International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Y.2067

(06/2014)

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Next Generation Networks – Frameworks and functional architecture models

Common requirements and capabilities of a gateway for Internet of things applications

Recommendation ITU-T Y.2067

ITU-T

International
Telecommunication
Union

ITU-T Y-SERIES RECOMMENDATIONS

GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	**Y.2000–Y.2099**
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Enhancements to NGN	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Packet-based Networks	Y.2600–Y.2699
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899
Carrier grade open environment	Y.2900–Y.2999
FUTURE NETWORKS	Y.3000–Y.3499
CLOUD COMPUTING	Y.3500–Y.3999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Y.2067

Common requirements and capabilities of a gateway for Internet of things applications

Summary

Recommendation ITU-T Y.2067 provides the common requirements and capabilities of a gateway for Internet of things (IoT) applications. The provided common requirements and capabilities are intended to be generally applicable in gateway application scenarios.

NOTE – This Recommendation focuses on the gateway as equipment interconnecting devices with communication networks.

History

Edition	Recommendation	Approval	Study Group	Unique ID[*]
1.0	ITU-T Y.2067	2014-06-06	13	11.1002/1000/12170

Keywords

Capabilities, common requirements, gateway, IoT, IoT applications.

[*] To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T Y.2067

Common requirements and capabilities of a gateway for Internet of things applications

1 Scope

This Recommendation provides the common requirements and capabilities of a gateway for Internet of things (IoT) applications. The provided common requirements and capabilities are intended to be generally applicable in gateway application scenarios.

The scope of this Recommendation includes:

- General characteristics of a gateway for IoT applications
- Common requirements of a gateway for IoT applications
- Common capabilities of a gateway for IoT applications

Use cases of a gateway for IoT applications are provided in appendixes.

NOTE – This Recommendation focuses on the gateway as equipment interconnecting devices with communication networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.2060] Recommendation ITU-T Y.2060 (2012), *Overview of Internet of things.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 device [ITU-T Y.2060]: With regard to the Internet of things, this is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing.

3.1.2 Internet of things (IoT) [ITU-T Y.2060]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – From a broader perspective, the IoT can be perceived as a vision with technological and societal implications.

3.2 Terms defined in this Recommendation

This Recommendation defines or uses the following term:

3.2.1 gateway: A unit in the Internet of things which interconnects the devices with the communication networks. It performs the necessary translation between the protocols used in the communication networks and those used by devices.

4 Abbreviations and acronyms

This Recommendation defines or uses the following terms:

3G	Third Generation
4G	Fourth Generation
CAN	Controller Area Network
CRM	Customer Relationship Management
ECU	Electronic Control Unit
GPRS	General Packet Radio Service
GPS	Global Positioning System
IoT	Internet of Things
IP	Internet Protocol
LTE	Long Term Evolution
MAC	Media Access Control
MSISDN	Mobile Subscriber International ISDN/PSTN number
NGN	Next Generation Network
PHY	Physical layer
QoS	Quality of Service
SMS	Short Message Service
TCP	Transmission Control Protocol
URI	Uniform Resource Identifier
WCDMA	Wideband Code Division Multiple Access
Wi-Fi	Wireless Fidelity
xPON	x Passive Optical Network

5 Conventions

In this Recommendation:

The keywords "**is required to**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

The keywords "**can optionally**" and "**may**" indicate an optional requirement which is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

6 Introduction to gateways for IoT applications

In IoT applications, information in either the physical or information world is collected by devices and then sent to the IoT applications through communication networks. Some devices cannot connect to the communication networks directly. The gateways support the interconnection of such devices with the communication networks.

Figure 1 shows the typical deployment scenario of gateways for IoT applications.

