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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Internet of things and smart cities and communities – Requirements and use cases

Requirements for interoperation of the smart port with the smart city

Recommendation ITU-T Y.4209

International Telecommunication Union

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Recommendation ITU-T Y.4209

Requirements for interoperation of the smart port with the smart city

Summary

Recommendation ITU-T Y.4209 addresses the interoperation of the smart port with the smart city, identifying the requirements for the smart port platform to be able to interoperate with smart city platforms and other smart elements in the environment where the port is located. Additionally, these requirements are the foundation that enables the provision of enhanced smart services by the smart port platform (which may also benefit smart cities), also described in this Recommendation.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.4209	2020-04-06	20	11.1002/1000/14163

Keywords

Interfaces, interoperation, port area of influence, smart city, smart city platform, smart port, smart port platform, smart port services.

* 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.

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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/.

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Requirements for interoperation of the smart port with the smart city

1 Scope

This Recommendation addresses the interoperation of the smart port with the smart city, identifying the requirements for the smart port platform to be able to interoperate with smart city platforms and other smart elements in the environment where the port is located, in order to provide enhanced services.

Nautical services and other services management provided by the smart port are out of the scope of this Recommendation.

Security aspects required by customs and immigration authorities are out of scope of this Recommendation.

Interoperation with other ports is out of scope of this Recommendation given the focus of this Recommendation is on interoperation between the smart port and the smart city.

Clause 6 provides an overview of the smart port in terms of interoperation with the components of the smart port ecosystem.

Clause 7 describes high-level requirements for the smart port platform to enable interoperation with smart city platforms and/or other smart elements.

Clause 8 describes the requirements of interoperation between the smart port platform and smart city platforms and/or other smart elements.

Clause 9 describes the smart services provided by the smart port platform interoperating with smart city platforms and/or other smart elements.

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 L.1370] Recommendation ITU-T L.1370 (2018), *Sustainable and intelligent building services*.

[ITU-T Y.3600] Recommendation ITU-T Y.3600 (2015), *Big data – Cloud computing based requirements and capabilities*.

[ITU-T Y.4000] Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things*.

[ITU-T Y.4111] Recommendation ITU-T Y.4111/Y.2076 (2016), *Semantics based requirements and framework of the Internet of things*.

[ITU-T Y.4114] Recommendation ITU-T Y.4114 (2017), *Specific requirements and capabilities of the Internet of things for big data*.

[ITU-T Y.4200] Recommendation ITU-T Y.4200 (2018), *Requirements for the interoperability of smart city platforms*.

[ITU-T Y.4201] Recommendation ITU-T Y.4201 (2018), *High-level requirements and reference framework of smart city platforms.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 big data [ITU-T Y.3600]: A paradigm for enabling the collection, storage, management, analysis and visualization, potentially under real-time constraints, of extensive datasets with heterogeneous characteristics.

NOTE – Examples of dataset characteristics include high-volume, high-velocity, high-variety, etc.

3.1.2 city [b-ITU-T Y.4900]: An urban geographical area with one (or several) local government and planning authorities.

3.1.3 data/knowledge layer [ITU-T Y.4201]: Architectural layer of a Smart Port that supports data processing, adding value and transforming information into knowledge.

3.1.4 Internet of things (IoT) [ITU-T Y.4000]: 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.

3.1.5 open interface [ITU-T Y.4201]: A public standard for connecting hardware to hardware and software to software. Open interfaces are designed and documented for safe and easy use by third party developers and freely available to all.

3.1.6 smart sustainable city (SSC) [b-ITU-T Y.4900]: A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental and cultural aspects.

3.1.7 smart city platform (SCP) [ITU-T Y.4200]: A computer system or integration of computer systems that, under control of the city, uses information and communication technologies (ICTs) to access data sources and process them to offer urban operation and services to the city. The concept is extended to a community and a territory.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 smart port: Innovative port that uses Information and Communication Technologies (ICTs) and other means to improve quality and efficiency of port operation and services, as well as its competitiveness.

3.2.2 smart port platform: A computer system or integration of computer systems that, under control of the port, uses information and communication technologies (ICTs) to access data sources and process them to offer both port operation and services.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

API Application Programming Interface

ICT Information and Communication Technologies

IoT Internet of Things

LTE Long Term Evolution

REST Representational State Transfer

RFID Radio-Frequency Identification

Wi-Fi Wireless Fidelity

WIMAX Worldwide Interoperability for Microwave Access

5 Conventions

The expression "is required" indicates a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The expression "is recommended" indicates a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance with this Recommendation.

