Connect
Low Power Wide Area
swisscom Enterprise IoT

www.swisscom.ch/iot

Content

Network technologies at a glance	**4**
LPN (LoRa)	**6**
NB-IoT	**8**
LTE-M (LTE Cat. M1)	**10**
LTE (Cat. 1)	**12**
Overview of main features	**14**
Detailed overview of network features	**16**
Detailed overview of supported network features, security, devices and their features	**18**

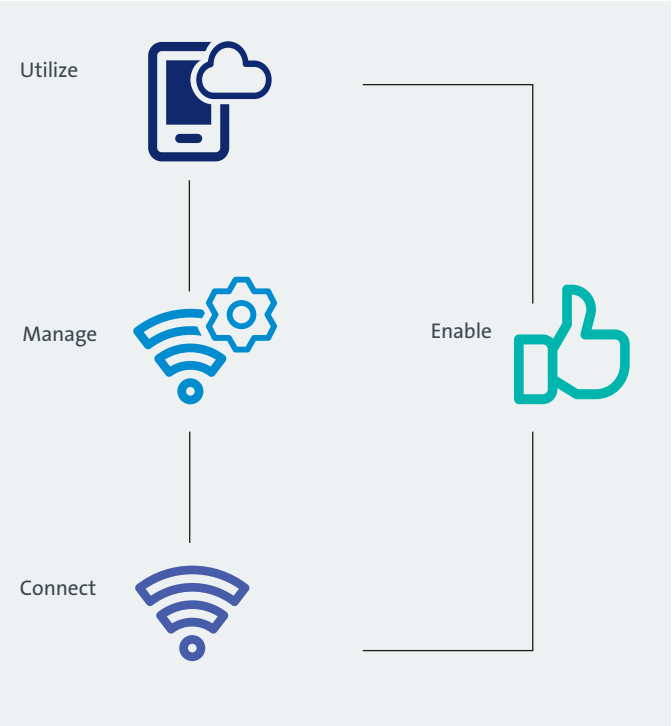
Network technologies at a glance Focus on Low-Power Wide-Area technologies

The Internet of Things (IoT) is a worldwide infrastructure that connects different objects such as meters, surveillance equipment and security systems with each other and with IT applications. Valuable information can therefore be collected, analysed and used. Data management is easier and efficient data transmission drives lucrative business models, automated processes and new types of customer interaction.

Swisscom Enterprise IoT guarantees secure data transmission by providing you with the networks you need for your IoT application. Network requirements vary according to data volumes, range, network coverage and data sensitivity.

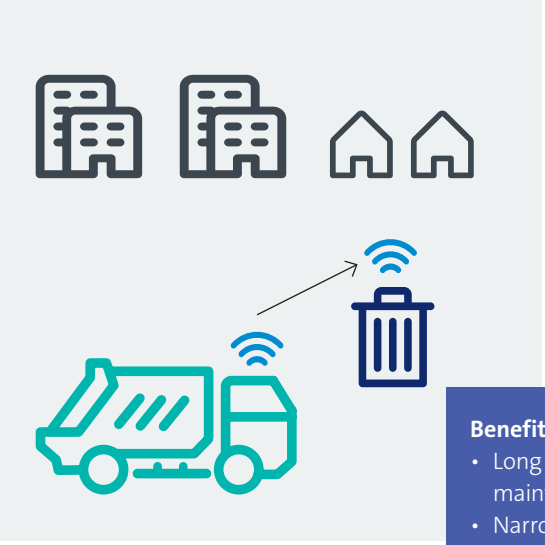
We follow a modular, technology-neutral approach and support all relevant standards such as LoRaWAN, Cat. M1, NB-IoT, 3G, 4G and 5G. With access to efficient IoT technologies, new business cases can be created for every conceivable industry application – whatever type of device or access option is used for your IoT application. Tap into the innovative potential of digitisation with Swisscom Enterprise IoT.