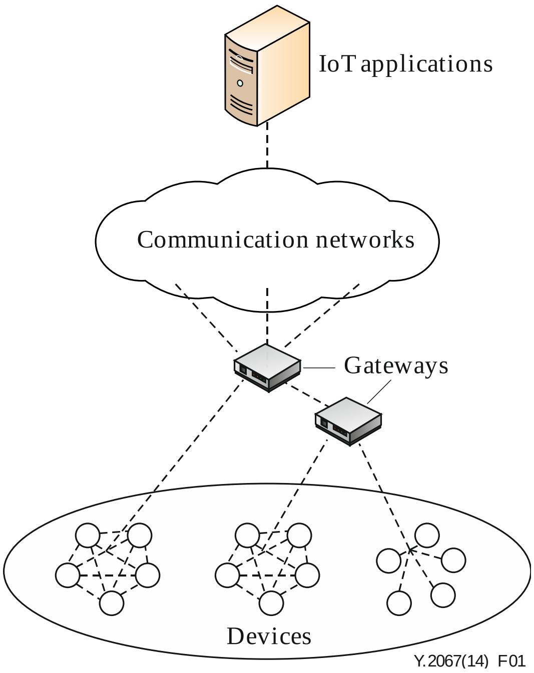


Figure 1 – Typical deployment scenario of gateways for IoT applications

As shown in Figure 1, different kinds of devices can connect to the communication networks through one or multiple gateways. The connectivity between devices and gateway(s) can be based on different kinds of wired or wireless technologies, such as a controller area network (CAN) bus, ZigBee, Bluetooth or Wi-Fi.

The communication networks can be realized via existing networks, such as conventional TCP/IP-based networks and/or evolving networks, such as next generation networks (NGN) [b-ITU-T Y.2001]. A gateway that connects to these networks should support the appropriate communication technologies.

The IoT applications implement application logic according to the application requirements. The applications can be based on proprietary application platforms, but can also be built upon common service/application support platforms providing generic enabling capabilities, such as authentication, device management, charging and accounting [ITU-T Y.2060].

The gateway connects to the IoT applications through the communication networks.

7 General characteristics of a gateway for IoT applications

7.1 Connection to the communication networks

The gateway has the general characteristic of connecting to the communication networks. Devices can connect to the communication networks through such a gateway. In some cases, for example in configurations with multiple gateways, one or more gateways are connected to other gateways (as shown in Figure 1) and not directly to the communication networks.

The gateway supports different kinds of communication technologies to connect to different communication networks.

7.2 Device access

The gateway has the general characteristic of supporting the access of devices. The devices can connect to each other or to the communication networks by accessing gateways. The gateway supports different kinds of device access technologies.

7.3 Protocol translation

The gateway has the general characteristic of protocol translation. The gateway supports the protocol translation between the devices and the communication networks. In some cases, a gateway translates the protocols among different devices which are connected to the gateway itself.

7.4 Interaction with applications

The gateway has the general characteristic to support the interaction with applications, including common application logic interaction.

7.5 Adaptability

The gateway has the general characteristic of adaptability. It is expected that the gateway has standardized interfaces. The gateway can be deployed in different application environments by adapting according to functional components and related protocols.

7.6 Management functions support

The gateway has the general characteristic to support management functions, including device management, network management and protocol management.

7.7 Security functions support

The gateway has the general characteristic to support security functions. The gateway provides security mechanisms to support the security requirements of applications.

NOTE – Common security mechanisms used in a gateway include those for device authentication, data encryption, privacy protection, etc.

8 Common requirements and recommendations of a gateway for IoT applications

8.1 General gateway requirements and recommendations

– **Scalability**

There may be a huge number of devices accessing a gateway. The gateway is required to be scalable in terms of the number of connected devices and to support interconnection with other gateways to increase the global scalability of the gateways.

– **Addressing**

The gateway is required to support various addressing schemes, e.g., IP and non-IP addressing schemes, including public and private addressing for IP schemes.

– **Openness to functional extensions**

The gateway is required to provide standard interfaces to support functional extensions of the gateway, e.g., for deployment in diversified application environments.

– **Quality of service**

The gateway usually plays a key role in the IoT application scenarios where quality of service (QoS) support is essential.

The QoS related requirements of the gateway are as follows:

1) The gateway is required to support traffic control policy and QoS differentiation according to the categories of traffic.
2) The gateway is required to provide mechanisms for performance measurement and management.

– **Communication aspects**

The gateway is deployed between devices and communication networks and can use different communication technologies (e.g., 3G, 4G, xPON, ZigBee, Wi-Fi and Ethernet) to transfer data.

The communication related requirements of the gateway are as follows:

1) The gateway is required to support communication bridging between devices and communication networks.
2) The gateway is required to support communications with at least one application.
3) The gateway is recommended to support multiple communication technologies to interact with communication networks and devices and be able to enhance the capabilities of the communication interfaces in case that the support of additional communication technologies is required. In such case, the gateway is required to be able to select the communication technologies according to the specific service requirements.

