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**COIMBATORE-641 035, TAMIL NADU**

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**19ECE306- SMART IoT APPLICATIONS**

**III ECE / V SEMESTER**

## UNIT IV

## IOT Standardization: ISO, IEC, ETSI, IEEE, IETF

### ISO, IEC

ISO/IEC JTC 1/SWG 05 is a Special Working Group (SWG) established under ISO/IEC JTC 1 specifically for the Internet of Things (IoT). Its primary purpose is not to create IoT standards but to identify and bridge standardization gaps, facilitating the development and implementation of IoT standards across different entities.

### Objectives and Scope of ISO/IEC JTC 1/SWG 05

**The main goals of ISO/IEC JTC 1/SWG 05 are as follows:**

**1. Identifying Market Needs and Standardization Gaps:** The group assesses what the market requires and identifies any existing gaps in IoT standardization. This helps JTC 1 prioritize and focus on areas where work on IoT standards may be consolidated in the future.

**2. Encouraging ISO/IEC Standards for IoT:** ISO/IEC JTC 1/SWG 05 encourages JTC 1 subcommittees and working groups to work toward developing specific standards for IoT.

**3. Facilitating Cooperation within JTC 1 Entities:** The group helps JTC 1 entities (subcommittees, working groups, etc.) collaborate effectively on IoT-related standardization.

**4. Promoting JTC 1 Standards in Industry:** It aims to increase recognition and adoption of JTC 1-developed standards for IoT within industries and other standard-setting bodies.

**5. Coordinating IoT Standardization Activities:** The group liaises with other organizations, such as IEC, ISO, and ITU, involved in developing IoT standards, ensuring a more synchronized approach.

**6. Reporting and Providing Recommendations:** Periodic reports and recommendations are presented to ISO/IEC JTC 1 and JTC 1/SWG 3 (Planning). This includes submitting a detailed report before each JTC 1 plenary meeting.

**7. Studying IoT Reference Architectures and Frameworks:** A report is compiled that could serve as a reference in proposals for new JTC 1 work items related to IoT. This report was expected to be presented by the 2014 JTC 1 Plenary.

**Structure of ISO/IEC JTC 1/SWG 05**

**ISO/IEC JTC 1/SWG 05 operates through four Ad Hoc groups, each with its own specific focus area related to IoT:**

**1. Ad Hoc Group 1:** Focuses on developing a common understanding of IoT, including creating an IoT Mind Map and identifying stakeholders.

**2. Ad Hoc Group 2:** Concentrates on identifying the market requirements for IoT to inform standardization efforts**.**

**3. Ad Hoc Group 3:** Works on identifying gaps in IoT standardization and developing a roadmap for addressing them.

**4. Ad Hoc Group 4:** Studies various IoT Reference Architectures and Frameworks to provide insights that might contribute to new IoT-related work proposals within JTC 1.

This Special Working Group thus plays a crucial role in aligning global efforts to standardize IoT, fostering collaboration across multiple organizations, and ensuring that JTC 1 is well-positioned to meet the evolving demands of the IoT landscape.

**ETSI, or the European Telecommunications Standards Institute,**

It is a key organization that creates globally recognized standards for Information and Communication Technology (ICT), covering areas like mobile, radio, Internet, and broadcast technologies. ETSI plays an essential role in advancing new technologies and ensuring that ICT solutions are standardized and interoperable. It collaborates closely with research entities, participates in European Commission projects, and works to promote emerging standards needed to drive future economic growth and societal benefits.

**Key Roles and Areas of Focus:**

**Mobile Communications Leadership:** ETSI has been a foundational influence in mobile communications, co-founding the Third Generation Partnership Project (3GPP), which standardizes mobile network technology.

**ICT in Other Sectors:** Beyond telecommunications, ETSI's standards now extend to sectors like transportation, health (eHealth), smart cities, smart manufacturing, and cloud services. This broad approach reflects how ICT underpins various industries, adapting to societal needs.