Enterprise IoT



LPN (LoRa)

Smart City



Benefits

- Long battery life with minimal maintenance costs
- Narrow bandwidth means wide range and energy-efficient transmission
- High scalability, low network costs, efficient local expansion
- Suitable for small volumes of data

https://lora-alliance.org/about-lorawan

The Low Power Network (LPN)* is a standalone data network specially created for IoT applications that transmi**t small quantities of data.** The resulting benefits make it possible to create a huge wealth of new IoT networks and digital applications **for private and business customers.**

Most common types of application (massive IoT)

- Smart cities: smart waste management, smart lighting, smart parking
- Smart utilities: remote reading of gas, water and electricity meters
- Smart buildings: meeting room management, connected fire extinguishers and defibrillators, temperature and air quality measurement
- Agriculture: monitoring of weather and plant growth, livestock tracking, soil quality measurement

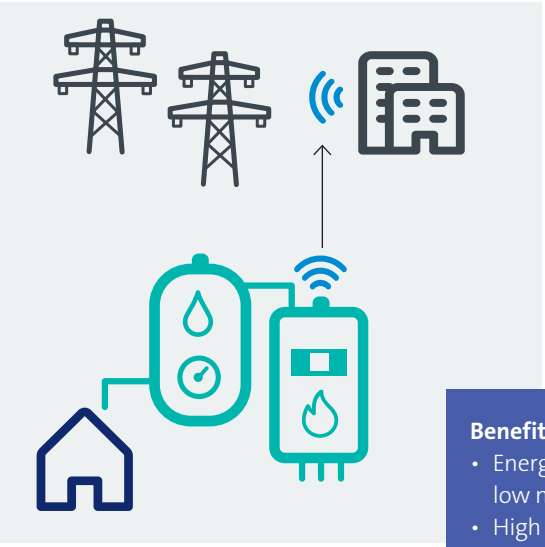
Application example

Temperature and presence sensors in office buildings deliver relevant information that can be used to adapt electricity consumption to current requirements and increase air quality and energy efficiency.

* The wireless network is based on the open LoRaWAN specification

NB-IoT

Smart Utilities



Benefits

- Energy-efficient transmission with low network costs
- High availability, security and reliable data transfer in hard-to-reach locations such as cellars, remote areas and underground
- Suitable for stationary use without power supply
- Suitable for large quantities of devices

http://www.3gpp.org/specifications/releases/

NB-IoT (Narrowband-IoT)* is a special extension of the LTE network (4G network) suitable for l**arge numbers and a high density** of devices and provides **deep building penetration.**

Most common types of application (massive IoT)

- Smart utilities: gas, water and electricity meters, smart grid management
- Industry 4.0: process monitoring and control, heating, ventilation and air conditioning technology
- Wearables: tracking of children and the elderly, animal tracking, remote control of domestic appliances

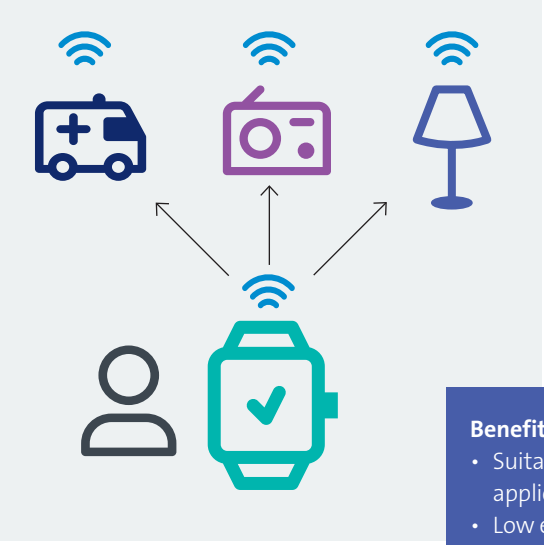
Application example

It is no longer necessary to regularly send an employee into individual buildings in order to see how much energy and water they are consuming each year. Smart meters can do this with the help of sensors and transfer the data automatically to your data centre.

* Cellular mobile network running on licensed spectrum; 4G, 3GPP Release 13

LTE-M (LTE Cat. M1)

Wearables



Benefits

- Suitable for quality-sensitive applications
- Low energy consumption and maintenance costs
- Long battery life, wide range and high security
- Higher data throughput (compared with NB-IoT), supporting software updates

http://www.3gpp.org/specifications/releases/

LTE-M is an extension of the LTE network (4G network)* suitable for **quality-sensitive applications.** This network technology is extremely energy-efficient and also supports mobile cell handover for non-static applications and voice functionalities (VoLTE).