8.2 Adaptation related requirements and recommendations

– **Protocol diversity support**

The gateway needs to communicate with devices and applications that may support different protocols. The gateway should be able to load new protocols according to the communication requirements.

The protocol related requirements of the gateway are as follows:

1) The gateway is required to support protocol translation between different protocols as necessary when communicating with devices and applications.
2) The gateway is recommended to support dynamic protocol loading.

– **Uniformity of interactions**

The gateway is recommended to support uniform interaction with different devices and applications in order to cope with their heterogeneity.

The requirements of the gateway related to uniformity of interactions are as follows:

1) The gateway is recommended to support uniform operations through standardized protocols on devices which use different communication technologies.

2) The gateway is recommended to support uniform interaction through standardized protocols with different applications.

8.3 Support capabilities related requirements and recommendations

– **Device and service discovery**

When devices are connected to a gateway, the gateway discovers them. In addition, the gateway discovers new services which are published by applications.

The device and service discovery requirements of the gateway are as follows:

1) The gateway is required to support mechanisms for device discovery when a device connects to the gateway for the first time or in the case of gateway restart.

2) The gateway is required to support mechanisms for service discovery when new services are published by applications.

– **Device management**

There are a great number of devices that are connected to a gateway and most of them have capability constraints. The gateway manages devices based on policies or instructions received from applications.

The device management requirements of the gateway are as follows:

1) The gateway is required to support management of device related information, e.g., device identification, device configuration, etc.

2) The gateway is required to support monitoring of device status for usage by applications or itself.

3) The gateway is required to support firmware and software update of devices.

4) The gateway is required to support device management on behalf of applications upon request.

5) The gateway is recommended to support fault management of devices based on policies.

6) The gateway is recommended to support performance management of devices based on policies.

– **Device identifier management**

Multiple types of device identifiers may be used in IoT applications, e.g., IP address, MSISDN, URI, data elements, etc. A device may have single or multiple identifiers which are managed by the gateway.

The device identifier requirements of the gateway are as follows:

1) The gateway is required to support identifier mapping capability between different types of device identifiers.

2) The gateway is recommended to support identifier combination capability, e.g., the combination of device identifier with gateway identifier.

NOTE – The combined identifiers may be provided to applications as globally unique identifiers, while the gateway resolves the combined identifiers in order to address the different devices.

3) The gateway is recommended to support the assignment of temporary communication identifiers to the devices connected to the gateway itself.

– **Storage**

A gateway has two methods to store data. The first is temporary storage, in this case the data which are temporarily stored need to be removed according to pre-defined policies, e.g., service logic, maximum data storage volume. The second data storage method is permanent storage, in this case the data which are permanently stored are important for successful service operations and for correct gateway and device operations.

For data safety and security, the data stored in gateways and applications should be kept consistent.

The storage requirements and recommendations of the gateway are as follows:

1) The gateway is required to support local storage, including temporary and permanent storage.
2) The gateway is recommended to support capabilities for ensuring data consistency between the gateway and applications.

NOTE – Applications are expected to support capabilities for ensuring data consistency with gateways.

– **Device grouping**

Devices may be grouped by type, location, etc. For example, all devices in the same room can constitute a group. Likewise the devices of the same type behind a gateway can constitute a group. A gateway can operate devices efficiently based on groups. The gateway is required to support group operations for devices, including operations to create, update, read and delete groups of devices.

– **Data capture and aggregation**

A gateway captures data from devices and transfers the data to applications. A gateway may have multiple modes of capturing and aggregating data based on policies.

The data capture and aggregation requirements of the gateway are as follows:

1) The gateway is required to support data capture from devices based on policies, e.g., real time collection or time schedule-based collection.
2) The gateway is recommended to support aggregation of data from devices.

– **Data dispatching and delivery**

For a large number of devices behind a gateway, the gateway can efficiently dispatch and transfer data between devices and applications based on policies.

The data dispatching and delivery requirements and recommendations of the gateway are as follows:

1) The gateway is required to support mechanisms to dispatch data based on policies.
2) The gateway is recommended to support mechanisms to pre-process data based on policies before dispatching them.
3) The gateway is required to support data delivery based on QoS requirements of applications.
4) The gateway is required to support data delivery based on devices' group identification if devices are grouped.

