ETSI GS LTN 001 V1.1.1 (2014-09)

Low Throughput Networks (LTN); Use Cases for Low Throughput Networks

Disclaimer

Reference
DGS/LTN-001

Keywords
LTN, M2M, network

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://ipr.etsi.org).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Low Throughput Networks (LTN).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

Low Throughput Network (LTN) is a technology of wide area wireless network with specific characteristics compared to existing radio networks.

LTN enables long range data transportation (distances up to 40 km in open field) and has the capacity to communicate with underground equipment, using minimal power consumption.

Furthermore, the low throughput transmission combined with advanced signal processing provides effective protection against interference. As a consequence, LTN is particularly well adapted for low throughput machine to machine (M2M) traffic where latency may be low.

LTN can be applied to autonomous battery operated M2M devices that sends only a few bytes per day, week or month.

LTN networks can cooperate with cellular networks addressing use cases where redundancy, complementary or alternative connectivity is suitable.

The elements provided in the document are intended to identify potential areas of standardization to ensure interoperability and provide guidelines for device, modem and software solutions for vendors, integrators and operators.

The document is intended for an audience with a business vision whereas the architecture document GS LTN 002 [1] addresses the technical architecture of LTN.

Clause 4 describes the **LTN network** main characteristics and compares LTN with other communications networks (GSM/cellular/PMR), by outlining key differentiators.

Clause 5 lists **typical use cases** with their individual characteristics and associated constraints. Parameters and criteria are described with the objective to get an overview of all applicable use cases.

Clause 6 describes specific **use cases** where the **usage of LTN brings a significant advantage** over regular communication networks.

1 Scope

The present document aims to:

- provide an overview of LTN;
- illustrate the applicability of LTN for industrial scenarios amongst M2M use cases which are particularly suitable for LTN technology.

2 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 http://docbox.etsi.org/Reference.

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

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS LTN 002: "Low Throughput Networks (LTN); Functional Architecture".

[2] IEEE 802.15.4™-2011: "IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)".

2.2 Informative references

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] General facts and figures in France, produced by French Government.

NOTE: Available at http://www.insee.fr/.

[i.2] EN 13757: "Communication system for readers and remote reading of meters".

[i.3] ETSI TR 102 691: "Machine-to-Machine communications (M2M); Smart Metering Use Cases".

3 Definitions and abbreviations

3.1 Definitions

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

accelerometer: device that measures proper acceleration

actuator: type of motor that is responsible for moving or controlling a mechanism or system

authentication: property by which the correct identity of an entity or party is established with a required assurance

back end system(s): system that supports back-office applications

budget link: way of quantifying the link performance

cyphering: cryptographic transformation of data (see cryptography) to produce cipher text

geofencing: application that uses the global positioning system (GPS) or radio frequency identification (RFID) to define geographical boundaries

IEEE 802.15.4 compliant protocol: specification for a suite of high level communication protocols used to create personal area networks built from small, low-power digital radios

multicast: communication between a single sender and multiple receivers

payload: cargo information within data transmission

practical daylight indoor**:** terminology used in radio to express range of coverage

radio downlink: transmission path from a cell site to LTN End Point (LEP)

security: ability to prevent fraud as well as the protection of information availability, integrity and confidentiality

turbidity: key indicator of water quality in stream and watershed monitoring

unicast: communication between a single sender and a single receiver over a network

Wireless Mbus: M-Bus interface is made for communication on two wires

NOTE: A radio variant of M-Bus is Wireless M-Bus.

3.2 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
Ah	Amp-hours
CAPEX	CAPital EXpenditure
CO	Carbon monoxide
CO2	Carbon dioxide
DA	Device Authentication
DI	Data Integrity
DP	Data Privacy
ECG	ElectroCardioGraphy
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
GWY	GateWaY
HES	Head End System
IHD	In-Home Display
IP	Internet Protocol
LAP	LTN Access Point
LEP	LTN End-Point
LPWA	Low Power Wide Area
LTN	Low Throughput Network
M2M	Machine to Machine
NW	NetWork
OPEX	OPerating EXpense
OTA	Over-The-Air
PAYD	Pay As You Drive
PMR	Private land Mobile Radio
PSTN	Public Switched Telephone Network
RTC	Real Time Clock
SMS	Short Message Service
UHF	Ultra High Frequency
VHF	Very High Frequency
VOC	Volatile Organic Compounds