Most common types of application (critical IoT)

- Security and surveillance applications: object and traffic monitoring
- Transport and logistics: fleet management, goods tracking
- Wearables: tracking of children and the elderly, animal tracking, remote control of domestic appliances
- Emergency applications: passenger lifts

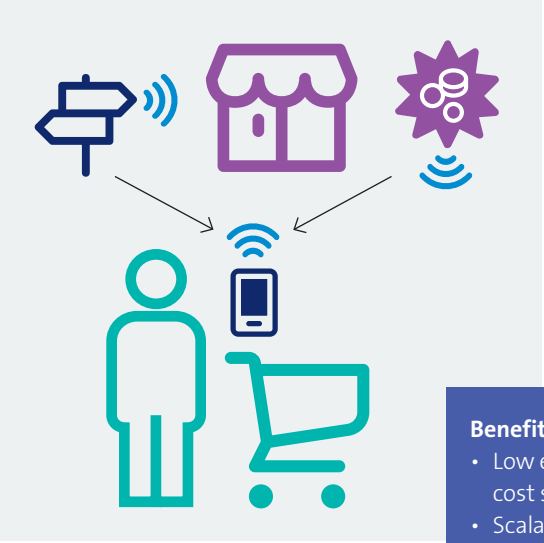
Application example

LTE-M is particularly suitable for mobile telemetry systems that require high reliability. These could include voice-controlled emergency wristwatches that need to be able to transmit small data volumes in critical timeframes.

* Cellular mobile network running on licensed spectrum; 4G, 3GPP Release 13

LTE (Cat. 1)

Digitale Signage



Benefits

- Low energy consumption and cost structure
- Scalability on 4G networks
- Suitable for VoIP video streaming
- High data transfer rate and security

http://www.3gpp.org/specifications/releases/

The lowest device category in the existing LTE network (4G network)* is suitable for IoT applications on account of a relatively **low data rate** and yet it offers the necessary speeds for **data streaming.**

Possible types of application (critical IoT)

- Health: health monitoring, remote controlled operations
- Security and surveillance applications: video surveillance, object surveillance, automatic emergency call
- Digital signage: electronic traffic and display signs, information boards, advertising
- Industry 4.0: remote monitoring and control, predictive maintenance

Application example

A potential customer enters a shopping centre and is informed of current promotions on his mobile device via a live stream. Through personalised advertising, potential customers can be reached directly at the point of sale, which makes them more likely to make a purchase.

* Cellular mobile network running on licensed spectrum; 4G, 3GPP Release 8

Overview of main features

	LPN (LoRa)	NB-IoT	LTE-M (LTE Cat. M1)	LTE (Cat. 1)	2G* (M2M)
Data rate	●○○○○	●○○○○	●●○○○	●●●●●	●●○○○
Range	●●●●○	●●●●●	●●●●○	●●●○○	●●●○○
Energy efficiency	●●●●●	●●●●○	●●●○○	●○○○○	●●●○○
Voice	No	No	Yes	Yes	Yes
Module costs	●○○○○	●●○○○	●●○○○	●●●●○	●●○○○
Availability	Since 2016	From Q4 2018	From Q4 2018	Since 2014	Until end of 2020
Security	●●●●○	●●●●●	●●●●●	●●●●●	●●●○○
Mobility	Yes	No	Yes	Yes	Yes
Roaming	International, as soon as available	International, as soon as available	International, available[1]	International (over 300 networks)	International (over 500 networks)[2]
Miscellaneous	Inexpensive local expansion	Greater indoor coverage			

* Supported until end of 2020

[1] On all LTE roaming networks introducing LTE-M, this wireless access technology is also available to Swisscom customers. More info here: https://www.gsma.com/iot/deployment-map/

[2] Although 2G will no longer be supported by Swisscom in Switzerland from the end of 2020, 2G-only devices will continue to function normally in Swisscom 2G roaming partner networks.

Disclaimer: Information on data rates, range and energy efficiency depends firstly on the configuration of the customer application and secondly on radio conditions. All wireless technologies provided by Swisscom are based on "best effort". Please also note that the topography, terrain, building structure, existing wireless infrastructure and number of users can influence the respective availability and quality of the services. Indicated coverage rates are based on a model calculation that depends on a wide range of factors. In reality, coverage may differ from these rates. An on-site evaluation is required for an exact assessment of coverage.

