ETSI TS 110 174-2-1 V1.1.1 (2018-11)

TECHNICAL SPECIFICATION

Access, Terminals, Transmission and Multiplexing (ATTM);
Sustainable Digital Multiservice Cities;
Broadband Deployment and Energy Management;
Part 2: Multiservice Networking Infrastructure
and Associated Street Furniture;
Sub-part 1: General requirements

Reference

DTS/ATTMSDMC-2

Keywords

digital, network, service, smart city, sustainability

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 2, sub-part 1 of a multi-part deliverable covering Sustainable Digital Multiservice Cities (SDMC). Full details of the entire series can be found in part 1 [i.1].

Modal verbs terminology

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Executive summary

The main objectives of cities are to improve citizens' lives, local economy dynamics and to attract new residents and enterprises to establish locally. Strong evolutions in the fixed and mobile Internet connectivity have impacted the expectations and behaviours of the people and the enterprises they are working in.

Digital services have become an important part of the daily life, crossing many activities within the day. From personalized morning news, through latest updates on the transportation schedule (bus, train, road traffic), the operations at work or schools even up to shopping at the supermarket; the way people behave has greatly evolved. This digital revolution has also entered the area of services and operations delivered by public services such as the city. To adopt this evolution, the Information Communication Technology (ICT) platforms of the city services should be rethought and changed from the silo strategy to an integrated approach. To achieve this goal, the ICT of the city should rely on a unified digital multi services infrastructure that combines cable-based and wireless networks.

This digital multi services infrastructure is expected to be economic, safe, multi purposes and future proof to enable the sustainability of the city with regard to its digital services strategy and roadmap.

Until now silo and vertical ICT have been mainly taken into consideration to deploy services. For a few years now, various smart city efforts and initiatives suggest to strongly adopt a transversal approach in which services share a common Internet Protocol (IP) network, co-operate between each other and furthermore enable third parties to leverage the value offered by the power of data mining and big data processing.

A common and shared multi services architecture for the city's digital services is therefore needed to achieve the city's goals and ambitions at a reasonable cost of ownership and of operation, in shorter time, while strongly taking into consideration the eco efficiency of the different elements of the ICT deployments.

Introduction

Today digital life is leading major evolutions in the expectations that peoples and enterprises have towards the public administrations. As the local representative and interface, the municipality is in front line. The boom of the mobile Internet economy has created many new types of services which requires the city to evolve and adapt to such new behaviours from their target audiences.

City parking or tourism attractiveness are two simple examples of such digital revolution. In both cases, one expects to have access to digital services which respectively facilitate the discovery of an available parking place or to the accessibility of local public transportation facility such as bus, tram and even city bikes.

These digital services have increased the requirements of the ICT infrastructures of the city and amplified the need for a more sustainable Information Technology (IT) design. Smart digital city parking service requires sensors to be deployed within the field, that their real-time status (busy of available parking place) are transmitted through a data network and that a digital service leverage this information to be made available to the driver but also to the financial department in case of the parking usage has to be charged.

Today many city applications are to be seen as island or silo application and have their own network, own software platform and as a result different operations and maintenances. A common architecture will reduce this multiplication of networks and software solutions while improving the economical and energy efficiently costs.

The present document contains information which covers topics such as physical network installation, network transmission implementation, digital services deployments through efficient Next Generation Network (NGN).

The generic IP metropolitan network which is introduced suggests a multi layers design gathering the engineering best practices that telecom service providers regularly follow when deploying a tier 2 telecommunication infrastructure.

Furthermore, the present document presents how urban asset and related street furniture can play a role in the enhancement of the sustainability of the city. Through digital engineering, these urban assets can be promoted to a role which provides additional services beyond their native one.

1 Scope

The present document details measures which may be taken to ease the deployment of smart new services and their multiservice street furniture of digital multiservice city within the IP network of a single city or an association of cities administratively clustered. Furthermore, the suggested measures will enable to engineer a reliable common networking infrastructure which can improve the Total Cost of Ownership (TCO) for the public administration while improving the energy efficiency of the overall deployment.

The present document also lists the requirements which have led to this common architecture.

Clause 4 presents a suggestion of an engineered digital multiservice city.

Clause 5 introduces the active role categorized urban assets can play in the delivery of digital services across the territory of the city.

Clause 6 reviews the spread efforts within the standardization organizations for the digital multiservice city.

Clause 7 suggests both the common engineering required to transform an urban asset into an active network nodes of the digital multiservice city while presenting a concrete illustration of network design for one of the categories.

