Topics

Low-power LTE Terminal for Gas Smart Meters

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Gas smart meters are fundamental platforms that improve consumer services by enabling visualization of energy usage, emergency valve shutoff, alarm notifications and flexible pricing. Also, since they solve issues with meter reading in situations such as those where meter reading workers cannot enter apartment buildings due to automatic locking, and meet gas supplier needs by bringing efficiency to their work and rationalizing facilities construction to reduce costs, implementation of gas smart meters is ongoing [1].

Currently, new technologies called "U-bus" and "U-bus air" standardized by the Japan Utility Telemetering Association (JUTA) are being introduced in the town gas industry [2].

- Enabling packet communications with higher speed than the conventional communication specifications, U-bus is a next-generation interface that connects gas meters, sensors and gas devices such as alarms and burning appliances easily to a center system[1]. This technology promises improved services (energy usage visualization, remote valve opening and closing).

- U-bus air is short distance radio communications operating in the 920 MHz band that enables relaying between gas meters using multihop communications[2]. The system makes it possible to connect gas meters and so forth that are outside the coverage area of a Wide Area Network (WAN).

To achieve the gas smart meter system, a WAN device to connect to a network configured with the aforementioned U-bus and U-bus air technologies, and a WAN to connect to the center system are required (**Figure 1**).

WAN devices are anticipated for their 10-year operating durability the same as other gas devices, as well as their ability to relay data from multiple devices through U-bus and U-bus air. However, because of the difficulties in providing stable power sources with outdoor installation etc., these devices must run on batteries, which means if they are to operate for at least 10 years, the communications systems used with the WANs must be energy-saving.

Also, to provide stable and secure services to general consumers, not only requirements for uplink communication to send the meter data to a

*1 Center system: Equipment to manage devices such as gas meters and acquired data.
*2 Multihop communication: A communication system that enables terminals to communicate directly with each other, or enables widely separated terminals to exchange data by relaying via multiple terminals on a network of hierarchically arranged terminals.
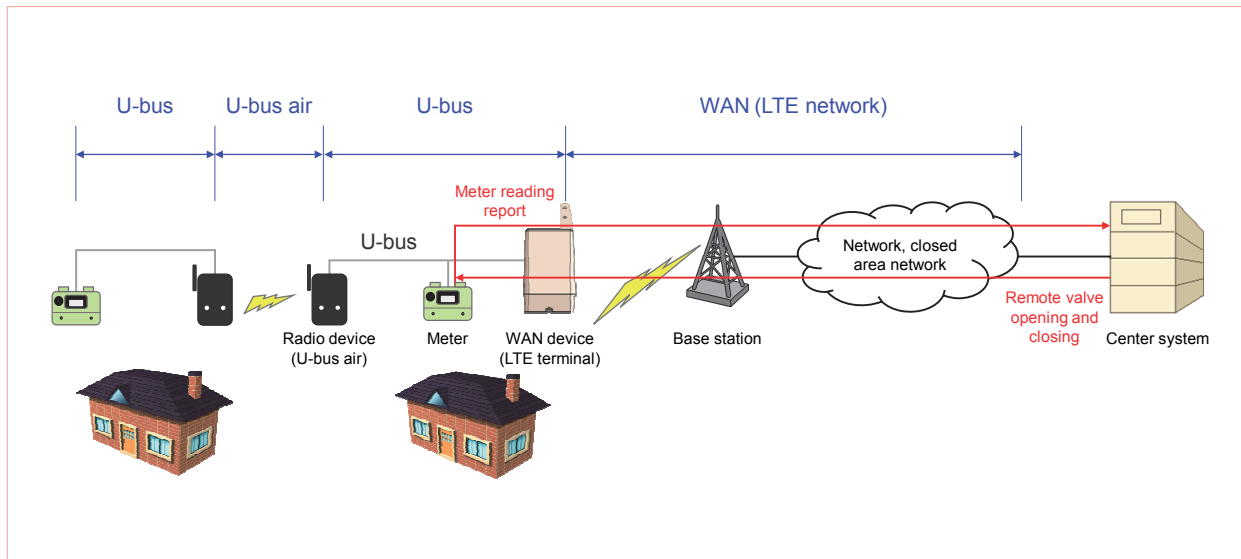
Figure 1　Gas smart meter system overview

center system, but also requirements for downlink communication to remotely open and close meter valves etc., must be satisfied. Therefore, low-power, bidirectional communications with high communications success rates must be achieved.