The expression "can optionally" and "may" indicates an optional requirement which is permissible, without implying any sense of being recommended. This term is 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 this Recommendation.

In this Recommendation the expression "smart city" is used instead of "smart sustainable city" as defined in clause 3.

6 Overview of the smart port in terms of interoperation

In the context of this Recommendation, a smart port is considered the central point of a smart port ecosystem.

As defined in clause 3, a smart port is an innovative port that uses information and communication technologies (ICTs) and other means to improve the quality and efficiency of port operation and services, as well as its competitiveness. At a practical level, the area considered a part of the smart port are the geographical areas having a relationship of mutual dependence and impact with the port, which are regarded in this Recommendation as the port area of influence. Components of the port area of influence are sources and/or destinations of data for the smart port.

A smart port is expected to provide services that enable the enhancement of the user experience in the port, including passengers, visitors and port employees.

A smart port may interoperate with the port area of influence, with one or more smart cities, with other smart elements (e.g., airport, railway stations) and with third parties (e.g., stakeholders, service providers).

A smart element is regarded in this Recommendation as a logical or physical entity that is typically part of the smart city ecosystem (e.g., railway stations, airport) but not necessarily (i.e., the smart port is an independent smart element that might not be related to any city), and that interoperates with the city itself or with any of the rest of the smart elements. The smart port itself is a smart

element, but not its area of influence, which is to be considered as a natural extension of the smart port.

NOTE 1 – Internal devices and infrastructure components within any of the smart elements cannot be considered smart elements themselves, as their interaction with others is performed by means of the participation of the platform which the devices or infrastructure components are part of.

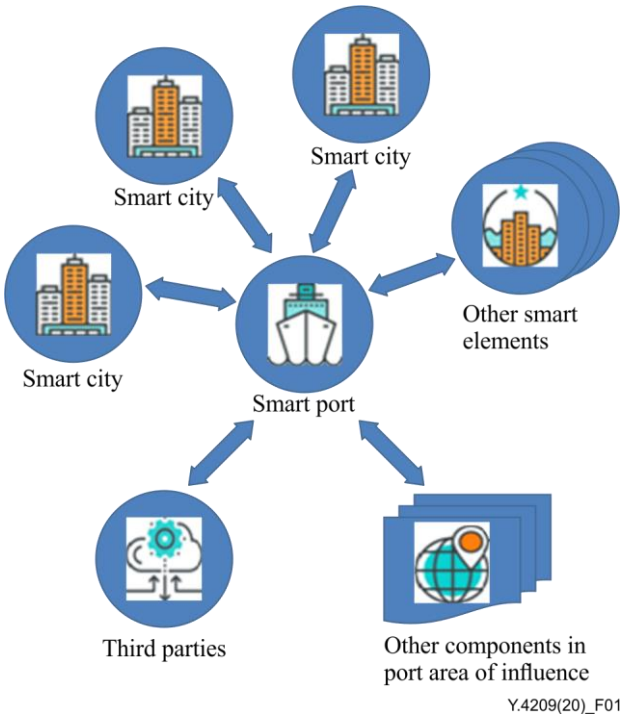

Figure 1 – Interactions of the smart port within the smart port ecosystem

Figure 1 shows at high level the interactions of the smart port within the smart port ecosystem. The port area of influence comprises nearby (and even distant) surroundings that have a relationship of mutual dependence and impact with the port.

Some components within the port and the port area of influence may not be relevant from a smart city perspective and will not take part in the interoperation with the smart cities.

NOTE 2 – Free zones, storage points, warehouses, transport terminals and transport networks are typical components of the port area of influence, whose activity and usage has a direct relation of interdependence with the port and its activity. Taking the concrete case of the transport network as an example, roads leading to the port are a part of its area of influence, as traffic jams or other situations that may occur on these roads have an impact on the port; on the other hand, traffic generated by the port, for example when a ferry arrives, will have an impact on the transport network and, ultimately, on the city (if there is one in that port's ecosystem).

Third parties include, but are not limited to, service providers, open data providers and other stakeholders of the smart port ecosystem.

