IoT and Edge Computing Standardization in the IETF

IoT and Edge Computing Standardisation Challenges and Beyond session

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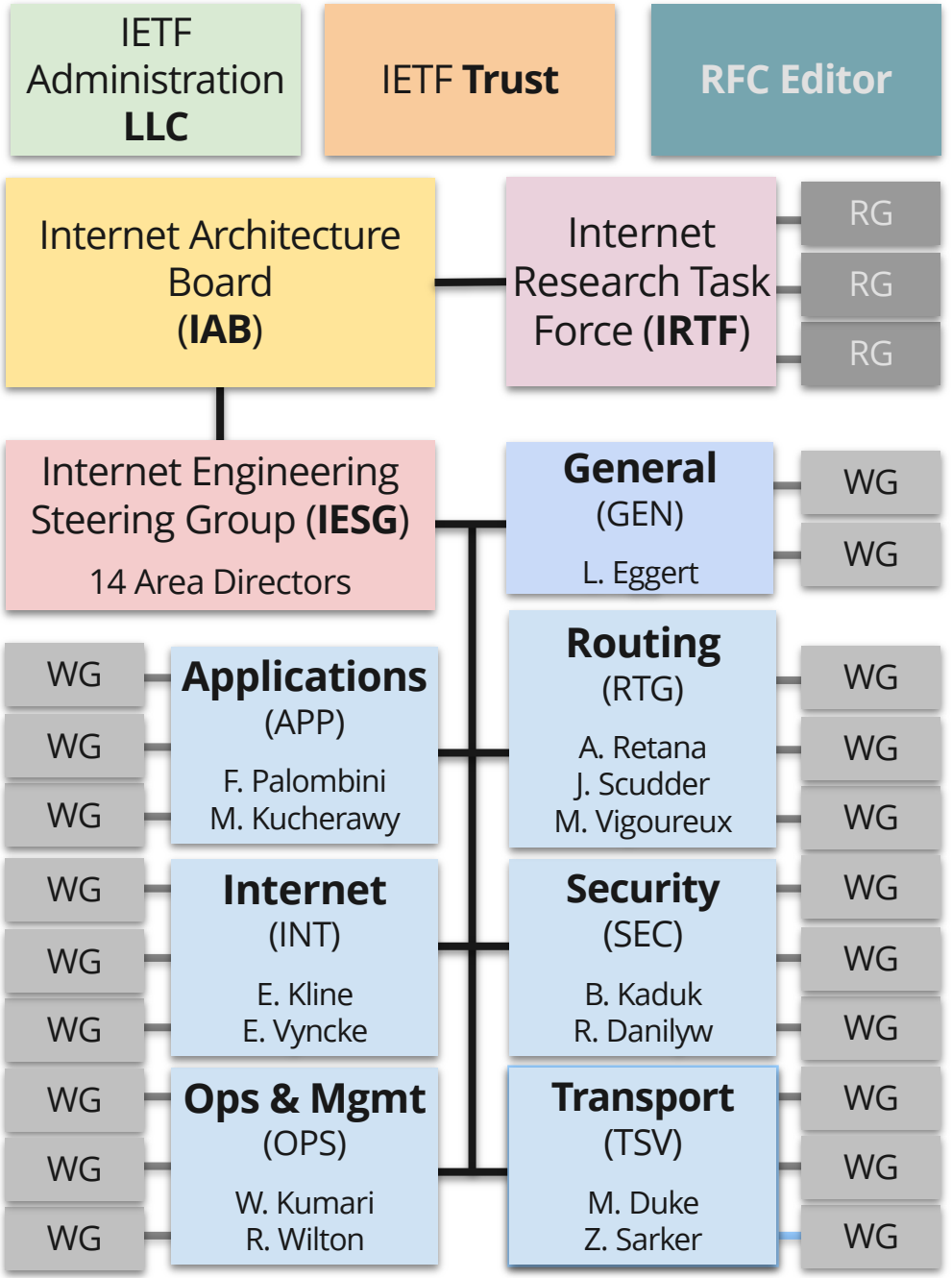
The mission of the IETF *is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet.*