**M2M and IoT Support:** ETSI's Technical Committee for Machine-to-Machine (TC SmartM2M) focuses on standardizing a platform for a wide range of IoT services such as smart metering, grids, and city automation. Through oneM2M, an international partnership, ETSI also ensures interoperability with 3GPP networks, system-level integration, security, and expanded functionality, which are crucial for scaling IoT applications.

**Testing and Interoperability:** ETSI's Centre for Testing and Interoperability (CTI) designs testing protocols for innovations like vehicle-to-grid interfaces, advancing electric vehicle infrastructure. It also supports the European Union's Global Navigation Satellite System (GNSS), which includes services like Galileo, vital for location-based services linked to IoT.

**Spectrum Management:** The Technical Committee on Electromagnetic Compatibility and Radio Spectrum Matters (TC ERM) manages wireless spectrum usage in Europe, providing guidelines for diverse wireless systems and applications crucial for IoT. These activities facilitate spectrum allocation for IoT devices such as RFID, NFC, and short-range devices, ensuring a reliable communication backbone for these technologies.

**Security and Cybersecurity Standards:** ETSI also emphasizes security, addressing aspects like mobile and wireless security, data retention, electronic signatures, and identity management for the Internet of Things. The Industry Specification Group on Information Security Indicators (ISG ISI) supports cybersecurity through benchmarks and indicators for event detection and security measures.

**Supporting Low Throughput Networks: E**TSI's Industry Specification Group on Low Throughput Networks (ISG LTN) works on creating energy-efficient, ultra-low power network specifications ideal for IoT devices with minimal data requirements, supporting affordable and long-lasting IoT solutions.

**Collaboration and Innovation:**

ETSI collaborates with other European Standards Organizations, such as CEN and CENELEC, to develop joint standards. This cooperation helps ETSI address various regulatory mandates and extend ICT standards to embedded communications and industrial IoT applications.

## IEEE's Role in IoT

By 2020, it was anticipated that **50 to 100 billion devices** would be electronically connected, creating a global Internet of Things (IoT). The IoT enables diverse devices to communicate, offering unprecedented opportunities for technological innovation, transformation of everyday life, and improved industry efficiencies. However, the effectiveness of IoT relies heavily on **standardization**, which ensures interoperability, compatibility, reliability, and efficiency on a global scale.

To support IoT's success, the **IEEE Standards Association (IEEE-SA)** has developed various standards, projects, and events aimed at building a robust foundation for IoT deployment and growth.

### IEEE's Focus Areas in IoT Standardization

The IEEE-SA recognizes that IoT spans multiple fields of technology, each contributing to the IoT landscape. Here are some critical areas IEEE focuses on:

1. **Lower Protocol Layers (Physical and MAC Layers)**

IEEE's primary efforts in IoT standardization are focused on the lower layers of the protocol stack, specifically the **Physical (PHY) layer** and **Medium Access Control (MAC) layer**.

These layers are essential for reliable and low-power communication across IoT devices, especially in industrial, scientific, and medical applications.

### IEEE 802.15.4 Standard

**IEEE 802.15.4** is a foundational standard for short-range, low-power radio communication, primarily used in industrial, scientific, and medical (ISM) bands.

Initially adopted for low-power applications, this standard laid the groundwork for protocols like **ZigBee**. However, as IoT grew, the IEEE recognized limitations in this initial framework and enhanced it in 2012 for more demanding applications.

#### Enhancements with IEEE 802.15.4g and 802.15.4e

**IEEE 802.15.4g PHY**: This updated version of the PHY layer allows for larger data packets, supporting up to **2 Kilo-Octets** per packet. It accommodates **IPv6**'s minimum requirement for maximum transmission units (MTU), which is 1280 octets, making it more suitable for IoT applications.

**IEEE 802.15.4e MAC**: Enhancements to the MAC layer introduced **Time Slotted Channel Hopping (TSCH)**, providing deterministic communication for time-sensitive applications, like **industrial automation** and **Smart Grid metering**.