WAN	Wireless Access Network
µWh	microwatt-hour

4 LTN Overview

4.1 Introduction

This clause provides an overview of some of the main characteristics of the LTN network. As illustrated in figure 1, the LTN network is typically based on LTN End-Point(s) (LEP) connected via a Radio Network to one or multiple LAP(s) (LTN Access Point). LTN networks are managed by Back End System(s) and deliver end user services via Customer Service Platform(s). More details on the building blocks and interfaces (A, B, C) are provided in the LTN architecture document GS LTN 002 [1].

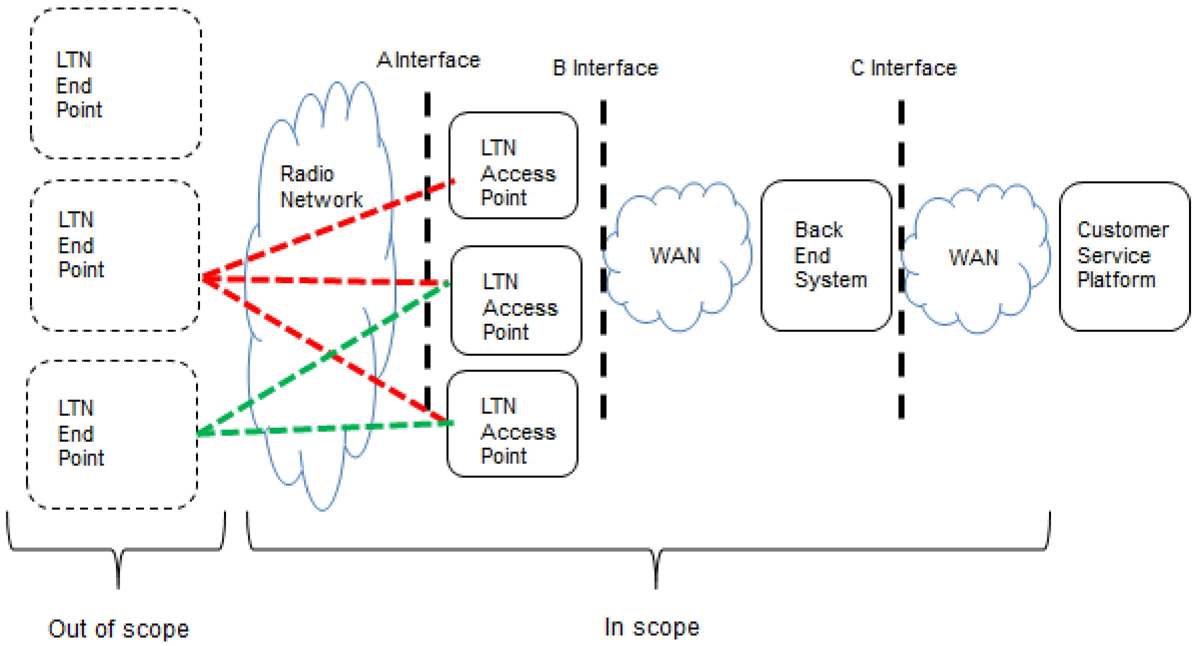

Figure 1: LTN network overview

4.2 LTN characteristics & points of comparison

This clause provides the pre-requisites to understand how LTN can be applied to the use cases described below and the comparison with other networks type's capabilities.