Detailed overview of network features

Technology	LPN (LoRa)	NB-IoT	LTE-M (LTE Cat. M1)	LTE (Cat. 1)	2G* (M2M)
Frequency band	SRD band B[3] 868 MHz not licensed	LTE band 20 800 MHz licensed	LTE band 20 800 MHz licensed	LTE band 1, 3 + 20 800/1800+2100 MHz licensed	GSM band 8 900 MHz licensed
Data rates	DL 1.7–5.4 kbit/s UL 0.3–5.4 kbit/s	DL 0.4–30 kbit/s UL 0.4–60 kbit/s	DL und UL 0.1 kbit/s bis 1 Mbit/s	DL 10.3 Mbit/s UL 5.2 Mbit/s	HSCSD 115 kBit/s GPRS 172 kBit/s EDGE 473 kBit/s
Max. path loss (MCL)	159 dB	164 dB	155 dB	140 dB	144 dB
Max. coverage in Switzerland[4]					
Outdoor	96%	98.8%	99.5%	99.5%	99%
Indoor	84.1%[5]	96.3%	90.5%	90.5%	89%
Coverage-enhancing functions[6]	Chirp spread spectrum	• Max. 128/2048 retransmissions • PSD/UL single-ton/multi-ton transmission	• Coverage enhancement A and B • max. 256–2048 retransmissions • Frequency hopping	• Rx diversity • Frequency diversity gain	None
Reception antenna UE	No MIMO, but Rx diversity	No MIMO, no Rx diversity	No MIMO, no Rx diversity	No MIMO, but Rx diversity	No MIMO, no Rx diversity
Battery life[7]	< 10 years	< 10 years	Max. 5–10 years	Days	Days
Voice telephony	No	No	Yes, VoLTE	Yes, VoLTE	Yes, GSM
Real-time application	No	No	Yes	Yes	Yes
Latency	1–10 s	1.4–10 s	~10–200 ms	~10–100 ms	~700 ms
Duplex transmission[8]	Half-duplex	Half-duplex FDD only	Full-duplex FDD and TDD	Full- and half-duplex FDD and TDD	
Max. device density	> 10,000 devices per cell			≤ 1,000 devices per cell	> 300 devices per cell
Power saving mode (PSM)	Specific device categories and ADR[9]	DTX/eDRX[10] max. 10,485.76 s (approx. 2.9 h)	DTX/eDRX[10] max. 2,621.44 s (~44 min)	DTX/DRX	DTX/eDRX
	PSM[11]/ periodic TAU timer max. 413.3 days + HLCom[12]				
Mobility	Broadcast	Cell reselection	Handover (connected mode) and cell reselection (idle mode)		
Multicast transmission	From Q1 2019	From Rel. 14	From Rel. 14	No	No

* Supported until end of 2020

[3] SRD (short-range device) band is a frequency range for low power devices used for voice and data transmission. The 868 MHz band can be used without a licence throughout Europe. It is also used for the following IoT standards: LoRa, Weightless-P and Sigfox EU.

[4] These values are based on a model calculation that depends on a wide range of factors. In reality, coverage may differ from these rates. An on-site evaluation is required for an exact assessment of coverage.

[5] With LPN, customers can extend local indoor coverage without Internet access from CHF 890 (hardware, network and gateway configuration and 3G/4G backhauling for 48 months).

[6] The following range-enhancing features mean that the data rate drops:
- PSD, the UE's available energy is concentrated in a smaller bandwidth (used in uplink from NB-IoT with single-tone or multi-tone transmission)
- coverage enhancement mode with corresponding retransmission
- more robust modulation; for LTE-M, only 16QAM and QPSK, and for NB-IoT, only QPSK modulation are used for data transmission.

[7] Battery life is affected by the following factors: the data transmission cycle (eDRX/PSM), the volume of data transmitted in each cycle, radio conditions or the necessary retransmission, the parameterisation of PSM and eDRx in the network and battery quality/self-discharge.

[8] Duplex transmission processes FDD (frequency division duplex) and TDD (time division duplex)

[9] Energy efficiency can be achieved by using ADR (adaptive data rate) and the most suitable device class. The LPN device classes are:
- class A devices, where each uplink transmission is followed by two short downlink windows;
- class B devices, where further receive windows open at scheduled times in addition to the class A windows;
- class C devices, where the receive window is open all the time, except during transmission.

[10] eDRX provides additional energy savings. Firstly, it extends the maximum DRX cycle length (in connected mode) from 2.56s to 5s, 12s and 10s. Secondly, in idle mode, energy consumption is further reduced through long sleep periods (eDRX) between UE page monitoring.

[11] Power-saving mode/periodic tracking area update; PSM/periodic TAU timer; in PSM deep sleep phases, the UE uses even less energy than during DRX operation. The UE is no longer reachable, although it is still registered to the network. The UE stays in PSM until the mobile device triggers a transaction such as another TAU or data transmission. PSM is applicable for Cat. 0, Cat. M1 and Cat. NB1 UEs. The TAU timer lasts a maximum of 11,520s in releases 8–12, extended to a maximum of 413.3 days in release 13.

