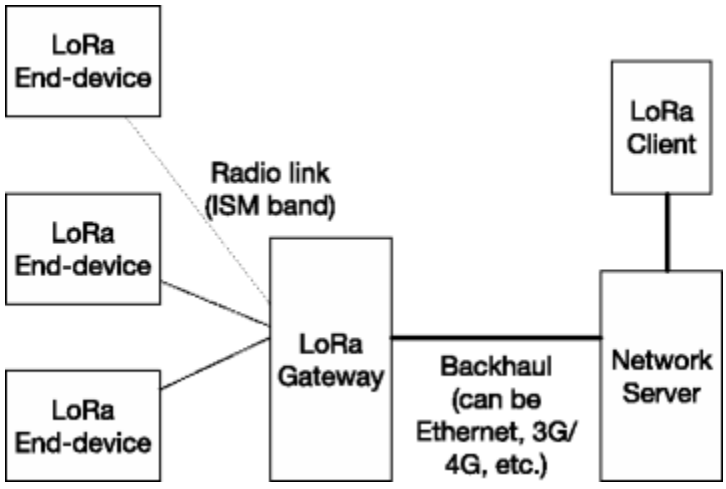
Low-power wide-area network

The term LPWA network refers to a network relying on low-power and wide-area connectivity technology that simultaneously supports low batter energy consumption and wide coverage area. The LPWA network is dedicated to serve battery-powered applications characterized by low throughput, delay tolerance, and being event-driven such as water-meter monitoring. Unlike the other technologies that are adapted for Internet of Things (IoT), LPWA networks are purposely designed from scratch to meet wide-area IoT application. LPWA technologies are typically narrow-band (with some exceptions) and operate in the ISM license-exempt spectrum bands. Faced with a potential huge market, lots of players propose their solutions. Some typical and already deployed proprietary technologies of LPWA network are LoRaWAN, SIGFOX, Weightless, OnRamp, etc.

LoRa alliance has issued their first vision of LoRaWAN specification [5] in January 2015, which is regarded as a major step towards international standardization in the field of LPWA networks. Thus, LoRaWAN technology is taken as a concrete example to give a general view about LPWA networks. The network architecture is illustrated in Fig. 7, which is a star-of-stars topology. A LoRaWAN network consists of the following components [5]:

- End-device: the end-device is the element in a LoRaWAN network which is responsible for collecting and uploading information to remote network server. LoRa supported functionalities can be classified to three classes: class A (bi-directional end-devices), class B (bi-directional end-devices with scheduled receive slots), and class C (bi-directional end-devices with maximal receive slots). All LoRaWAN end-devices at least support class A. According to applications, end-devices can optionally support class B and class C.

Fig. 7



LoRaWAN network architecture. (based on [5])

Full size image

- LoRa air interface: The LoRa air interface provides the connectivity between LoRa end-devices and gateway. It is on ISM (Industrial Scientific Medical) band and based on LoRa modulation, which is a proprietary modulation scheme. The LoRa data rate ranges from 0.3 kbps to 50 kbps. The selection of data rate is a trade-off between communication range and message duration, and communications with different data rates do not interfere with each other.
- LoRa gateway: the LoRa gateway receives the communications from the LoRa end-devices and then transfers them to a network server via the backhaul system. Note that LoRa gateways may be co-located with a cellular base station. In this way, they are able to use spare capacity on the backhaul network.
- Network server: the LoRa network server manages the network. The network server acts to eliminate duplicate packets, schedules acknowledgment, and adapts data rates (adaptive data rate scheme). The communication between the LoRa gateway and the network server is IP-based, and the underlying carrier networks can be wired or wireless, Ethernet or 3GPP cellular, public or private networks.