Table 1: LTN comparison with other network technologies

Characteristic	LTN	GSM SMS	GSM/Cellular (GPRS)	Wireless Mbus	IEEE 802.15.4 [2] compliant protocol	PMR
Typical Frame size (payload)	12 bytes	140 octets	IP packet (0-65 000 bytes)	30-130 bytes	127 bytes (104 bytes payload)	100 bytes

Table 2: Usage oriented characteristics related to the devices connected to the network

Characteristic	LTN	GSM SMS	GSM/Cellular (GPRS)	Wless Mbus (mode N) (see note 2)	IEEE 802.15.4 [2] compliant protocol	PMR
Typical applications	Alarm, telemetry, control, sensing, tracking	Alarm status, mobile health	Telemetry, metering, control, tracking,	Smart metering	Home &Process automation, metering	Data over voice channel for police
Differentiated Application	Low power sensing, intercontinental roaming if same frequency data received, support nomadic (across cell) & mobility	Support direct device to device transmission	Mobility, roaming Needs application to collect data	Fixed network	Low power, 802.15.4, industry domain profiles	Private network, private frequency, large power
Typical Usage • typical bytes per day • maximum kilobytes per day	< 200 B/day (type) 5 KB/day (max)	1 SMS/day (140 B)	< 10-15 kB/day	< 200 bytes/day < 50 kBytes/day	Typical around 150 kB/day Max < 1 GB/day	50 bytes a 1-2 Mo
Payload data rate • typical for 1 message in bits per second • maximum peak possible in kilobits per second	< 10-100 b/s (type) < 50 kb/s (max)	Not relevant	35 kpbs	<2,4-4,8> kbps 19,2 kpbs	250 kb/s on 2,4 GHz 20 kb/s on 868 MHz	<500 bps- 4 kps>
Maximum Latency From modem to availability on internet	ms to second	second	640ms (ping)	ms to second	250 s on 2,4GHz 786 ms on 868 MHz (min 15 ms)	Relative to data rate (few ms)
Typical distance "day light indoor" (see note 1) density of antenna • Range from a device to an antenna • Density to cover city of 1 M inhabitants • Density to 1 000 km² of country side area	Up to 10-12 km (city) Up to 40-60 km (countryside) 3 1-3	3 km (city) 30 km (countryside)	3 km (city) 30 km (countryside)	up to 1 km (city) Up to 7 km (countryside) 50 gwy 10 gwy	10 m	Up to 10-12 km (city) Up to 40-60 km (countryside) 3 1-3 (same as LTN)
Frequency bands	868-915 MHz (typical) 433-868-915 (< 1 GHz)	900, 1 800 MHz	900, 1 800 MHz	169 MHz		VHF, low VHF, high VHF, low UHF
OPEX/CAPEX end user (+ device/gwy deployment)	Modem+subscription	Modem+subscription	Modem+subscription	Modem+GWY	Modem+GWY	Network + licence (user owns the NW)
Budget link	Up to 170 dB (100 bps, 500 mW)	145 dB (2W)	145 dB (2W)	Up to 150 dB (2,4 kbps, 500 mW)	115 dB	Up to 170 dB
Downlink	Possible	Yes	Yes	Yes	Yes	Yes
Security Authentication, cyphering	Yes	Yes	Yes	Yes	Yes	Yes

NOTE 1: Practical daylight indoor: typical terminology used in radio to express range of coverage.
NOTE 2: Mode N, a specific transmission mode, as defined in EN 13757 [i.2].

Table 3: Energy characteristic for a device with a usage of 12 messages per day, 100 bytes per message

Characteristic	LPWA (Low Power Wide area) Technologies		Conventional cellular	Typical multi hop area Networks
	LTN	Wireless Mbus	GPRS/3G	IEEE 802.15.4 [2] compliant protocol
Electrical consumption for a modem (average)	24 µWh mono 120 µWh bidir	75 µWh mono 80 µWh bidir	4 000 µWh -	150-700 µWh -
Battery life voltage 3 V (2,5 Ah for modems)	20 years	20 years	2 months	2-10 years

4.3 Key differentiators of LTN

LTN is a standalone network that provides open interfaces for an ecosystem of end points, access points, networks and service providers.

LTN differentiators include:

- Ultra Low Power on the end points
- Optimization for Low Payload volume and data rate
- High budget link for improved coverage (urban, underground, fixed objects)
- Low cost of operations
- Low cost of ownership

5 Use cases

5.1 Characteristics and criteria for use cases

Table 4 lists and describes the parameters and constraints that are used to classify the LTN use cases.

