stations and other network equipment required to cope with peak traffic volumes.

Hitachi's solutions provide reliable and trouble-free telecommunications by detecting and controlling the time and location of traffic bursts in realtime. They also optimize investment in communication equipment by utilizing techniques that absorb and minimize bursts of peak traffic. Specifically, this optimization of investment in communication equipment is achieved through realtime data collection using deep packet inspection (DPI), high-speed analysis on Hitachi's stream processing platform, and realtime bandwidth and compression control based on policy control techniques (see Fig. 2).

(2) Network functions virtualization solution (TMS × NFV)

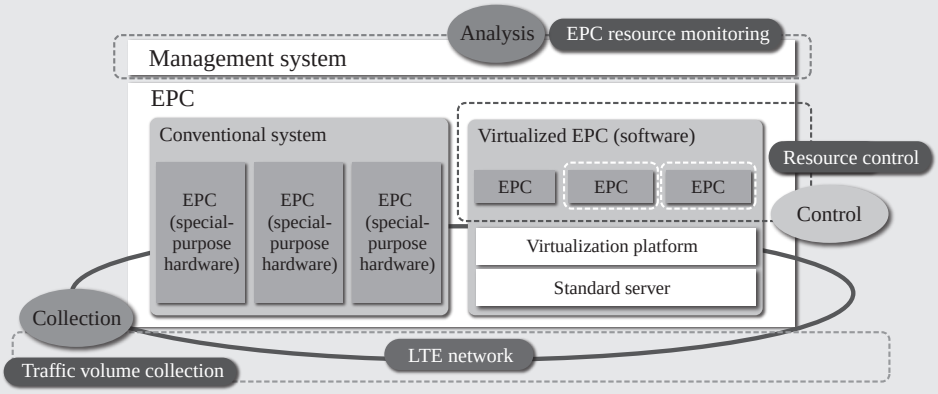
Mobile telecommunications operators currently use equipment configurations in which a key role is played by the special-purpose hardware that handles the evolved packet core (EPC) control function in Long Term Evolution (LTE) mobile communications. Operators also have a growing need for flexible equipment that can quickly implement changes such as network upgrades or the addition of new functions to handle increasing user numbers and a greater diversity of services.

Hitachi's solutions combine the TMS with NFV technology to determine traffic volumes and service usage so that resources can be allocated accordingly. Specifically, by drawing on its past experience in the development of conventional EPCs, Hitachi is seeking to ensure scalability and agility together with significantly shorter lead times for new and upgrade installations. This is achieved by implementing the EPC function on a virtualization platform on standard servers, and by using the resource monitoring, analysis, and control functions of the TMS (see Fig. 3).



DPI: deep packet inspection

Fig. 2—Solution for Optimizing Capital Investment.
The investment in communication equipment is optimized through realtime collection using DPI, high-speed analysis using Hitachi's stream processing platform, and realtime bandwidth and compression control based on policy control techniques.



EPC: evolved packet core LTE: Long Term Evolution

Fig. 3—NFV.
NFV ensures scalability and agility and significantly reduces the lead time for new and upgrade installations by hosting the EPC function for an LTE network on a virtualization platform running on standard servers, and using the resource monitoring, analysis, and control functions of the TMS.

Smart Information

(1) M2M traffic solution (TMS × M2M)

One application for M2M networks is in the management and maintenance of equipment used in social infrastructure, such as roads, electric power, and water. Hitachi is working on optimizing traffic management on M2M networks.

M2M networks differ from general network traffic in a variety of ways, including being characterized by large numbers of often small packets, and by the sources of this traffic being spread over a wide geographical area. While it has typically been difficult to provide an end-to-end guarantee of communication quality for M2M traffic, by collecting and analyzing network traffic, Hitachi is seeking to control it in ways that suit its characteristics (large numbers of small packets).