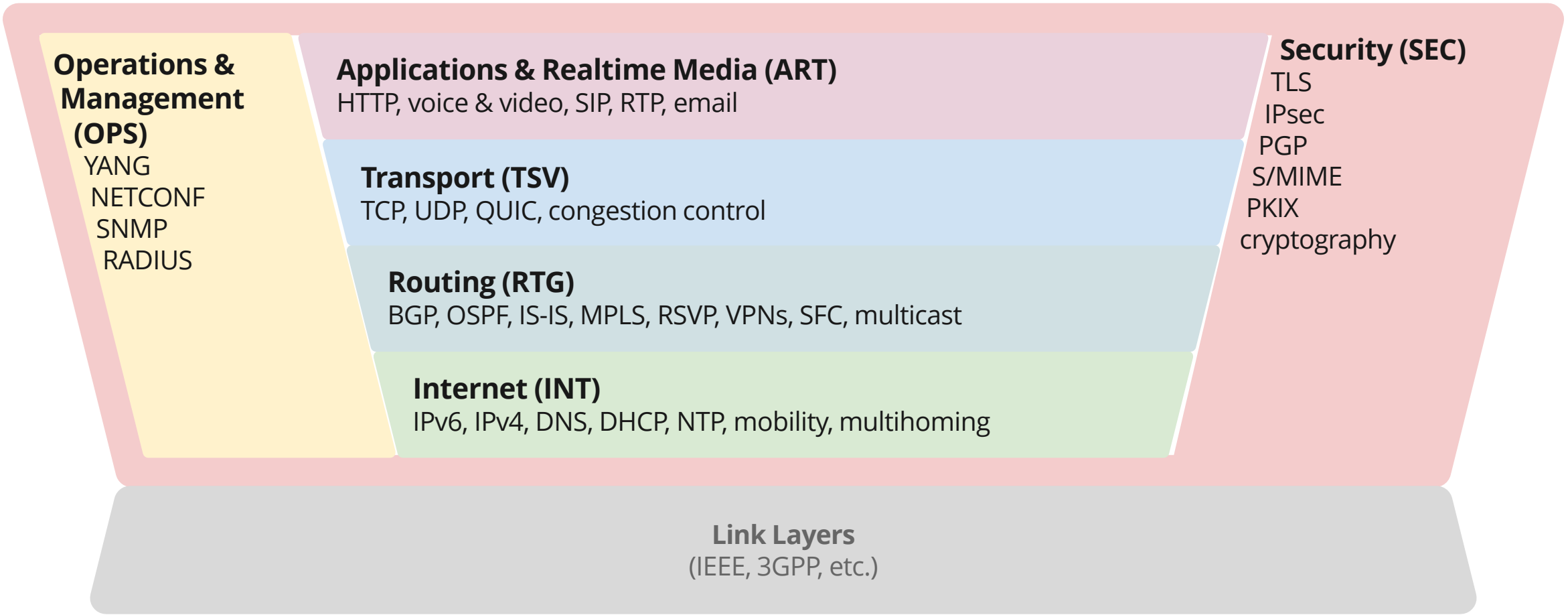
RFC 3935

IETF Organizational Structure

- Seven areas that are are structured into working groups (WGs)
- Internet Engineering Steering Group (IESG) approves RFCs and manages WGs
- Internet Architecture Board (IAB) oversees the standards process and Internet Architecture
- Internet Research Task Force (IRTF) is organized into research groups (RGs) and promotes relevant research



