TELECOMMUNICATION SYSTEMS IN SMART CITIES

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Annotation: Telecommunication systems play a very important role in the Infrastructure of smart cities. A plethora of networked devices interacts to provide safe, convenient and environmentally conscious new services. Residents in smart cities can enjoy their lives using these services, seamlessly and without being aware of the existence of the networks. To make such telecommunication systems possible, Hitachi is accelerating research into new network technologies, including gateways, highly reliable wireless communications, and network virtualization. Products and solutions under development include home gateways, wireless sensor networks, and M2M solutions.

Key words: Smart city, machine-to-machine, human-to-human.

If people are to enjoy comfortable lives in smart cities, telecommunication systems must be able to connect all manner of things, including human-to-human, human to- machine, and machine-to-machine connections. These connections and interactions between things make it possible for people to use energy efficiently while still enjoying comfortable lives. Examples include checking up remotely on what other people are doing, getting the information, you need from a portable device as and when you need it, and communication between vehicles and traffic signals to avoid congestion. This article describes the telecommunication systems necessary for smart cities.

Telecommunication systems necessary for smart cities*:* Adoption of the most appropriate communication technologies should make possible the seamless provision of a wide variety of services in smart cities Greater use of cloud services and visual communication tools using high speed broadband communication networks in the corporate and local government sectors is improving business efficiency and convenience while also being a source of new value creation. Meanwhile, sensor networks utilizing a variety of wireless technologies give access to information on the flow of goods and the status of equipment and the environment. They also facilitate the use of remote control. This makes possible the implementation of systems that are safe, secure, and environmentally conscious. In the home, network connections for products such as home appliances and cars, as

well as telephones and PCs (personal computers), will make life more enjoyable, secure, and comfortable. In cities, transportation, distribution, finance, and energy services are connected to networks and interact to provide more reliable, convenient, and environmentally conscious new services. Residents in smart cities will have seamless access to these services without needing to know about the networks on which they are based.

***Technical Issues*:** In smart cities, everything will be connected to the network. This means that networks will not only require the high speed, high reliability, high availability, and other features demanded of today's networks, they must also satisfy new requirements, including the connection of various types of device, effective use of carrier networks, the flexibility to support new devices and services, the economics to provide services at a reasonable price, and consideration for the environment. To satisfy these difficult requirements, Hitachi is undertaking research and development of IP- (Internet protocol) based gateway technologies, highly reliable wireless communication technologies, and network virtualization technologies.

***Gateway Technologies**:* To establish an environment in which objects of all types can link together, gateways for connecting devices to the network play an important role in ensuring support for a wide variety of devices so that they can deliver reliable services. Such gateways face the following issues:

- Need to ensure interconnectivity with IP networks
- Application communications environment for resource-constrained devices
- Traffic optimization for effective use of carrier networks

In order to solve these issues, Hitachi is currently carrying out research on protocol conversion, data aggregation, and scheduling technology. The huge address space of IPv6 (Internet protocol version 6) is needed if large numbers of sensors are to connect to the network. Because of their constrained resources, if they are to support IPv6, sensor nodes will require a protocol conversion function to convert between standard IPv6 and light-weight 6LoWPAN (IPv6 over low-power wireless personal area network). In addition, support for M2M (machine-to-machine) applications in an end-to-end web service environment requires mapping between HTTP (hypertext transfer protocol) and CoAP (constrained application protocol). Standardization and prototyping of related protocols are currently in progress at The Internet Engineering Task Force (IETF). Highly Reliable Wireless Communication Technology for Remote Monitoring The intelligent control of the environment inside smart city facilities will require the use of sensors to measure the equipment power consumption and the temperature and humidity in the facility, as well as the

transmission of this data via a communication network to a monitoring center for collection, analysis, and use. Although most remote monitoring systems currently use reliable wired networks to send data, there is growing interest in the use of wireless networks because of their lower set-up costs and the ease with which layouts can be changed, especially at existing sites where it is difficult to lay new cabling. Furthermore, use of the existing cellular network is likely to be particularly efficient in situations where the factory or building being monitored is a long way from the monitoring center. However, the use of wireless networks in these remote monitoring systems faces two issues. The first is the potential for radio interference between the signals transmitted by the sensors and those from wireless LANs (local area networks) or other existing equipment when wireless sensor networks are used in factories or buildings. This results in more frequent data communication errors. The second is the risk, when using cellular networks that are experiencing heavy traffic loads that delays may occur in the arrival of alarm signals from the sensors reporting trouble at a facility being monitored. Given these concerns, Hitachi has developed wireless communication technologies both for reducing the data communication error rate in wireless sensor networks and for reducing delays in the arrival time of alarm signals carried over cellular networks.

M2M Solutions It is anticipated that services and applications in smart cities will continue to evolve over time in response to changes in industrial activity and improvements in lifestyle. This will require service providers and network managers to provide new services and applications in a timely and economical manner. Hitachi is accelerating its research and development of M2M platforms in order to satisfy these requirements.

M2M platforms connect a variety of M2M devices via wired or wireless networks in a way that hides any differences among the networks and devices from the applications. The use of management functions provided by the platform, which include device and line management, network monitoring and operation, activation, billing, and data control, enables service providers to provide reliable and stable services, quickly and easily. Gateway functions are also needed to handle specific protocols, data processing and conversion, and security to allow the connection of a wide variety of devices to the networks, beyond just PCs and mobile phones.

Conclusions: Telecommunication systems play a very important role in smart cities. They must be highly reliable and available as well as flexible, economical, and environmentally conscious. To satisfy these difficult requirements, Hitachi is accelerating its research and development of new telecommunication systems for smart cities.