Table 4: Parameters and constraints for LTN use case classification

Operations & maintenance	
Check-alive	The network ensures on a regular basis that a device is connected to the network: operational and reachable. This kind of operation may not be needed for all use cases.
Keep-alive	Device ensures on a regular basis that is connected to the network: operational and reachable.
RTC update	Ensure that the device can do a Real Time Clock update on a regular basis.
Device monitoring **Alarm transmission**	Uplink spontaneously transmitted data from the end-point toward the HES, with the purpose of informing the HES that an unexpected event has occurred at the end-point. This is generated by the device and not by the head end.
Device monitoring **Battery status update**	Battery life time monitoring. Spare battery or a mix of other power sources.
Provisioning	Specific information or a signal needs to be sent in order to initialize or guarantee that the device is operational.
Location/movement	Location of a moving device (e.g.: dog, car), determined by LTN network.
Electrical consumption	Specific constraints on energy consumption.

Usage & hardware constraints	
Payload volume	Typical bytes per day + Maximum kilobytes per day. This is directly linked to number of update/read per day.
Payload data rate	Typical for 1 message in bits per second. Maximum peak possible in kilobits per second.
Maximum Latency	The time between the data is sent from the device to the server back end or vice versa.
Data Privacy (DP)	Sent data are encrypted in order to limit the access to the transmitted information.
Device Authentication (DA)	Network devices authenticate themselves in order to avoid that a pirate device can access to the network.
Data Integrity (DI)	Network devices protect data integrity, in order to avoid modifications or falsification of transmitted information.
Delivery assurance/reliability	For surveillance or alarm application for instance, high reliability is required and all packets shall be delivered. For other services, interpolation for missing samples can be performed, this is typically the case of temperature monitoring.
Downlink • Unicast • Multicast • Broadcast	Occasional or regular commands coming from the LAP and addressing one or more LEPs. (e.g. synchronization, cryptography, configuration, actuator/command, tariff modification, etc.).

5.2 Domains of application and use cases

The following use cases are applicable to LTN.

The LEP sends sensor data, alerts or acknowledgements. The back end server sends commands and acknowledgments.

Use cases can use unidirectional or bidirectional traffic this depends on the network capability, the LEP capability or the application requirements.

Table 5: Domains of application and use cases

Domain	Sub-domain	Use case
Metering	Water & Gas distribution	Collect 3-4 times daily water and gas usage data
	Electricity distribution	Collect daily or hourly electricity usage data
Infrastructure networks	Water & Gas transportation	Water and Gas infrastructure network surveillance (alarm, metering parameters)
	Electricity transportation	Electricity transport status monitoring and command/control
	Road/traffic management	Traffic light control, traffic level monitoring, emergency gate status control, digital signage status and updates
	Pipelines	Collect data on Metrics (temperature, pressure), alarms, leakage, vibration
	Drains	Collect data on Levels, turbidity ratio
Environment/Smart City	Waste management	Collect data on Levels, location
	Air pollution monitoring and alerting	Collect data on Humidity, temperature, VOC, CO2, CO, etc.
	Acoustic noise monitoring	Noise level monitoring
	Public Lighting monitoring	Bulb monitoring
	Parking Management	Availability monitoring
	Self Service bike rental	Bike & rack availability, status monitoring, location
	Digital board monitoring	Status, screen display rotation/timeslot control
	Water pipe leakage monitoring	Leakage monitoring

Domain	Sub-domain	Use case
Environment/Country side	Soil quality monitoring	Acidity, humidity, nitrogen , landslide prevention,
	Livestock surveillance	Geolocation, health status, wolf prevention (accelerometer), geofencing, teleguidance
	Cattle & pet monitoring	Geolocation
	Climate	Rain, wind, temperature, humidity (pressure)
	Irrigation	Leakage
Remote monitoring (telesurveillance)	House	Fire detection, smoke, CO, flood, leakage, intrusion, temperature, home automation (blinds, etc.)
	Building	Fire detection, smoke, CO, flood, leakage, intrusion, temperature, building automation (blinds, heating, air conditioning, etc.), telesurveillance
Industrial	Water tank management	Water level, leakage, refill management
	Asset tracking	Location, antitheft
Automotive	Vehicle tracking	Location, antitheft
	Impact detection	Send message when vehicle is stopped
	Pay as you drive	Send message to the conductor about the driving behaviour Collect data about driving behaviour
	Assistance request, Break down call, Comfort Call	Send a localization message to request support
Logistics	Goods tracking	Localization of goods
	Conservation parameters	Send message alarms related to temperature/shock for sensitive products
Healthcare	Patient monitoring	Fall down detection, out of area detection, ECG monitoring, activity monitoring, Alert
	Home Medical Equipment status and usage	Control of correct usage of medical equipment and status
Conventional Cellular Cooperation	Alarm sending	Send alarm message and activation of 3G for sending data (video, etc.)
House appliances	Pet tracking	Localize pets
	White goods	Usage identification Preventive maintenance
	Personal asset	Location of luggage , clothes, satchel , phone (when battery down), etc.
Truck	Tyre monitoring	Check pressure and tyre usage
Identification	Authentication	Additional level of security for exchange Identification/authentication data