IETF
Key Technologies and Protocols by Area

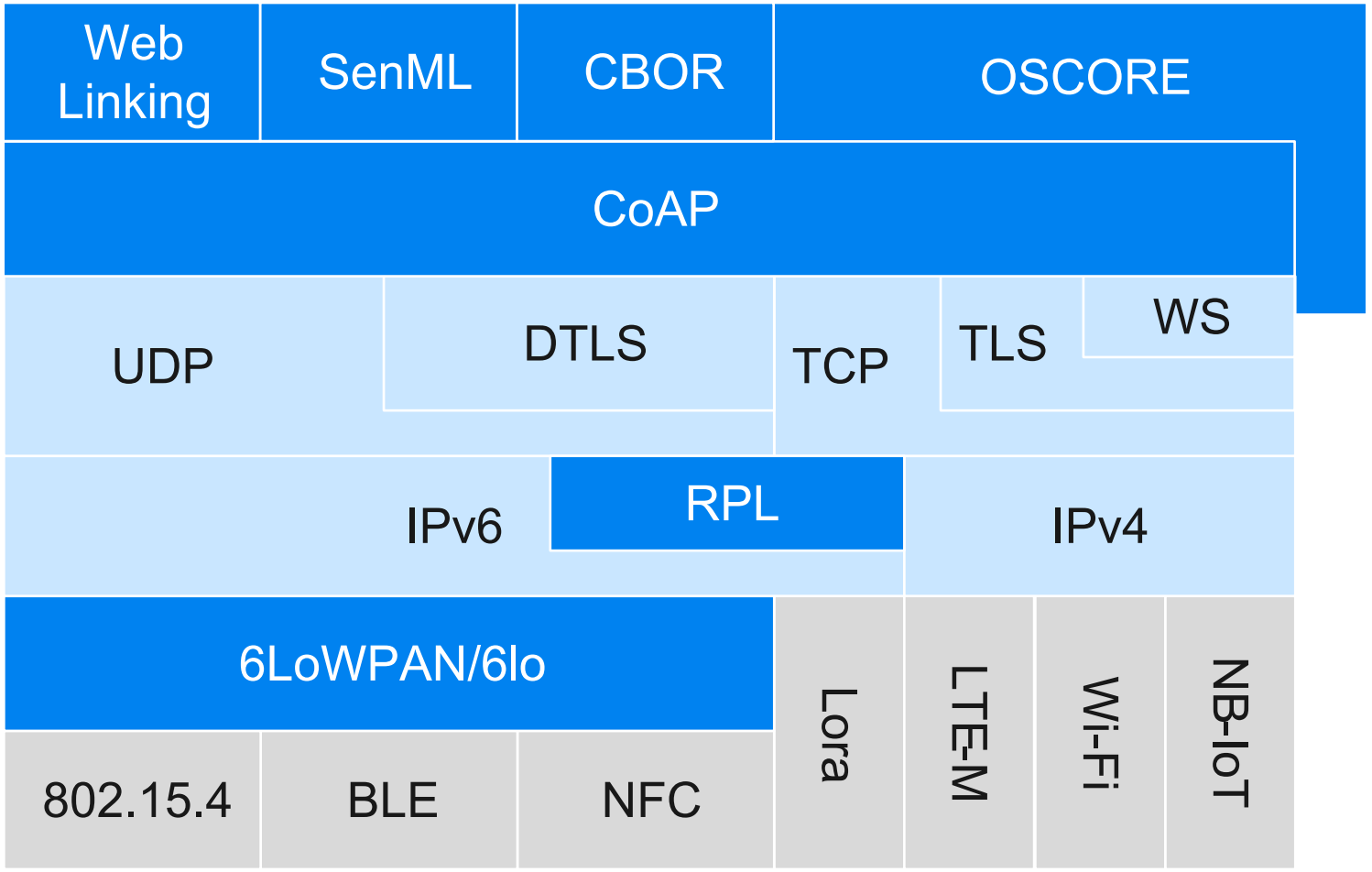


IoT Definition and Approach

> *The Internet of Things (IoT) refers to devices that are often constrained in communication and computation capabilities, now becoming more commonly connected to the Internet, and to various services that are built on top of the capabilities these devices jointly provide. It is expected that this development will usher in more machine-to-machine communication using the Internet with no human user actively involved .*
>
> https://www.ietf.org/topics/iot/