The monitoring of tunnels and bridges, for example, has traditionally required staff to make costly and time-consuming visits to the site to make an assessment based on sensor data. By combining a TMS with technologies for sensor nodes, highly reliable wireless communications, and sensor node platforms developed through trials conducted with social infrastructure operators and other customers, Hitachi's M2M traffic solution aims to allow remote inspections to be conducted via high-definition video, for example, by dynamically reallocating network bandwidth when status changes occur. Hitachi also intends to integrate the solution's control functions with road traffic systems, and to include a function for sending emergency notifications to users' digital devices to inform them when an abnormal situation arises (see Fig. 4). In the future, Hitachi intends to combine TMSs with know-how built up through its social infrastructure businesses to control the flow of utilities such as water or electric power.

Similarly, Hitachi also intends to help improve the efficiency of equipment management and maintenance by supplying M2M traffic solutions to a wide range of service providers in social infrastructure and other fields.

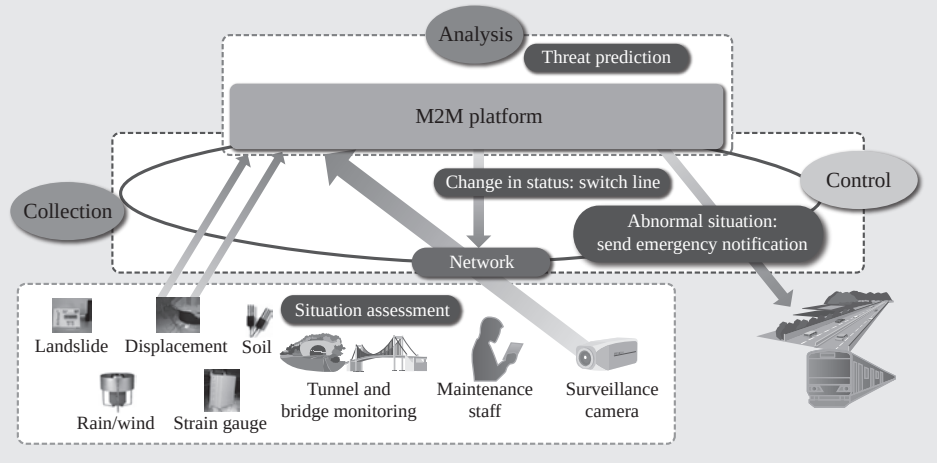


Fig. 4—M2M Network Solution.
In addition to dynamically reallocating network bandwidth when status changes occur to allow remote inspections to be conducted via high-definition video, for example, the intention is also to integrate the solution's control functions with road traffic systems so that emergency notifications can be sent to users' digital devices to inform them when an abnormal situation arises.

RESEARCH AND DEVELOPMENT WORK UNDERPINNING TMS BUSINESS

This section describes the research and development associated with Hitachi's work on TMSs.

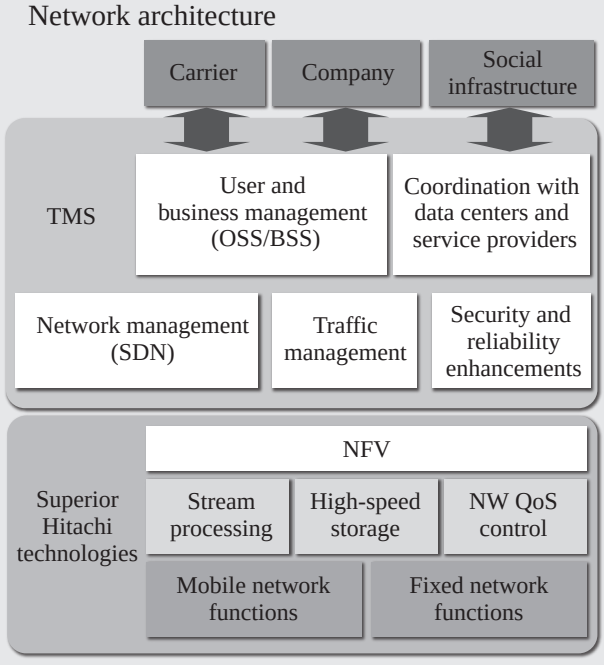
There currently exists a demand from social infrastructure such as transportation and finance for telecommunications systems that incorporate critical infrastructure protection to ensure stable and reliable operation. Recognizing this, Hitachi is undertaking research and development work aimed at optimizing investment in communication equipment and delivering innovations that will encourage better business practices (see Fig. 5). Hitachi is providing highly reliable communication platforms that utilize NFV technology based on dependable hardware technologies built up over time, and then using these as a basis for implementing TMSs. The technologies required by TMSs include user and business management, traffic management, network management, coordination with data centers and service providers, and security and reliability enhancements.