NOTE 3 – The internal components of the smart port interoperate with the smart port platform but this interoperation at the service level is out of scope of this Recommendation.

The wide range of different port activities, apart from the touristic ones, show the reason why the nature of the data to be exchanged with the city cannot be focused strictly on the tourism industry. Hence, the nature of the interoperation of the smart port with smart cities and other smart elements must be extended to a wider approach considering all of the related aspects in the port's activity, and taking into account the role that the smart port can play as a major centre of activity and development, for both cities and the whole port area of influence.

In just the same way that the smart city needs a smart city platform in order to provide the smart city with smart services and interoperation capabilities, the smart port needs a smart port platform. As defined in clause 3.2.2, the smart port platform is a computer system or integration of computer systems that, under control of the port, uses information and communication technologies (ICTs) to access data sources and process them to offer both port operation and services.

The focus of this Recommendation is on the smart port platform, as the interoperation requirements for the smart port generate requirements for the smart port platform.

The smart port will have to accomplish its functions in terms of its traditional port activities, for which it relies on its underlying traditional sub-systems, that are out of the scope of this Recommendation, and for which proprietary interfaces are allowed.

The smart port platform is an abstraction which embraces not only all of the underlying traditional sub-systems of the port, but also the functions and interfaces that arise when considering that the smart port interoperates with the smart city. The part of the smart port platform that is related to legacy, pre-existent and underlying sub-systems apart from the interoperation with the city is out of the scope of this Recommendation, but in any case, this Recommendation considers the smart port platform as a whole.

NOTE 4 – It is expected to minimize port platform system complexity. A scenario to be avoided is one where there is not a single smart port platform, but a number of different and independent platforms, all of them integrating on their own. This scenario would multiply integration efforts and interoperation maintenance, and would open the door to costly and complicated "spaghetti" integrations (each platform is integrated with every other platform), involving different platforms with different levels of interoperation.

Figure 2 shows the interfaces of the smart port platform with the interoperating components of the smart port ecosystem.

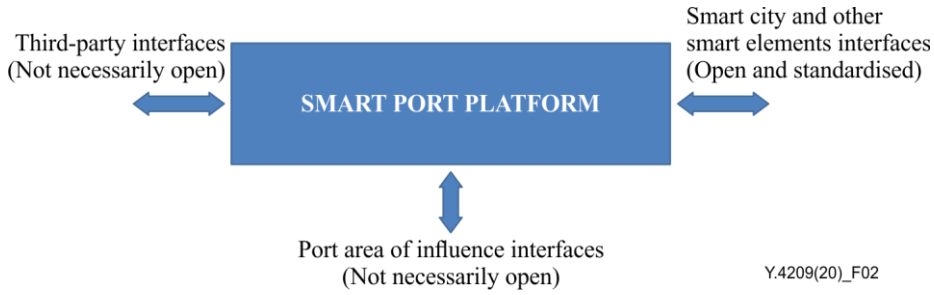

Figure 2 – Interfaces of the smart port platform

In common with any platform, a traditional port platform acquires data from sensors or other sub-systems, processes this data, and exchanges information with external entities.

The data which is shared by the smart port platform with the smart cities or other smart elements, in an anonymized and aggregated or individual way, depends on its utility at city level and on the legal considerations.

7 High-level requirements for the smart port platform to enable interoperation with smart city platforms and/or other smart elements

In terms of interoperability and data exchange needs, the smart port platform has similar requirements to a smart city platform.

[HighLevel-Req1] In order to exchange data with smart cities and other smart elements, a port platform is required to support open interfaces [ITU-T Y.4201], preferably based on internationally recognised standards, and according to [ITU-T Y.4200].

NOTE 1 – In most cases, and in order to improve the horizontality of platforms [ITU-T Y.4201], it is appropriate to provide the aforementioned open and preferably internationally standardised interfaces that are suitable for this exchange. However, a practical solution to offer open interfaces may be to develop interface adaptors: they are independent components which may be added to the smart port platform's interface, and which translate the information exchange taking place through the interface and its structure, so that the smart port platform can interoperate with other sub-systems and platforms of the ecosystem that implement different information structures.

[HighLevel-Req2] The smart port platform is required to fulfil the Internet of things (IoT) related requirements identified in [ITU-T Y.4000].