8.4 Application related requirements

– **Application logic integration**

The gateway is recommended to support application logic integration.

NOTE – By supporting application logic integration, the gateway can process application related functions locally and independently from remote facilities. For example, in some cases, the gateway can perform some processing and analysis of the data captured from the connected devices before transferring the data to applications.

8.5 Security and management related requirements

– **Security and privacy**

For the security of applications, a gateway must control the access to devices and to itself and must protect data security and privacy for the gateway and devices.

The security and privacy requirements of the gateway are as follows:

1) The gateway is required to support identification of each access to the connected devices.
2) The gateway is required to support authentication with devices. Based on application requirements and device capabilities, it is required to support mutual or one-way authentication with devices.
3) The gateway is required to support mutual authentication with applications.
4) The gateway is required to support the security of the data which are stored in devices and the gateway, or transferred between the gateway and devices, or transferred between the gateway and applications. The gateway is required to support the security of these data based on security levels.
5) The gateway is required to support mechanisms to protect privacy for devices and the gateway.

– **Self-management and remote maintenance**

The gateway is required to support self-management and remote maintenance.

The self-management and remote maintenance requirements of the gateway are as follows:

1) The gateway is required to support self-diagnosis and self-repair as well as remote maintenance.
2) The gateway is required to support firmware and software update.
3) The gateway is required to support auto configuration or configuration by applications. The gateway is required to support multiple configuration modes, e.g., remote and local configuration, automatic and manual configuration and dynamic configuration based on policies.

9 Common capabilities of a gateway for IoT applications

9.1 Reference technical framework and typical high-level flows of a gateway for IoT applications

9.1.1 Reference technical framework

The reference technical framework of a gateway for IoT applications is composed of the following capability groups:

- Applications group
- Support capabilities group
- Adaptation capabilities group
- Security and management capabilities group

The applications group provides support for interacting with remote applications and for local processing of application logic. It supports the deployment of multiple IoT applications of different kinds and used in different domains (e.g., power metering in smart home domain, elder people monitoring in e-health domain, etc.). This group may utilize the capabilities provided by the support capabilities group.

The support capabilities group provides common capabilities for the gateway to interact with devices and applications. This group includes the following capabilities:

– Device management, which provides capabilities for managing devices and communicates device profiles to the gateway itself and to applications.

– Communication management, which provides capabilities for establishing and managing communication with devices and applications. It includes capabilities for the support of the communication QoS requirements (e.g., communication delay, packet loss, etc.).

– Data storage, which provides capabilities for permanent and temporary storage of data, including data collected from devices, gateway configuration data, data from applications, etc.

– Data processing, which provides capabilities for processing data, including analyzing data, transforming data formats, encapsulating data based on application protocols and aggregating data from devices.

– Data dispatching, which provides capabilities for pre-processing data from applications based on policies and optimizing data dispatching.

The adaptation capabilities group provides capabilities for communicating with devices and applications and hiding the differences between devices and applications. This group includes the following capabilities:

– Interface abstraction, which provides an abstract interface supporting basic operations (such as reading data from a device) to interact with devices and applications and also provides mapping capability from an abstract interface to specific interfaces supported by devices and applications.

– Device adaptation, which provides connectivity adaptation for the different types of devices or other gateways that connect to the gateway.

– Network adaptation, which provides adaptation to different network technologies, including PHY/MAC layer adaptation between the gateway and the (access portion of the) communication networks.

The security and management capabilities group provides capabilites for supporting security and management of the gateway itself.

Figure 2 shows the reference technical framework of a gateway for IoT applications.