The following sections describe work on technologies for traffic management and coordination with data centers and service providers.

Traffic Management

In addition to the use of traffic management technologies to improve quality of experience (QoE) and optimize investment in equipment through the collection, analysis, and control of traffic, this also includes treating traffic information as big data and using it to improve investment efficiency. This improvement in investment efficiency is achieved by analyzing traffic information collected by DPI equipment to detect any degradation in service quality, and also by analyzing the causes of this quality degradation to determine ways of improving the network.

Specifically, this involves measuring device response delays to detect any loss of communication quality on the radio access network. The analysis of instances of quality degradation in terms of devices, areas, and time periods can then be used to infer the cause of this degradation. Identifying the causes of quality degradation allows countermeasures such as modifying the area design or optimizing system parameters to be implemented efficiently (see Fig. 6).



TMS technology

Technologies	Description
User and business management (OSS/BSS)	User and business workflow management
Traffic management	Make network more robust Collection, analysis, and control
Network management (SDN)	Multi-layer network management Setting up of highly reliable paths
Coordination with data centers and service providers	Handle requests from data centers and companies. Setting up of high-quality communication paths
Security and reliability enhancements	Countermeasures against DoS attacks Advance system verification

OSS: operation support system BSS: business support system NW: network QoS: quality of service DoS: denial of services

Fig. 5—TMS Application Architecture.
Hitachi is seeking to build networks that incorporate critical infrastructure protection to ensure stable and reliable operation and satisfy the varying communication quality requirements of different users.

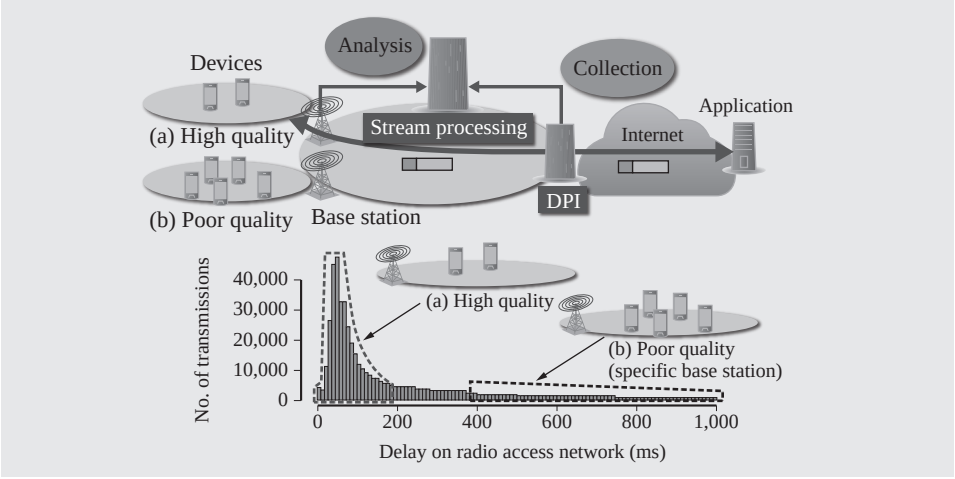


Fig. 6—Detection of Quality Degradation and Analysis of Causes.
This involves using response delays on the radio access network to detect degradation in communication quality, and analyzing the reasons for longer delays.