NOTE 2 – There might be services that benefit from the exchange of raw sensor and device data between the smart port platform and the smart city platform. The smart port platform capability of enabling such data exchange improves the horizontality of both platforms. It may also enable third parties to enrich the data further as well as to enable data subscription services for third parties and/or other smart elements.

[HighLevel-Req3] The smart port platform is required to fulfil the requirements for interoperability of a smart city platform according to [ITU-T Y.4200].

[HighLevel-Req4] In terms of data acquisition, e.g., data collected from sensors and devices, the smart port platform is required to be able to interoperate directly or indirectly with existing networks and sub-systems in the port, e.g., sensor networks, energy supply networks (for usage and consumption), multimedia and multiservice networks (e.g., for volumes calculation of goods and location of those volumes) and building sub-systems.

[HighLevel-Req5] As far as the interoperation with networks and sub-systems in the port, the smart port platform is required to have the ability to use either fixed communication technologies, e.g., optical wiring, power line communications and/or radio technologies (e.g., Wi-Fi, WiMax, LTE, RFID, Zigbee, low-range technologies, narrow band technologies).

[HighLevel-Req6] The interfaces and associated APIs of the smart port platform used to interoperate with the smart city platform and/or other smart elements are required to be open and preferably based on internationally recognized standards.

[HighLevel-Req7] The interfaces and associated APIs of the smart port platform, as well as the information and data being exchanged through them (either with origin in the port or with the port as destination), are required to adopt best practices in information security including confidentiality, integrity and availability.

NOTE 3 – Notwithstanding, in general terms, it is expected to allow access by default only to non-critical and non-personally identifiable information. Access to critical information is based on access granting by port authorities.

[HighLevel-Req8] The smart port platform is required to support capabilities to manage big data [ITU-T Y.3600] [ITU-T Y.4114].

[HighLevel-Req9] The smart port platform is recommended to minimize platform system complexity.

NOTE – Actually, the smart port platform can be implemented via a set of platforms, each one providing different services. On the other hand, independently of the number of the other port sub-systems, a single smart port platform may minimize complexity.

[HighLevel-Req10] The smart port platform is recommended to enable semantics-based capabilities [ITU-T Y.4111] in support to the smart port platform data acquisition, e.g., data collected from sensors and devices, and data exchange.

[HighLevel-Req11] From the interoperability perspective, the smart port platform is recommended to be implemented in accordance with [ITU-T Y.4201].

NOTE 4 – The smart port platform implementation is strongly related to the underlying IoT infrastructure deployed in each port.

[HighLevel-Req12] In terms of the connectivity with internal port components, it must be taken into account that the smart port platform is required to integrate, either directly or by means of intermediate platforms, with the existing networks and systems in the port.

[HighLevel-Req13] It is required that this integration is based on open interfaces [ITU-T Y.4201] and preferably on recognized international standards, so that the smart port can easily integrate other future networks and related sub-systems.

8 Requirements of interoperation between the smart port platform and smart city platforms and/or other smart elements

Information produced by the smart port may be very useful for cities and other smart elements. Data exchange is expected to be performed in both directions for the mutual benefit of the port and the cities and other smart elements.

Figure 3, adapted from [ITU-T Y.4200], shows an overview of a smart city platform and external systems/platforms.