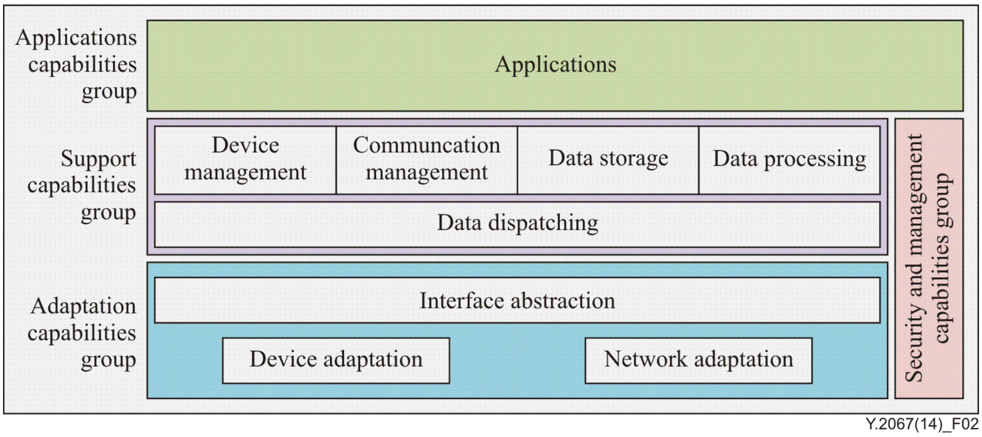


Figure 2 – Reference technical framework of a gateway for IoT applications

9.1.2 Typical high-level flows

In IoT applications, a gateway can receive data from IoT applications and then send the data to devices and it can receive data from devices and then send the data to IoT applications. In this regard, the typical high-level flows with respect to the capability groups identified in the gateway reference technical framework are as follows:

- Data are received from IoT applications and sent to devices: the gateway receives data from IoT applications through the adaptation capabilities group which provides network adaptation and interface abstraction. The gateway makes the necessary application logic process ing via the applications capabilities group, and sends data to devices through the adaptation capabilities group which provides interface abstraction and device adaptation. These processes are accomplished in collaboration with the support capabilities group and the security and management capabilities group.
- Data are received from devices and sent toIoT applications: the gateway receives data from devices through the adaptation capabilities group which provides device adaptation and interface abstraction. The gateway makes the necessary application logic processing via the applications capabilities group, and sends data to IoT applications through the adaptation capabilities group which provides interface abstraction and network adaptation. These processes are accomplished in collaboration with the support capabilities group and the security and management capabilities group.

9.2 Details on common capabilities of a gateway for IoT applications

9.2.1 Applications group

The functionalities of the applications group are as follows:

- Support deployment of specific IoT application logic in the gateway via standard open interface. Via such application logic, the gateway can process some IoT application related functions locally.
- Support resource openness with proper access control, so that the resources of the gateway which are usable for the creation of new IoT applications, can be discovered and accessed. The gateway is required to support functions for resource openness, including resource abstraction, resource identifier management, resource registration and deregistration etc.

9.2.2 Support capabilities group

9.2.2.1 Data dispatching

The functionalities of data dispatching are as follows:

- Support capability of dispatching data to devices according to the sequential order of the devices' data.
- Support capability of dispatching data from devices to applications as appropriate.
- Support capability of adjusting the sequential order of the devices' data based on policies.

9.2.2.2 Device management

The functionalities of device management are as follows:

- Support capability of providing collection and monitoring of device status.
- Support capability of providing device related information to applications.
- Support capability for device firmware and software update.
- Support device configuration, according to configuration profiles (downloaded from applications, or stored in the gateway) or configuration commands (received from applications).

- Support device diagnosis and automatic reparation.
- Support capability of creating, updating, deleting and retrieving device identifiers and managing identifier mapping.
- Support device discovery.
- Support capability of grouping devices based on device attributes (such as device type, device location, etc.).

9.2.2.3 Data processing

The functionalities of data processing are as follows:

- Support capability of data format transformation between different data formats as required by devices and applications.
- Support capability of aggregating data from devices and applications.

9.2.2.4 Data storage

The functionalities of data storage are as follows:

- Support access rights (e.g., read, write) to data that are stored in the gateway for security and privacy purposes.
- Support capability of data caching for data from devices and applications.
- Support data synchronization between the gateway and applications, e.g., upload of collected data from devices to applications, download of configuration management data from applications to the gateway.

9.2.2.5 Communication management

The functionalities of communication management are as follows:

- Support capability of establishing and managing communications between the gateway and applications.
- Support selection of the access network (to connect with the communication networks) according to the communication technologies supported by the gateway (e.g., GPRS, WCDMA, LTE, etc).
- Support capability of data transferring from applications and devices based on QoS enabled policies, e.g., priority of data transferring from devices in different network environments.
- Support capability of communication based on device grouping.