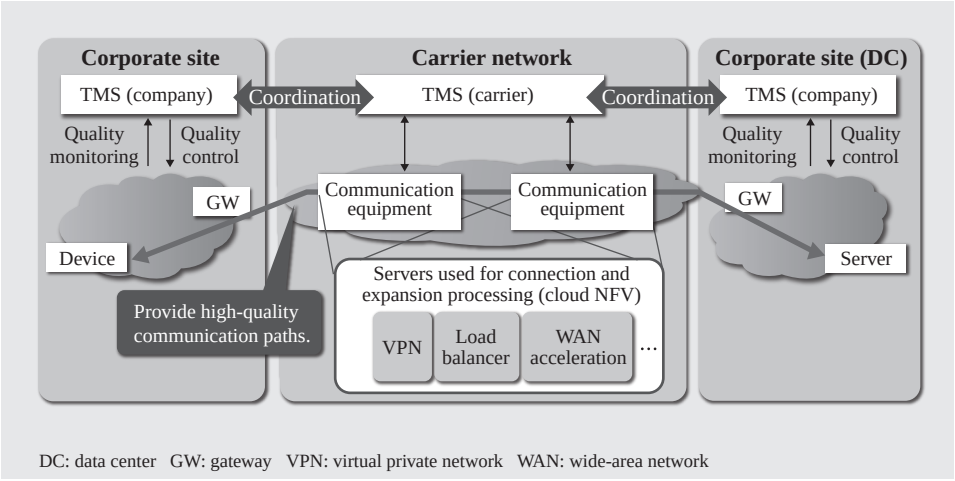
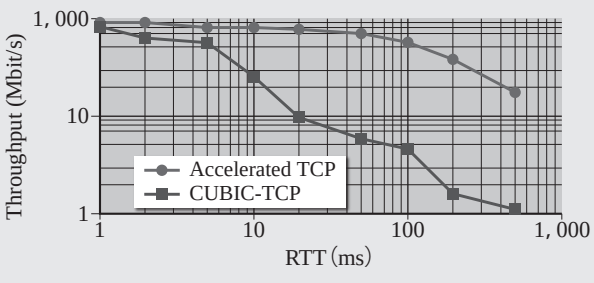


Fig. 7—Coordination with Data Center Networks.
High-quality communication paths are established by dynamically incorporating virtualized functions in response to requests from data center networks.

Coordination with Data Centers and Service Providers

Coordination with data centers and service providers can be used to implement highly reliable end-to-end networks through the coordinated control of both highly reliable carrier networks that use TMSs to support diverse communication quality requirements and unified cloud networks that span across multiple data centers (see Fig. 7).

Specifically, high-quality communication paths can be configured dynamically by incorporating virtualized functions on the carrier network based on the requirements of the cloud network. In the case of corporate applications that place a priority on communication bandwidth, for example, high-quality communication paths that are independent of the communication methods used by the application can be provided by dynamically incorporating acceleration on the wide area network (WAN) that provides the communication guarantee. WAN acceleration can provide high throughput even when the round trip time (RTT) is very long, such as when communicating between physically distant sites (see Fig. 8).



WCC: WAN-centric cloud networking
TCP: transmission control protocol RTT: round trip time

Fig. 8—Benefits of Using WCC.
The graph plots the improvement in TCP performance achieved by using WAN acceleration. High throughput can be achieved even on network with a long RTT.

CONCLUSIONS

This article has described Hitachi's work on TMSs based around the collection, analysis, and control of traffic data.

In the future, in addition to marketing its TMSs to customers in Japan and elsewhere, Hitachi intends to supply solutions that support its Social Innovation Business, including the utilization of big data and smart information.

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