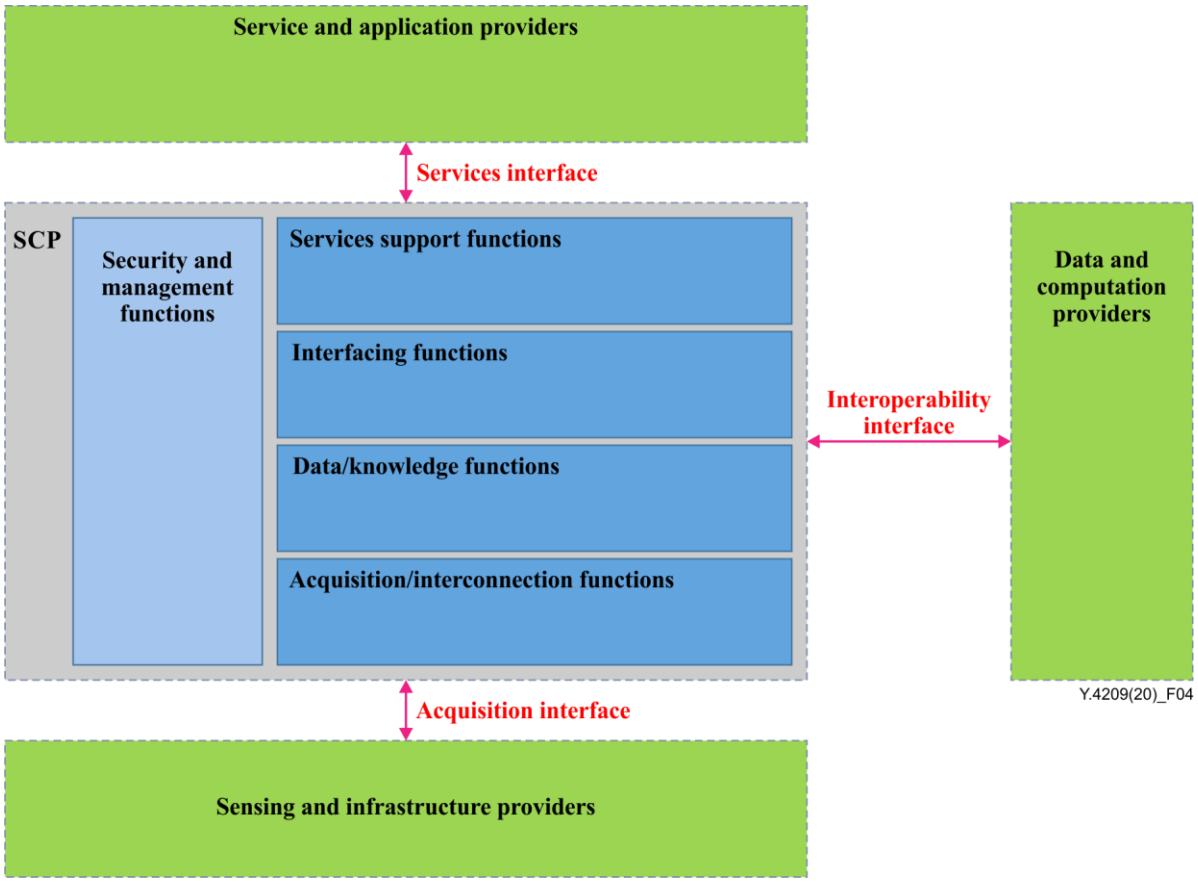

Figure 3 – Overview of a smart city platform and external systems/platforms
Adapted from [ITU-T Y.4200]

[Interop-Req1] Figure 3 is directly applicable to the interoperation of the smart port platform with the smart city platform or other smart elements, i.e., from the interoperability perspective, the smart port platform functions are recommended to be aligned with the functions defined for the smart city platform [ITU-T Y.4200].

[Interop-Req2] Regarding smart port services and open data related services interfaces, these are required to be open, preferably based on internationally recognized standards and in accordance with [ITU-T Y.4200].

[Interop-Req3] Regarding third party interfaces, API-based connectivity is required in order to provide third parties with interoperability capabilities for connecting to the smart port platform.

[Interop-Req4] Although third party interfaces are not necessarily open, these APIs are recommended to be well documented, explaining how to get connected to the smart port platform in a clear and unambiguous way. Through the usage of these APIs, third parties may gain access to different services and information of the smart port platform as appropriate, providing that they do have the access rights needed for this access.

[Interop-Req5] Regarding interfaces with the port area of influence, these interfaces do not need to be necessarily either open nor based on internationally recognized standards, but this is recommended where possible, as well as being documented in a clear and unambiguous way.

[Interop-Req6] It is required to enable the access of the smart port platform only to the services provided by the smart city platform and/or other smart elements that are useful and appropriate for the smart port activity.

[Interop-Req7] Similarly, it is required that the smart city platform and/or other smart elements gain access only to the services provided by the smart port platform that are useful and appropriate for the smart city activity.

Examples of information handled by the smart port services which may be relevant for the smart city platform and/or other smart elements are provided in Appendix I.

Examples of information handled by smart city services which may be relevant for the smart port platform are provided in Appendix I.

An example of smart port interoperation with the smart city, including the flow of the exchanged messages and API REST calls, is provided in Appendix II.