9.2.3 Adaptation capabilities group

9.2.3.1 Interface abstraction

The functionalities of interface abstraction are as follows:

- Support interface mapping from abstract interface to specific interfaces supported by devices and applications. This includes interface mapping for new device interfaces when new types of devices connect to the gateway.

9.2.3.2 Device adaptation

The functionalities of device adaptation are as follows:

- Support capability of connectivity adaptation for the different types of devices or other gateways that connect to the gateway.

9.2.3.3 Network adaptation

The functionalities of network adaptation are as follows:

- Support capability for connecting to various types of communication networks according to the appropriate communication technologies, including for PHY/MAC layer adaptation between the gateway and the access portion of the communication networks.
- Support capability for dynamic loading of communication protocols.

9.2.4 Security and management capabilities group

The functionalities of security and management capabilities group are as follows:

- Support mutual authentication between the gateway and applications.
- Support mutual or one-way authentication between the gateway and devices.
- Support security policies according to different security levels.
- Support key lifecycle management including key generation, key distribution, key update, key destruction, etc.
- Support data encryption and decryption based on security policies.
- Support privacy protection of the data of the gateway and devices.
- Support automatic discovery of services.
- Support gateway self-management and remote maintenance.
- Support gateway firmware and software update.
- Support gateway configuration according to multiple configuration modes, e.g., remote and local configuration, automatic and manual configuration and dynamic configuration based on policies.

Appendix I

Use cases of a gateway for IoT applications

(This appendix does not form an integral part of this Recommendation.)

This appendix describes some use cases of a gateway for IoT applications.

I.1 Gateway in home services

A gateway in home services can connect to electrical equipment and safety equipment through local networks and can connect to remote application servers through the communication networks. The electrical equipment and safety equipment can be controlled remotely by the gateway. Figure I.1 shows a use case of a gateway in home services.

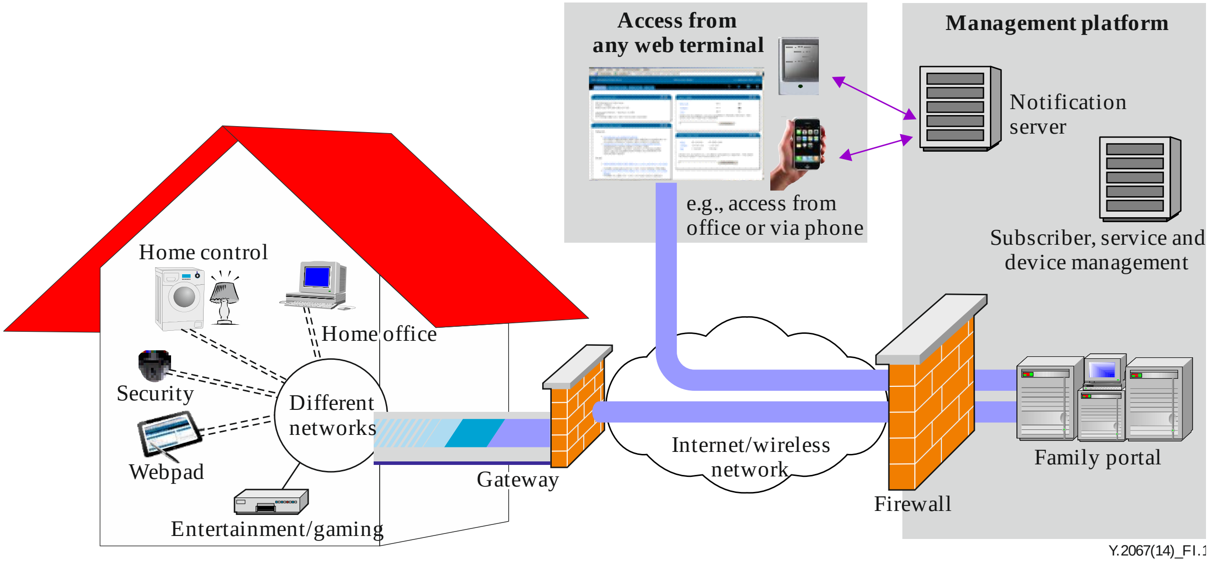


Figure I.1 – Use case of a gateway in home services

Home monitoring and management applications include:

- Monitoring of home security remotely (i.e., remote monitoring through web cameras via the TV, laptop or smartphone)
- Control of appliances (e.g., turn on/off lights, sprinklers, garage door, security alarm, thermostat, pool heater) remotely via a device with a web browser
- Scheduling of appliances (e;g. scheduling of lights, water heater, alarm system, heat, and more) via automatically created profiles

In these scenarios, as shown in Figure I.1, the gateway has a very important role.