1)　Solving Issues with LPWA Technology

　　Technology called Low Power Wide Area (LPWA) is gaining attention as a low-cost solution for the aforementioned issues. In general, Internet of Things (IoT)[*3] devices differ from communications terminals such as smartphones, because the frequency of uplink communications from terminals is low (around 1 time per day), and the amount of data sent in a single transmission is extremely small. LPWA is IoT device data communications technology that covers a wide area with low power consumption instead of small amounts of transmitted and received data, and satisfies the requirements for gas smart meters.

　　With the demand expansion in the IoT field including gas smart meter projects, the 3rd Generation Partnership Project (3GPP) standardization organization newly prescribed specifications for IoT devices in LTE Release 13 formulated in 2016. One of the LPWA technologies, extended Discontinuous Reception (eDRX), is a new technology prescribed

in Release 13 [3]. Conventional DRX is technology that uses intermittent signal reception, and saves power by putting terminal communications functions to sleep during periods of no reception. eDRX promises even greater power savings by significantly extending the intermittent reception interval (**Figure 2**).

2)　Overview of Low-power Communications Terminals for Gas Smart Meters

　　Based on the stable communications platform that NTT DOCOMO has provided to date, we have developed an LTE terminal (a WAN device) that supports eDRX low-power technologies for gas smart meters. **Photo 1** shows the external appearance of the terminal.

　　The LTE module in this LTE terminal is designed with the assumption that the LTE terminal will still only communicate small amounts of data, and adopts Category 1, which promises lower power consumption and chip cost reductions compared to UE Category[*4] used with smartphones. Using an 81.92 sec intermittent reception interval (eDRX

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*3　IoT: Mechanisms of mutual control via exchange of information among various "things" connected to the Internet.

*4　UE Category: An index indicating the communications performance of a terminal.
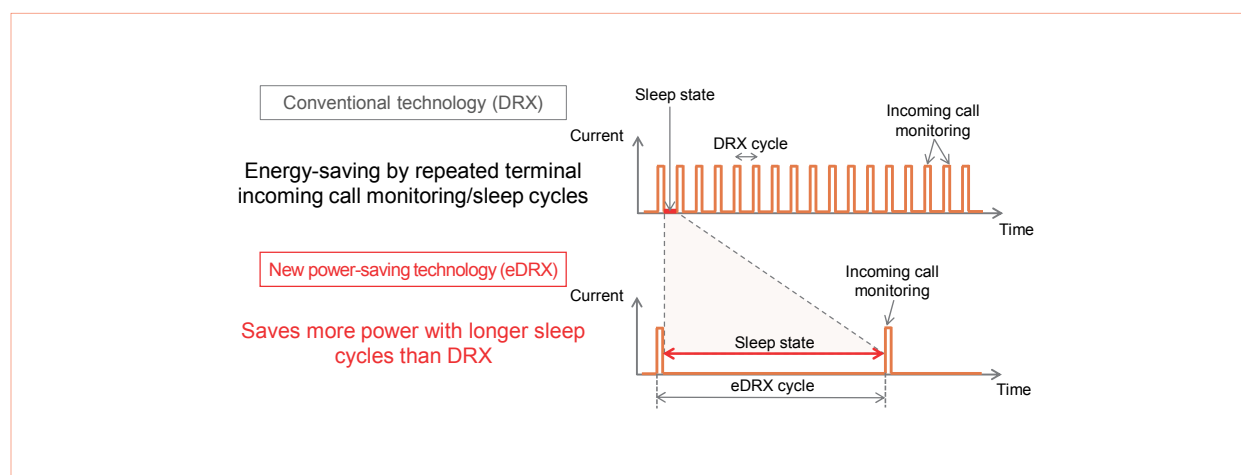
Figure 2   eDRX overview

Photo 1   LTE terminal external
appearance

applied) in a prototype using the newly developed low powered User Identity Module (UIM)*5, we were able to confirm more than 90% power saving compared to a conventional UIM with an intermittent reception interval of 1.28 sec (eDRX unsupported) [4]. This system promises operations of 10 years or more with batteries, and cheaper costs through reduction in the number of batteries required.

After installation, one LTE terminal issue is function updating, because it has been necessary to collect the terminals for updating, which affects operations.

To solve this issue, we equipped the terminals with a function to update firmware from the center system (remote firmware update function). This enables flexible function addition and alteration to expand the functionality of gas smart meter systems.