5.3 Use cases recapitulation

Table 6: Number of LEP estimate per use case

	100 M inhabitants basis (see notes)
Water smart meter	30 M
Gas smart meter	16 M
Electricity smart meter	57 M
Waste management	25 M
Air Pollution	200 k
Acoustic Noise	200 k
Public Lighting	1 M
Parking management	4 M
Self Service Bike rental	200 k
Automotive	60 M
Paper Advertising Board monitoring	50 k
Patient Monitoring	1 M
TOTAL number of LEP	185 M (around 2 per inhabitants)

NOTE 1: The above numbers are based on a population of 100 M inhabitants and estimate the number of LEP per different LTN use cases.
NOTE 2: 100 M inhabitants, 55 % individual houses/45 % apartment buildings [i.1].
NOTE 3: 41 M households with an average of 2,4 people/households [i.1], 23 M residential house, 18 M apartment buildings, dustbin: 10 % of apartment buildings, 50 000 cities.
NOTE 4: Parking excludes: indoor parking (use wire line connectivity), private parking.
NOTE 5: Self Service Bike Rental: based in France [i.1], Automobile: based in France [i.1].

6 Specific LTN use cases

This clause details use cases that are suited for LTN or that can be implemented only with LTN.

6.1 Metering

Metering is a broad domain that covers multiple areas listed below.

Application	Number of End Point	Uplink			Daily Uplink load (kbytes)	Downlink			Daily downlink load (Kbytes)
		Periodicity	Dataset (bytes)	Long preamble		Periodicity	Dataset (bytes)	Long preamble	
Water metering	37 500	1/day	200	Option	7 324	1/week	50	Yes	262
Gas metering	37 500	4/hour	100	Option	351 652	1/week	50	Yes	262
Waste Management	100	1/hour	50	Option	117	none	none	none	0
Pollution monitoring	150	1/hour	1 000		3 515	2/day	1 000	Yes	293
Pollution alerting	20	4/hour	5000	Option	9 375	1/week	1 000	Yes	3
Public lightning	200	1/day	20 000		3 906	2/day	1 000		390
Parking management	80 000	1/hour	100	Option	187 500	1/day	100	Yes	7812
Watering	200	2/day	100	Option	39	1/day	100	Yes	20
Self-service bike renting	500	4/hour	50	Option	2 344	1/hour	50	Yes	586
Total	156 170				565 684				9 628

Figure 2: Metering information (Source [i.3])

6.1.1 Water & gas metering

Typical segmentation of the water and gas metering domain includes high end needs with sophisticated features, and low end needs that are more basic.

Table 7: High-expectations metering characteristics

Need	Period	Payload (raw data)	Communication mode
Consumption sampling (log)	4/hour to 1/hour	N/A	N/A (local storage)
Index transmission	4/day to 1/day, periodic	→ 10 bytes (one log) → 200 bytes + header (optional)	1.5-way or 2-way
Downlink command (valve, tariff modification, etc.)	1/month to 1/year	5 to 50 bytes	1.5-way or 2-way
Firmware upgrade (OTA)	1/year to 1/device life time	Several kBytes	1.5-way or 2-way
Alarm transmission	Occasionally	6 to 25 bytes	1.5-way
Connectivity (check-alive)	1/hour to 1/day	At least 1 byte	1.5-way or 2-way
Real Time Clock (RTC) update	1/day to 1/week	Up to 10 bytes	1.5-way or 2-way
Battery status update	1/day to 1/month	Up to 10 bytes	1.5-way or 2-way
Encryption key update	1/day to 1/year		2-way
In-Home Display (IHD) communication	1/hour → to 1/day →	→ 10 bytes → 200 bytes	1.5-way or 2-way
Maintenance	1/day to 1/year	10 bytes to 1kByte	1.5-way or 2-way