9 Smart services provided by the smart port platform interoperating with smart city platforms and/or other smart elements

Based on the requirements provided in clauses 7 and 8, the smart port platform is able to implement appropriately interoperability, and thus a range of smart services can be provided.

The services provided by the smart port platform can be associated either to devices (such as mobile devices) or can be provided by the devices installed in the smart port.

From a pure service point of view, these services may be classified in four different service categories. These categories are related to the way in which a smart port can contribute to the improvement of the port functioning and the users' experience in the port, which may be improved by the smart port platform interoperating with the smart city platforms and/or other smart elements: services for users including citizens, services for port and commercial operators, services for the city and smart process efficiency.

Examples of information that may be provided by the smart port services, classified per service category, are provided in Appendix I.

Appendix I

Examples of smart port's information exchange and provision of services to the smart city

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

Examples of information handled by the smart port services which may be relevant for the smart city platforms and/or other smart elements include, but are not limited to:

– Levels of pollution produced by port activities and ships.

– Prevision of arrival/departure of ships, with the relevant related information:
  - Number of passengers
  - Purpose of visit
  - Interests of passengers
  - Information from businesses such as tour or shore excursion operators
  - Information related to transportation and destinations
  - Information related to goods

– Information to improve the port users' (including passengers) experience and meet their needs.

– Water supply used in port activities.

– Energy supply used in the port activities.

– Waste management.

– Vehicles on-board and off-board management.

– Contingency plan designed for the case that an emergency event takes place and its needs of support and involvement by the city.

  NOTE – The port may send relevant information to the city in critical crisis, making it possible to do risk evaluation, emergency detection, and coordination with emergency services.

Examples of information handled by smart city services which may be relevant for the smart port platform include, but are not limited to:

– Recommendations from the local and national authorities.

– Information about incidents in the city.

– Municipal events, such as concerts, festivals, sport events.

– Touristic activities in the city and surroundings.

– Points of interest and their tickets availability for the following days.

– Concentrations and demonstrations in the city (especially those affecting means of transport or touristic attractions).

– Information related to transportation such as public transportation, roadways and traffic, disruptions.

– Public services available for tourists and visitors, their location and opening hours.

– Meteorological forecast and relevant recommendations.

Examples of information that may be provided by the smart port services, classified per service category, include but are not limited to:

– Services for users including citizens:
  - Tickets availability and people influx in the case of concerts, sports events, etc. that are held within the port area (onshore or offshore).
– Services for port and commercial operators:
  - Presence of taxis at the port's taxis rank and its correlation with expected needs from passengers' influx.
  - Excursion hiring possibilities, both for the users including citizens going to the port (for example for a day-trip to a nearby island), and for the passengers that arrive to the port and would like to hire an excursion by themselves.
– Services for the city:
  - Capacities, services and facilities offered by and for the city, with a special attention to be paid to touristic offering.
  - Points of interest in the city and in the port (e.g., fish marketplace, commercial areas, exhibitions that take place within the port premises).
  - Information about mobility in the city (e.g., traffic forecasts, routes, incidents).
  - Passengers with origin/destination from/to the port connecting with other means of transport (e.g., flights, long-haul trains, etc.).
  - Hotel availability.
– Smart process efficiency:
  - Efficiency of port and ships' energy consumption.
  - Efficiency of port and ships' water supply usage.
  - Efficiency in the detection and measures taken to minimize the pollution produced by the port, with special attention to sonic pollution and pollution discharged to the sea, and their impact in the city and its surroundings (e.g., nearby beaches).
  - Other data provided for better decision-making at the port level, which can be extended to the city.

Appendix II

Example of smart port interoperation with the smart city

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

This appendix outlines a general flow taking place in the interoperation of the smart port with the smart city, with respect to a generic service provided by the smart port and/or the smart city. This is just an example consisting in a concrete case that may serve as a basis to better understand, from a practical point of view, the implementation of the interoperability between the port and the city.

The example includes a sample API REST calls schema that does not intend to fully describe the messages to be exchanged with accuracy, but just shows the messages' general structure for the purpose of this appendix.

