lamaPLC Communication: IoT

Internet of things (**IoT**) describes devices with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communication networks. The Internet of Things encompasses electronics, communication, and computer science engineering. *"Internet of things"* has been considered a misnomer because devices do not need to be connected to the public internet; they only need to be connected to a network and be individually addressable.

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning. Older fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with *"smart home"* products, including devices and appliances (lighting fixtures, thermostats, home security systems, cameras, and other home appliances) that support one or more common ecosystems and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. IoT is also used in healthcare systems.

There are a number of concerns about the risks of the growth of IoT technologies and products, especially in the areas of privacy and security. Subsequently, industry and government moves have been made to address these concerns, including the development of international and local standards, guidelines, and regulatory frameworks. Because of their interconnected nature, IoT devices are vulnerable to security breaches and privacy concerns. At the same time, the way these devices communicate wirelessly creates regulatory ambiguities, complicating jurisdictional boundaries of the data transfer.

Background

Around 1972, for its remote site use, *Stanford Artificial Intelligence Laboratory* developed a computer-controlled vending machine, adapted from a machine rented from Canteen Vending, which sold for cash or, through a computer terminal (*Teletype Model 33 KSR*), on credit. Products included, at least, beer, yogurt, and milk. It was called the Prancing Pony, after the name of the room, named after an inn in Tolkien's The Lord of the Rings, as each room at Stanford Artificial Intelligence Laboratory was named after a place in Middle-earth. A successor version still operates in the *Computer Science Department at Stanford*, with updated hardware and software.

Enabling technologies

There are many technologies that enable the IoT. Crucial to the field is the network used to communicate between devices of an IoT installation, a role that several wireless or wired technologies may fulfill:

Addressability

The original idea of the Auto-ID Center is based on RFID tags and distinct identification through the Electronic Product Code. This has evolved into objects having an IP address or URI. An alternative view, from the world of the Semantic Web, focuses instead on making all things (not just those electronic, smart, or RFID-enabled) addressable by the existing naming protocols, such as URI. The objects themselves do not converse, but they may now be referred to by other agents, such as powerful centralised servers acting for their human owners. Integration with the Internet implies that devices will use an IP address as a distinct identifier. Due to the limited address space of IPv4 (which allows for 4.3 billion different addresses), objects in the IoT will have to use the next generation of the Internet protocol (IPv6) to scale to the extremely large address space required. Internet-of-things devices will additionally benefit from the stateless address auto-configuration present in IPv6, as it reduces the configuration overhead on the hosts and the IETF 6LoWPAN header compression. To a large extent, the future of the Internet of Things would not have been possible without the support of IPv6. Consequently, the global adoption of IPv6 in the coming years will be critical for the successful development of the IoT.

Application Layer

ADRC defines an application layer protocol and supporting framework for implementing IoT applications.

Short-range wireless

- Bluetooth mesh networking—A specification providing a mesh networking variant to Bluetooth Low Energy (BLE) with an increased number of nodes and a standardized application layer (Models).
- Li-Fi (light fidelity) is a wireless communication technology similar to the Wi-Fi standard, but it uses visible-light communication for increased bandwidth.
- Near-field communication (NFC) – Communication protocols enabling two electronic devices to communicate within a 4 cm range.
- Radio-frequency identification (RFID) is a technology that uses electromagnetic fields to read data stored in tags embedded in other items.
- Wi-Fi – Technology for local area networking–based on the IEEE 802.11 standard, where devices may communicate through a shared access point or directly between individual devices.
- Zigbee – Communication protocols for personal area networking– based on the IEEE 802.15.4 standard, providing low power consumption, low data rate, low cost, and high throughput.
- Z-Wave – Wireless communications protocol used primarily for home automation and security applications

Medium-range wireless

- LTE-Advanced is a high–speed communication specification for mobile networks. It enhances the LTE standard with extended coverage, higher throughput, and lower latency.
- 5G—5G wireless networks can be used to achieve the high communication requirements of the IoT and connect a large number of IoT devices, even when they are on the move. Three features of 5G are each considered useful for supporting particular elements of IoT: enhanced mobile

broadband (eMBB), massive machine type communications (mMTC), and ultra-reliable low latency communications (URLLC).
- LoRa: Range up to 3 miles (4.8 km) in urban areas, and up to 10 miles (16 km) or more in rural areas (line of sight).
- DASH7: Range up to 2 km.

Long-range wireless

- Low-power wide-area networking (LPWAN) – Wireless networks are designed to allow long-range communication at a low data rate, reducing power and transmission costs. Available LPWAN technologies and protocols: LoRaWan, Sigfox, NB-IoT, Weightless, RPMA, MIoTy, IEEE 802.11ah
- Very-small-aperture terminal (VSAT) – Satellite communication technology using small dish antennas for narrowband and broadband data.

Wired

- Ethernet is a general–purpose networking standard that uses twisted pair and fiber optic links in conjunction with hubs or switches.
- Power-line communication (PLC) is a communication technology that uses electrical wiring to carry power and data. Specifications such as HomePlug or G.hn utilize PLC for networking IoT devices.

Sources

Wikipedia (here)

IoT topics on lamaPLC

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