The home owner can configure the gateway to control each of the connected devices. Control functions may be implemented through pre-set rules (time-of-day, threshold or alarm driven, etc.) or implemented through commands delivered via a SMS message.

The gateway can aggregate the information collected from multiple sensors and permit the information to be combined in order to provide more advanced services.

For example, in home security scenarios, the gateway usually integrates the inputs coming from different sensors and provides the home owner with a user interface to configure the home security system.

I.2 Gateway in automotive telematics

Automotive telematics deals with wireless communications of information and applications between a vehicle and/or its occupants and external entities. Such communications allow authorized entities such as automakers, emergency services and service centres, to interact with a vehicle and its driver, enabling enhanced safety and support services. In its most advanced modes, automotive telematics also allows motorists to safely expand mobile computing capabilities directly into their vehicles and benefit from Internet-based services.

The applications of automotive telematics can be divided into four categories:

– Driver safety and security applications

– Customer relationship management (CRM) applications for automakers and dealers

– Personal applications and services

– Business applications and services

Figure I.2 shows a typical use case of a gateway in automotive telematics.

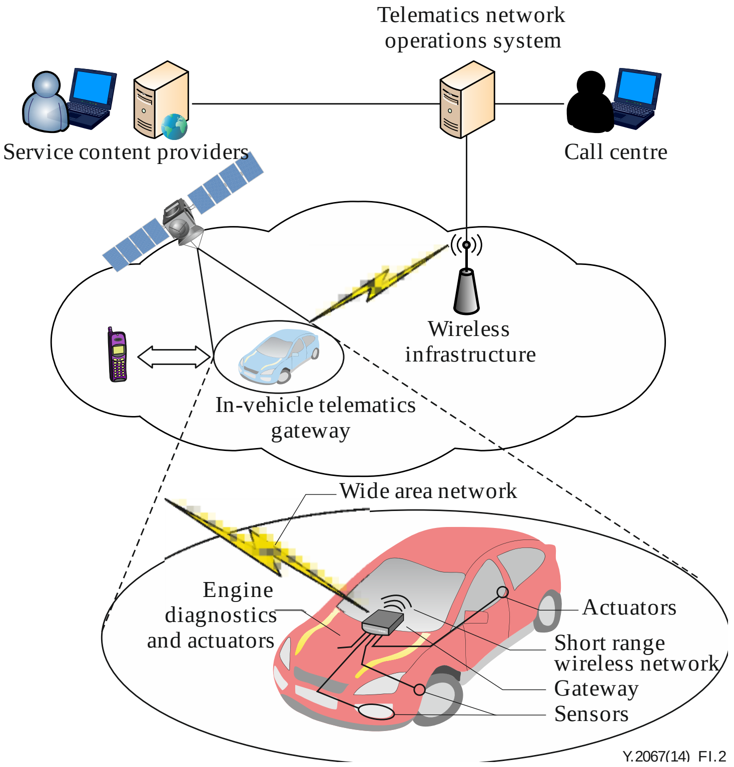

Telematics network operations system
Service content providers
Call centre
Wireless infrastructure
In-vehicle telematics gateway
Wide area network
Engine diagnostics and actuators
Actuators
Short range wireless network
Gateway
Sensors
Y.2067(14)_FI.2

Figure I.2 – Use case of a gateway in automotive telematics

In automotive telematics, the gateway is the key entity. It is the embedded in-vehicle gateway that communicates with the automobile electronic control units (ECUs) and the global positioning system (GPS) satellite and accesses the telematics services over the wireless infrastructure.

In driver safety and security applications the gateway can monitor the various crash sensors in the vehicle and in the event of a crash, sends the details of the crash (e.g., intensity and location information) to the service centre if the crash notification service is provided. For the stolen vehicle tracking, anti-theft alarm notification and remote door service, the in-vehicle gateway can be triggered to periodically send precise location information to the service centre or can be triggered automatically by the anti-theft sensors in the vehicle. In this way, the service centre can track the vehicle.