Table 8: Low expectation metering characteristics

Need	Period	Payload (raw data)	Communication mode
Consumption sampling (log)	1/hour to 1/day	N/A	N/A (local storage)
Index transmission	1/day to 1/month, periodic	→ 10 bytes (one index) → 200 bytes + wake up preamble (optional)	1-way or 1.5-way
Downlink command (valve, tariff modification, etc.)	1/month to 1/year	5 to 50 bytes	1.5-way
Firmware upgrade Over-The-Air (OTA)	Optional		
Alarm transmission	Occasionally	6 to 25 bytes	1-way or 1.5-way
Connectivity (check-alive)	1/day to 1/month	At least 1 byte	1-way or 1.5-way
Real Time Clock (RTC) update	1/day to 1/month	Up to 10 bytes	1.5-way
Battery status update	1/day to 1/month	Up to 10 bytes	1-way or 1.5-way
Encryption key update	Optional		
In-Home Display (IHD) communication	1/day (optional)	→ 10 bytes → 200 bytes	1-way or 1.5-way
Maintenance	1/month to 1/year	10 bytes to 1kByte	1.5-way or 2-way (local)

6.1.2 Electricity metering

Electricity metering has a similar segmentation as the tables above, with high expectations and low expectations requirements.

Table 9: High expectation electricity metering characteristics

Need	Period	Payload (raw data)	Communication mode
Consumption sampling (log)	1/min to 1/hour	N/A	N/A (local storage)
Index transmission	6/hour to 1/day, periodic	several hundreds of bytes + header (optional)	1-way or 2-way
Downlink command (contact, tariff modification, etc.)	1/month to 1/year	5 to 1 kBytes	2-way
Firmware upgrade Over-The-Air (OTA)	1/year to 1/device life time	Several kBytes	2-way
Alarm transmission	occasionally	6 to 200 bytes	1-way
Connectivity (check-alive)	1/hour to 1/day	At least 1 byte	1-way or 2-way
Real Time Clock (RTC) update	1/day to 1/week	Up to 10 bytes	2-way
Encryption key update	1/day to 1/year	N/A	2-way
In-Home Display (IHD) communication	1/hour to 1/day	10 to 200 bytes	1-way or 2-way
Maintenance	1/day to 1/year	10 to several kBytes	2-way

Table 10: Low-end electricity metering characteristics

Need	Period	Payload (raw data)	Communication mode
Consumption sampling (log)	1/min to 1/hour	N/A	N/A (local storage)
Index transmission	6/hour to 1/day, periodic	several hundreds of bytes + header (optional)	1-way or 1.5-way
Downlink command (contact, tariff modification, etc.)	1/month to 1/year	5 to 1 kBytes	1.5-way
Firmware upgrade Over-The-Air (OTA)	Optional	N/A	N/A
Alarm transmission	Occasionally	6 to 200 bytes	1-way
Connectivity (check-alive)	1/hour to 1/day	At least 1 byte	1-way or 1.5-way
Real Time Clock (RTC) update	1/day to 1/week	Up to 10 bytes	1.5-way
Encryption key update	Optional	N/A	N/A
In-Home Display (IHD) communication	1/hour → to 1/day →	10 to 200 bytes	1-way or 1.5-way
Maintenance	1/day to 1/year	10 to several kBytes	1.5-way or 2-way (local)

6.2 Smart City

The Smart City use case(s) have a number of interesting characteristics.