### Wireless HART and ISA100.11a Standards

The **Time Slotted Channel Hopping (TSCH)** mode demonstrated significant value in the **wireless HART standard**, later expanded as **ISA100.11a** by the ISA. However, these enhancements were not entirely compatible, resulting in some fragmentation in the standard.

## IEEE's Initiatives and the IoT Project

The IEEE Communications Society (ComSoc) has undertaken initiatives to promote IoT standardization across various fields. One key project is the **IoT6 Project**, which focuses on establishing IPv6-based IoT solutions:

- **IoT Project and IPv6 Integration**: The IoT6 project aims to promote IoT solutions that leverage IPv6 for scalability and future-proofing of IoT networks. The project has established

a dedicated website and rapidly attracted interest, with **400 members joining in the first three months**.
- **Dissemination and Collaboration**: IoT6 serves as a platform for sharing IPv6-based IoT solutions on a large scale, leveraging the **Emerging Technologies Committee** within IEEE ComSoc.

### IEEE's Contribution to IoT Standardization

IEEE's contributions to IoT standardization include creating a global platform for knowledge exchange, fostering interoperability, and supporting IPv6 adoption across IoT networks. This enables widespread compatibility and prepares IoT infrastructure for the growing number of devices that require connectivity.

## IETF

The Internet Engineering Task Force (IETF) has been instrumental in advancing the standardization of the Internet of Things (IoT), particularly with the integration of IPv6 support through the 6LoWPAN Header Compression protocol. This development enhances the capability of resource-constrained nodes to communicate over the Internet. A notable competition within this space has emerged with the parallel development of the WIAPA protocol in China, contributing to the fragmentation of the industrial wireless automation market.

In July 2013, a Birds of a Feather (BoF) session was proposed in Berlin to discuss the formation of a working group (WG) aimed at extending existing protocols such as RSVP and RPL to accommodate the demands of large-scale IoT deployments. Subsequently, in November 2013, the IETF established a new working group called 6lo, focusing on the IPv6-over-Network of Resource Constrained Nodes. This group aims to build on the existing 6LoWPAN specifications outlined in RFC 4944, RFC 6282, and RFC 6775, while explicitly excluding routing aspects to ensure a concentrated effort on adaptation layer specifications.

The ongoing work of the 6lo working group encompasses several drafts as of January 2014, including specifications for Bluetooth Low Energy (BTLE) and low power wireless personal area networks (LoWPAN). The efforts reflect a strategic move to solidify IPv6 implementation across a diverse array of constrained devices, which are expected to form the backbone of future IoT solutions. Through close collaboration with other IETF working groups like 6man, intarea, lwig, Core, and Roll, 6lo is positioned to enhance the functionality and interoperability of IoT applications.

Another critical initiative within the IETF is the formation of the 6TiSCH working group. This group aims to create a unified protocol that bridges existing standards while ensuring backward compatibility and scalability for distributed operations. The goal is to support thousands of nodes in a wireless mesh network, paving the way for new large-scale monitoring applications. The 6TiSCH will develop a complete suite of layer 3 and 4 protocols to facilitate both distributed and centralized routing operations, building on the IEEE802.15.4e TSCH MAC standard. Existing protocols will be adapted to create an architecture that integrates these components effectively.

An innovative aspect of the 6TiSCH effort is the introduction of 6TUS, a new component that operates beneath the 6LoWPAN Header Compression layer. This component is designed to manage the time slots supported by the MAC layer and facilitate frame switching across predetermined paths. Furthermore, aspects of centralized routing may be explored by leveraging previous work from the Path Computation Element (PCE) Working Group, which will likely require integration with the CoAP protocol and enhancements to IPv6 Neighbor Discovery protocols for wireless devices.

The IETF's ongoing commitment to IoT standardization positions it as a pivotal player in the development of protocols that will underpin the next generation of interconnected devices. The collaborative efforts within various working groups underscore the necessity of creating cohesive standards that address the diverse challenges presented by IoT deployments.