Considered for the example is an event triggering the information flow exchange between the port and the city, i.e., a cruiser arrival at the port. The general schema of the exchanged messages and API REST calls is as follows:

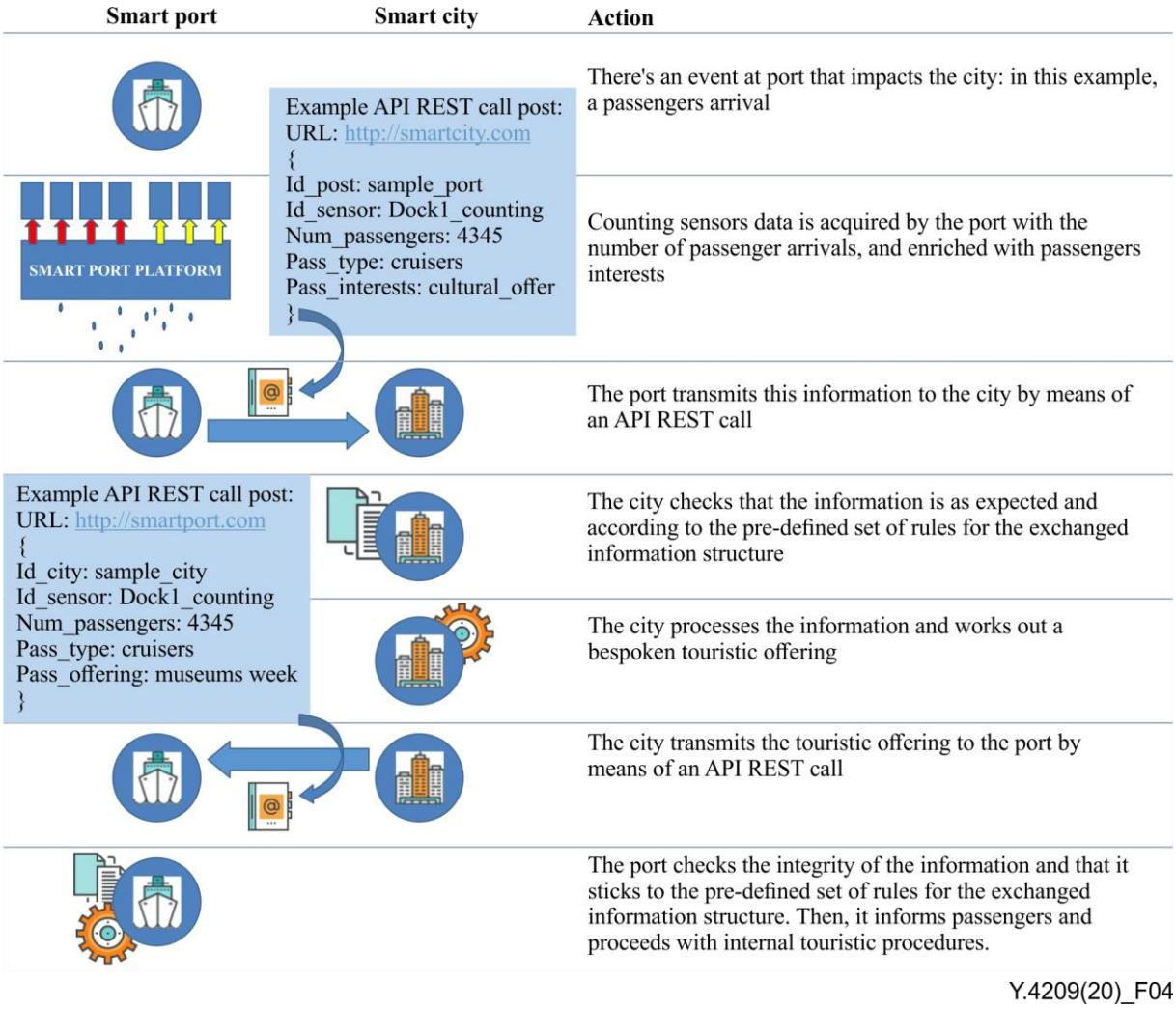

Figure 4 – Example of smart port interoperation with the smart city

Bibliography

[b-ITU-T Y.4900] Recommendation ITU-T Y.4900/L.1600 (2016), *Overview of key performance indicators in smart sustainable cities*.

[b-Forum] Digital Transport And Logistics Forum: Forum led by the European Commission addressing collaborative or federated digital platforms, among other transport and logistic issues.
https://ec.europa.eu/transport/themes/logistics-and-multimodal-transport/digitalisation-transport-and-logistics-and-digital-transport-and_fr

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