Table 11: Smart city LTN advantages

Smart City Use Case	LTN key benefits	LTN general benefits
Connected vehicles	Ready to operate for after sale market (not wired, "place & play")	• Collect data and Push data efficiently • High object density • Can co-exist with multiple radio technologies already deployed in urban environment • One network for aggregation of many services • high coverage with lightweight infrastructure, suitable for dense urban environment
Public transportation	Autonomous system monitoring (tyre pressure, fuel level, etc.)	
Smart home and intelligent buildings	Ready to install solution (fire detectors, temperature control, usage knowledge)	
Urban metering	Low cost of ownership for monitoring systems deployed in public domain (fire hydrants, street lightning, wastewaters, solid waste, etc.	
Innovative urban services	Low cost of ownership that allows large numbers of sensors for more precise environmental monitoring (noise, electromagnetic field, park places, traffic status, structural health, air quality, etc.)	
Remote patient monitoring	Deployment independent from local communication infrastructure and the mains (i.e. ADSL, PSTN, etc.)	

6.3 Automotive

Automotive use cases including PAYD, geo-localization assistance, stolen vehicles, shock detection can be delivered with LTN.

These services are all based on the following set of infrastructure and services:

- Embedded/on board devices including:
  - GPS
  - Communication modem
  - Power supply
- A communication network
- Back end system
- Equipment installation/set up
- Back off services (call centre, maintenance operational centre, etc.)

Table 12: Benefits of LTN (estimated by LTN group)

Component	% of current cost	LTN benefit	Comment
On board Device	30 %	15 % : Divide by ½ the cost of the equipment	
Communication Network	15 %	1,5 % : Divide cost by 5 or 10	
Back end System	5 %	Same: 5 %	
Equipment Set up	50 %	Cost = 0 No need for equipment by professional	Small size and low power LTN equipment does not require connectivity to the vehicle battery
Back off services	Independent of the NW (not taken into account)		
Total	100 % E.g. 100 euros	21,5 % E.g. 21,5 euros	

6.4 Cellular/LTN cooperation

Cellular and LTN have different capabilities, and a number of use cases could benefit from combining the two networks, by using LTN as a back up to cellular network to carry small critical packets when the cellular network is out of reach, or accidently out of service, or as a default network for small payload traffic.

Figure 3 shows a hybrid solution for Mobile Carriers that could complement their existing mobile network services with a LTN network solution.