In diagnostics services, the gateway in the vehicle can perform a detailed diagnostic scan when triggered remotely or when some key thresholds are crossed (e.g., distance travelled or time elapsed since last diagnostic scan).

I.3 Gateway in online collaborative whiteboard

Online collaborative whiteboard is an application for web-based visual collaboration.

The online collaborative whiteboard application allows distributed project participants to collaborate on developing and managing software projects. For example, online collaborative whiteboard allows participants, via the network, to share web documents (e.g., web pages) and spread sheets, exchange ideas, write and edit annotations, ask questions, post tasks and web applications and other collaboration tasks with other participants.

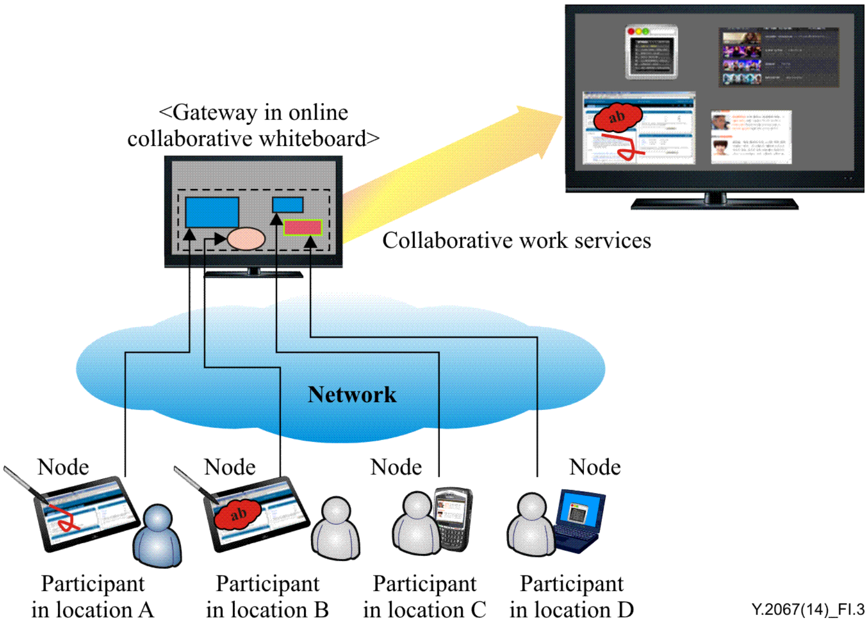
The data (e.g., web pages, web applications, spread sheets, etc.) transferred through the network by different devices (e.g., pad, mobile phone, laptop, etc.) are handled by the gateway for display in online collaborative whiteboard. The gateway in online collaborative whiteboard acts as the data aggregation point for real-time management and visualization. The data can be regarded as a resource for collaborative work services, such as brainstorming, virtual meeting, remote learning and remote training. Figure I.3 shows a use case of a gateway in online collaborative whiteboard.

Via the gateway in online collaborative whiteboard, the participants of the distributed project, who use different devices, can for example, upload background images and web documents and draw on top of them. All participants connected to the whiteboard can see the various changes in real-time.

The gateway in online collaborative whiteboard represents a typical use case of integration of application functionalities into the gateway. In these use cases, the gateway can process some application functions locally without communicating with remote application servers.

The features provided by the local application functionalities of the gateway in online collaborative whiteboard include:

- Providing a fast web document viewer
- Being a browser-based application
- Automatically synchronizing between project participants
- Recording and displaying of edited web documents
- Writing, inserting and replacing annotations
- Deleting web documents and web applications
- Connecting the gateway with the participants of the distributed project via the network



<Gateway in online collaborative whiteboard>
Collaborative work services
Network
Node
Node
Node
Node
Participant in location A
Participant in location B
Participant in location C
Participant in location D
Y.2067(14)_FI.3

Figure I.3 – Use case of a gateway in online collaborative whiteboard

Bibliography

[b-ITU-T Y.2001] Recommendation ITU-T Y.2001 (2004), *General overview of NGN*.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	**Global information infrastructure, Internet protocol aspects and next-generation networks**
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2014