This will enable the proper introduction and implementation of a new service, application or content within the city digital portfolio on a unified energy efficient network, though it is not the goal of the present document to provide detailed standardized solutions for network architecture.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 110 174-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Sustainable Digital Multiservice Cities (SDMC); Broadband Deployment and Energy Management; Part 1: Overview, common and generic aspects of societal and technical pillars for sustainability".

[i.2] ETSI TS 105 174-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 1: Overview, common and generic aspects".

[i.3] ETSI TR 105 174-4: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 4: Access networks".

[i.4] ETSI TS 105 174-4-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Energy Management; Part 4: Access Networks; Sub-part 1: Fixed access networks (excluding cable)".

[i.5] ETSI TS 102 973: "Access Terminals, Transmission and Multiplexing (ATTM); Network Termination (NT) in Next Generation Network architectures".

[i.6] ETSI TR 103 375: "SmartM2M IoT Standards landscape and future evolutions".

[i.7] AIOTI Recommendations for future collaborative work in the context of the Internet of Things Focus Area in Horizon 2020.

NOTE: Available at https://ec.europa.eu/digital-single-market/en/news/aioti-recommendations-future-collaborative-work-context-internet-things-focus-area-horizon-2020.

[i.8] Light Fidelity TED Talk: "Wireless data from every light bulb".

NOTE: Available at http://www.ted.com/talks/harald_haas_wireless_data_from_every_light_bulb.

[i.9] IEEE 802.11™: "IEEE Standard for Information technology -- Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[i.10] IEEE 802.11s™: "IEEE Standard for Information Technology -- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking".

[i.11] IEEE 802.15™: "Visible Light Communications (VLC)".

[i.12] IEEE 802.15.4™: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (WPANs)".

[i.13] IEEE 802.11ah™: "IEEE Draft Standard for Information Technology -- Telecommunications and Information Exchange Between Systems-Local and Metropolitan Area Networks-Specific Requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment 2: Sub 1 GHz License Exempt Operation".

[i.14] IETF RFC 3031: "Multiprotocol Label Switching Architecture".

[i.15] IETF RFC 4761: "Virtual Private LAN Service Using Label Distribution Protocol (LDP) Signaling".

[i.16] IETF RFC 4762: "Virtual Private LAN Service Using BGP for Auto-Discovery and Signaling".

[i.17] IEEE 802.3™: "Ethernet".

[i.18] IEEE 802.3az™: "IEEE Standard for Information technology -- Local and metropolitan area networks -- Specific requirements -- Part 3: CSMA/CD Access Method and Physical Layer Specifications -- Amendment 5: Media Access Control Parameters, Physical Layers, and Management Parameters for Energy-Efficient Ethernet".

[i.19] IEEE 802.3ab™: "IEEE Standard for Information Technology -- Telecommunications and information exchange between systems -- Local and Metropolitan Area Networks -- Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications -- Physical Layer Parameters and Specifications for 1000 Mb/s Operation over 4 pair of Category 5 Balanced Copper Cabling, Type 1000BASE-T".

[i.20] IEEE 802.3u™: "IEEE Standards for Local and Metropolitan Area Networks-Supplement -- Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units and Repeater for 100Mb/s Operation, Type 100BASE-T (clauses 21-30)".

[i.21] IEEE 802.3z™: " Media Access Control Parameters, Physical Layers, Repeater and Management Parameters for 1,000 Mb/s Operation, Supplement to Information Technology -- Local and Metropolitan Area Networks -- Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[i.22] IEEE 802.3af™: " IEEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems -- Local and Metropolitan Area Networks - Specific Requirements -- Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications -- Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)".

[i.23] IEEE 802.3at™: "IEEE Standard for Information technology -- Local and metropolitan area networks -- Specific requirements -- Part 3: CSMA/CD Access Method and Physical Layer Specifications -- Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements".

[i.24] IEEE 802.1q™: "EEE Standard for Local and metropolitan area networks--Bridges and Bridged Networks".

[i.25] Guide Pratique - Déploiement de la Boucle Locale Optique Mutualisée sur support aérien.

NOTE: Available at https://www.objectif-fibre.fr/wp-content/uploads/2015/12/121115-Guide-pratique-BLOM.pdf.

[i.26] IETF RFC 1034: "Domain Names - Concepts and Facilities".

[i.27] IETF RFC 1035: "Domain Names - Implementation and Specification".

[i.28] UEFI Forum: "ACPI specification".

NOTE: Available at http://www.uefi.org/specifications.

[i.29] IETF RFC 2474: "Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers".

[i.30] IETF RFC 2475: "An Architecture for Differentiated Services".

[i.31] Recommendation ITU-T G.9959: "Short range narrow-band digital radiocommunication transceivers - PHY, MAC, SAR and LLC layer specifications".

[i.32] IEEE 802.1D™-2004: "IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges".