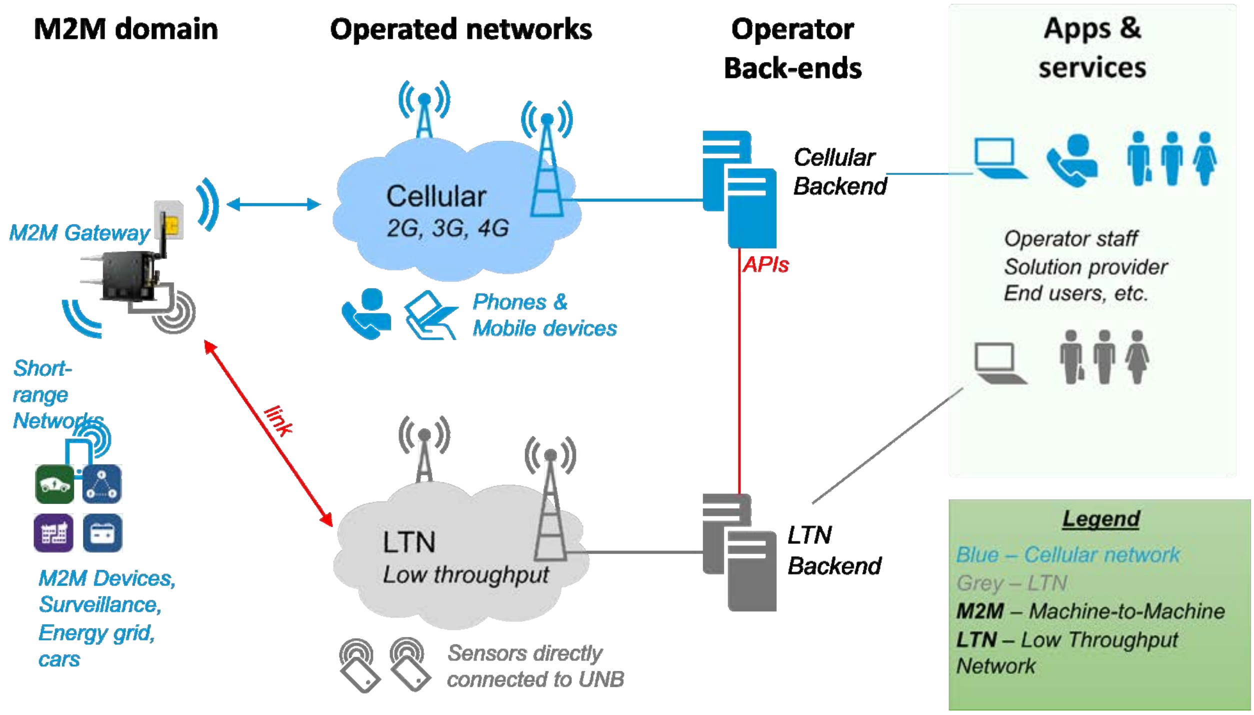

Figure 3: Cellular collaboration with LTN

The following scenarios could be envisioned, providing a bidirectional LTN network:

- Battery saving: 3G back end sends command to LTN to wake up the gateway 3G modem to send data via 3G.
- Keep alive: LTN is used for low power keep alive; 3G is used for data transmission, etc.
- Wake up device via LTN alarms, then transmit via 3G (i.e. video).
- E.g.: call flow.
- Sensor => Gwy => LTN back end "OK".
- Sensor => Gwy (alarm) => activate cellular modem => send data via cellular.
- Sensor => Gwy (alarm) => back end => activate cellular modem => Send data via cellular.
- Redundancy: send data via both LTN and cellular (secured services).
- Security: LTN to collaborate with cellular to increase security.
- Fall-back: When 3G is out of service, limited coverage => LTN is used as fall back to carry limited throughput.

Annex A (informative): Authors & contributors

The following people have contributed to the present document.

Rapporteur:
Chief Technologist, Marie-Paule Odini, Hewlett-Packard

Other contributors:

Chairman, Alain Gaudon, Sigfox

Christophe Fortet, Sigfox

Benoit Ponsard, Kimeggi

Francois Sforza, Semtech

Olivier Seller, Semtech

Vincenzo La Tosa, Elster

Aurelien Cogoluegnes, Hewlett-Packard

Marylin Arndt, Orange

Jean Schwoerer, Orange

Patrick Favennec, Covea

Annex B (informative): Bibliography

ETSI TS 102 689: "Machine-to-Machine communications (M2M); M2M service requirements".

ETSI TS 102 690: "Machine-to-Machine communications (M2M); Functional architecture".

ETSI TS 102 921: "Machine-to-Machine communications (M2M); mIa, dIa and mId interfaces".

ETSI EN 300 220: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW".

ETSI EN 300 113-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement".

ETSI EN 300 113-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

FCC CFR 47 Part 15: "Telecommunication: Radio Frequency Devices".

ETSI EN 300 328: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

OMA DM: "Device Management".

ETSI TR 103 055 (V1.1.1): "Electromagnetic compatibility and Radio Spectrum Matters (ERM); System Reference document (SRdoc): Spectrum Requirements for Short Range Device, Metropolitan Mesh Machine Networks (M3N) and Smart Metering (SM) applications".

ETSI TR 102 725: "Machine-to-Machine communications (M2M); Definitions".

ETSI TR 102 935: "Machine-to-Machine communications (M2M); Applicability of M2M architecture to Smart Grid Networks; Impact of Smart Grids on M2M platform".

ETSI TR 102 898: "Machine to Machine communications (M2M); Use cases of Automotive Applications in M2M capable networks".

ETSI TR 102 732: "Machine-to-Machine Communications (M2M); Use Cases of M2M applications for eHealth".

ETSI TR 102 966: "Machine-to-Machine Communications (M2M); Interworking between the M2M Architecture and M2M Area Network technologies".

ETSI TR 102 886 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM);Technical characteristics of Smart Metering (SM) Short Range Devices (SRD) in the UHF Band; System Reference Document, SRDs, Spectrum Requirements for Smart Metering European access profile Protocol (PR-SMEP)".

History

Document history		
V1.1.1	September 2014	Publication