Also, a smooth batch terminal control from the center system is enabled by acquisition of terminal in-range information etc. and updates are dispersed geographically due to concerns about increased traffic and increased communications time, and the associated increased power consumption in areas with a high density of terminal installations (**Figure 3**).

3) Future Approaches

Working towards automating the meter reading work of town gas suppliers, we are evaluating the performance and validity of these eDRX communications terminals and communication systems from FY 2017 to FY 2018. This specifically entailed installing eDRX-enabled terminals and test gas meters in the houses and apartments of 50 households in FY 2017, and 500 households in FY 2018. Using an actual LTE network, we evaluate communications success rates, time required for communications and power consumption [5].

The UE Category called Category M1, Category NB1 is newly supported in 3GPP Release 13 [3]. These technologies promise to reduce LTE module

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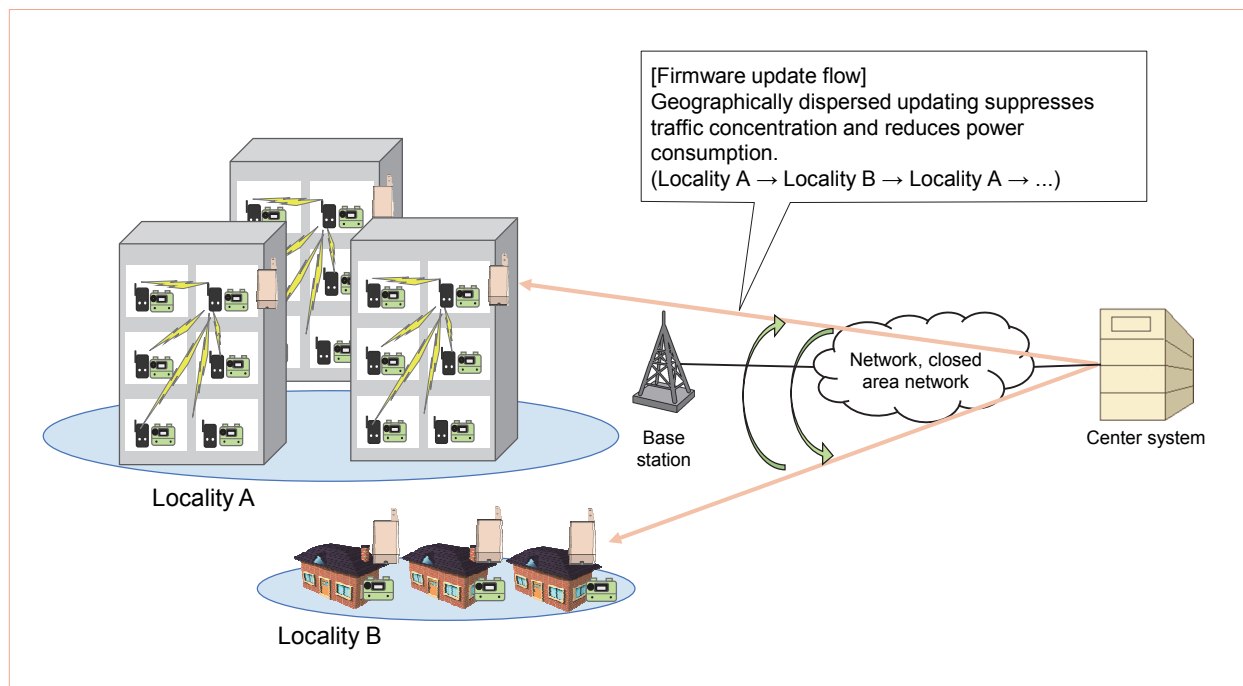*5   UIM: A card on which information for identifying a subscriber is recorded.

Figure 3 Firmware update overview

power consumption and costs by restricting the terminal transmission/reception bandwidth. In the future, we plan to study and verify Category M1 and Category NB1 in parallel with Category 1 field trials to further reduce power with terminals using these technologies, and lower costs by reducing the number of required batteries.

Also, in industries other than the town gas industry, customer needs for communications terminals for smart meters vary greatly. For example, in the LP gas industry, it is necessary to replace gas cylinders before the gas remaining in the cylinder runs out, and the replacement cycle relies on the experience of meter reading workers. However, using LPWA technology, information about the amount of gas remaining in gas cylinders can be collected in real time. Then with AI and this collected information, replacement cycles can be optimized and thus reduce workloads through greater efficiency. In this way, we are not only aiming for stable operation of gas smart meters currently on offer, but also taking initiatives to solve a range of issues facing customers.

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