[i.33] IEEE 802.11e™-2005: "IEEE Standard for Information technology -- Local and metropolitan area networks -- Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications -- Amendment 8: Medium Access Control (MAC) Quality of Service Enhancements".

[i.34] IEEE 802.11ad™-2012: "IEEE Standard for Information technology -- Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications -- Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band".

[i.35] IEEE 802.11ac™: "IEEE Standard for Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications -- Amendment 4: Enhancements for Very High Throughput for Operation in Bands below 6 GHz".

[i.36] IEEE 802.3bv™: "IEEE Standard for Ethernet Amendment: Physical Layer Specifications and Management Parameters for 1000 Mb/s Operation Over Plastic Optical Fiber".

[i.37] 3GPP specifications.

NOTE: Available at http://www.3gpp.org/specifications/specifications.

3 Definition of terms and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

digital multiservice cities: cities using digital infrastructure which consists of a single unified high-speed networking infrastructure that allows the ICT systems of the complete city services departments to interconnect seamlessly and securely to each other

street furniture: collective term for objects and pieces of equipment (subcategory of the urban assets), installed on city streets, city roads, and public areas under responsibility of the city for various purposes

NOTE: These objects and equipment belong to the wider terminology of the urban assets as named by cities.

urban asset: collective term to qualify the physical assets which belong to a city and which are located across its territory, in streets, roads, public parks and associated urban constructions

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACPI	Advance Configuration and Power Interface
AIOTI	Alliance for the Internet of Things Innovation

NOTE: In particular AIOTI WG3 on IoT Standardization.

AP	Access Point
ATTM	Access, Terminals, Transmission and Multiplexing
BTS	Base Transceiver Station
CCTV	Closed-Circuit TeleVision
DNS	Domain Name Service
Gbit/s	Giga bits per second
HMI	Human Machine Interface
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IEEE	Institute for Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IIC	Industrial Internet Consortium
IMT	International Mobile Telecommunications
IoT	Internet of Things
IP	Internet Protocol
ISM	Industrial, Scientific, and Medical
ISO	International Organization for Standardization
ISP	Internet Service Provider
IT	Information Technology
ITU	International Telecommunication Union
JTC	Joint Technical Committee
Kbit/s	Kilo bits per second
LAN	Local Area Network
LP-LAN	Low-Power Local-Area Network
LP-WAN	Low-Power Wide-Area Network
LR-WPAN	Low-Rate Wireless Personal Area Networks
LSP	Label Switch Path
M2M	Machine to Machine

MAC	Media Access Control
MAN	Metropolitan Area Network
MPLS	Multiprotocol Label Switching
NFC	Near Field Communication
NGN	Next Generation Network
NT	Network Termination
OASIS	Organization for the Advancement of Structured Information Standards
OCF	Open Connectivity Foundation
oneM2M	Partnership Project oneM2M launched by a number of SSOs including ETSI
ONVIF	Open Network Video Interface Forum
OS	Operating System
PoE	Power over Ethernet
POF	Plastic Optical Fiber
PSIA	Physical Security Interoperability Alliance
QoS	Quality of Services
RF	Radio Frequency
RFC	Request For Comments
SLA	Service Level Agreement
SP	Service Provider
SSID	Service Set IDentifiers
STF	Special Task Force
TR	Technical Report
TxRx	Transceiver equipment
UEFI	Unified Extensible Firmware Interface
UHD	Ultra High Definition
UTP	Universal Twister Pair
VLAN	Virtual Local Area Network
VLC	Visible Light Communications
VPLS	Virtual Private LAN Service
W3C	World Wide Web Consortium
WAN	Wide Area Network
Wi-Fi	Wireless Fidelity
WiGig	Wireless Gigabit
WMM	Wi-Fi Multimedia
WSN	Wireless Sensor Network

4 Multiservice digital infrastructure

4.1 A shared digital infrastructure as core foundation

The core foundation for a digital multiservice city is strongly tightened to the ability that the components of its ICT systems have to interoperate. To achieve this goal, a city should install a shared communications infrastructure that will allow the ICT systems of the complete services departments to interconnect seamlessly and securely to each other.

4.2 Management of the various network cabling infrastructures of the city

Performant ICT requires the access to a high-speed network. To achieve the goal of an ubiquitous digital access the city network backbone should span across the entire territory. When seen through the silos approach, the deployment of such a broadband network architecture, mainly composed of optical fibre and most probably high-speed wireless point to point links, on a large geographical scale is a complex and expensive civil engineering challenge. However, when seen through the cross-domain approach, evidence demonstrates the benefit of sharing passive infrastructure amongst different city departments of city partners such as utilities.

Numerous city network infrastructures can be leveraged to achieve this strategy:

- Access to electrical power distribution infrastructure.