[12] High latency communication. Data sent to the device while it is in sleep mode (sleep periods or deep sleep phases) is temporarily stored by the network and sent to the device as soon as it connects to the network.

Detailed overview of supported network features, security, devices and their features

Technology	LPN (LoRa)	NB-IoT	LTE-M (LTE Cat. M1)	LTE (Cat. 1)	2G* (M2M)
Supported network features					
Coverage enhancement	Yes	Yes	Yes	No	No
eDRX	n/a	Connected max. 10.24 s Idle max. 2.91 s	Max. 43.69 min	No	Yes
PSM/periodic TAU timer	Broadcast/ADR	Max. 413.3 days	Max. 413.3 days	Max. 413.3 days	No
Network positioning	Under evaluation	From Rel. 14	From Rel. 14	From Rel. 14	
PSD boosting in downlink	Yes	Yes	Yes	No	No
Multicast	From Q1 2019	From Rel. 14	From Rel. 14	No	No
Voice/VoLTE	No	No	Yes from Q2 2019	Yes from Q2 2019	No
Security					
Subscriber identity[13]	Optional HSM possible	USIM[14]	USIM[14]	USIM[14]	SIM 5
Identity protection	Device ID	Device and subscriber ID[15]	Device and subscriber ID[15]	Device and subscriber ID[15]	Device and subscriber ID[15]
Authentication	Radio module and network	Radio module and network	Radio module and network	Radio module and network	Radio module
Encryption	128-bit encryption	128-bit encryption	128-bit encryption	128-bit encryption	64-bit encryption
Integrity check	User and network	User and network	User and network	User and network	User

* Supported until end of 2020

Technology	LPN (LoRa)	NB-IoT	LTE-M (LTE Cat. M1)	LTE (Cat. 1)	2G* (M2M)
Devices and their features					
Device classes	Class A / battery-powered Class B / battery-powered Class C / network-powered[17]	NB-IoT Cat. 1 NB-IoT Cat. 2[13]	LTE-M Cat. M1 LTE-M Cat. M2	LTE Cat. 0 LTE Cat. 1	GPRS only EDGE or GPRS EDGE and/or GPRS
Power class	14 dBm/25 mW	23 dBm/200 mW 20 dBm/100 mW[16]	23 dBm/200 mW	23 dBm/200 mW 20 dBm/100 mW	23 dBm/200 mW
Max. data rates	n/a	NB-IoT Cat.1 30/60 kbit/s NB-IoT Cat.2 120/150 kbit/s	LTE-M Cat. M1 1 Mbit/s LTE-M Cat. M2 2.4 Mbit/s	LTE Cat. 0 1 Mbit/s LTE Cat. 1 10–5 Mbit/s	HSDCD 115 kbit/s GPRS 172 kbit/s EDGE 473 kbit/s
Reception antenna	Rx diversity	No MIMO, no Rx diversity	No MIMO, no Rx diversity	No MIMO, but Rx Diversity	No MIMO, no Rx diversity
Firmware upgrade OTA (over the air)	Under evaluation	Yes	Yes	Yes	Yes

*** Supported until end of 2020**

[13] Manufacturers have the option of producing their devices as HSM (hardware security module) in order to ensure efficient, secure implementation of cryptographic operations or applications (a question of price).

[14] NB-IoT and LTE-M are extremely secure in comparison with 2G.
- USIM card offers greater security, more opportunities for user applications and more storage than the old 2G SIM card. It also cannot be cloned.
- In the 4G network, authenticity is verified at both ends (LTE network and radio module). In 2G, only the radio module is authenticated.
- In the 4G network, signal and usage data between the network and the radio module are encrypted with a 128-bit algorithm and integrity is checked. In 2G, encryption only uses a 64-bit algorithm.

[15] In order to protect subscriber identity (IMSI), during the unencrypted phase a temporary IMSI is always used when establishing the connection – apart from the first connection in a network. The device identity (IMEI) is only transmitted in encrypted form.

[16] With NB-IoT, device classes with only 14 dBm/25 mW will be available from Rel. 14.

[17] Brief description of LPN device classes:
- Class A devices: each uplink transmission is followed by two short downlink windows
- Class B devices: further receive windows open at scheduled times in addition to the class A windows;
- Class C devices: the receive window is open all the time, except during transmission.

Swisscom (Switzerland) Ltd Enterprise Customers, P.O. Box, CH-3050 Berne,
iot.spoc@swisscom.com, swisscom.ch/enterprise

The information in this document does not constitute a binding offer. It is subject to revision at any time.