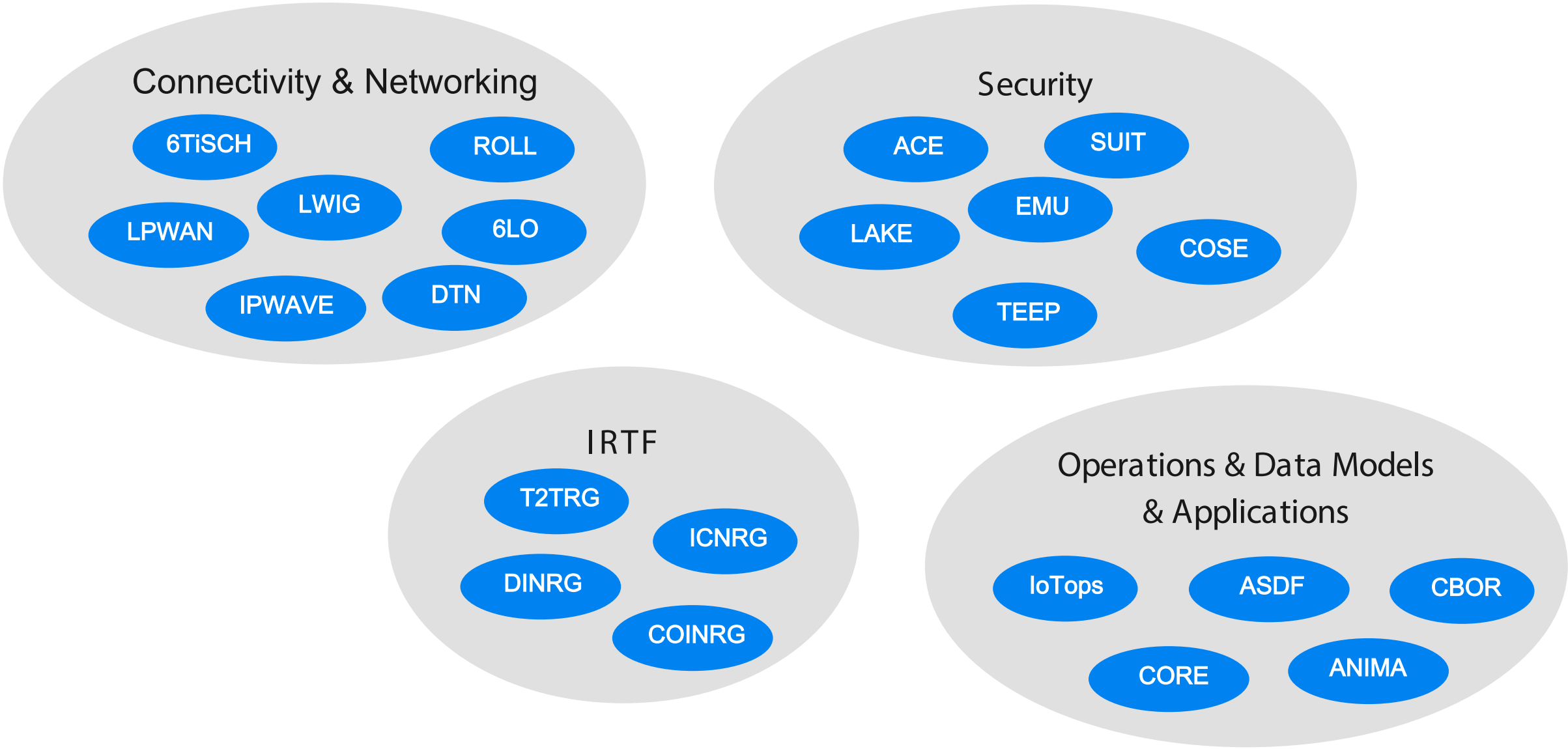
The IETF aims to ***use existing protocols*** and extend/adapt them to IoT scenarios such that protocols should enable to be used with a ***wide range of things*** and ***support interoperability*** as much as possible.

Example IoT Device Stack using IETF protocols



This graph is based on the paper “IETF protocol suite for the Internet of Things: Overview and Recent Advancements”
https://ieeexplore.ieee.org/document/9139045

Overview of IoT Activities in the IETF and IRTF



IRTF Activities
IoT and Edge

- Thing-to-Thing Research Group (T2TRG)
  - RFC8576: Internet of Things (IoT) Security: State of the Art and Challenges, e.g. how can things securely configured before they are functional?
  - On-going: IoT Edge Challenges and Functions (draft-irtf-t2trg-iot-edge)
    - Time sensitivity, Data volume, Uplink costs, Resiliency in the face of intermittent services, Privacy and security
- Computing in the Network Research Group (COINRG)
  - Looking as use cases (draft-irtf-coinrg-use-cases), e.g. Extended Reality
  - Use Cases of Edge Data Discovery, e.g. Autonomous Vehicles
- Information Centric Networking (ICNRG)
  - RFC7476 includes a section on ICN scenarios for IoT
- Decentralized Internet Infrastructure (dinrg)

IETF Standardization Activities
IoT Operations, Data Models, and Applications

- Operations
  - New group on IoT Operations (iotops), e.g. terminology and processes for initial security setup of IoT devices
  - Automatic Control Plane (ACP) in ANIMA working group
  - RFC8520: Manufacturer Usage Description (MUD) in OPSAWG

- Data Models and Formats
  - A Semantic Definition Format for Data and Interactions of Things (ASDF) working group
  - Concise Binary Object Representation (CBOR)

- Application layer protocol: CORE working group defines and maintains CoAP (RFC7252)

IETF Standardization Activities
IoT Security

- Secure Operations: Bootstrapping and Software Updates
  - EAP Method Update (EMU) working group
    - RFC9140: Nimble out of band authentication for EAP (EAP-NOOB) to address bootstrapping
  - Software updates for Internet of Things (SUIT) working group
  - Trusted Execution Environment Provisioning (TEEP) working group
    - Protect sensitive data, such as authentication credentials, on IoT devices placed in locations where attackers might have physical access

- Secure Communication: Data Encryption and Authentication
  - Authentication and Authorization for Constrained Environments (ACE)
    - RFC8613: Object Security for Constrained RESTful Environments (OSCORE)
  - CBOR Object Signing And encryption (COSE) working group
  - Lightweight Authentication Key Exchange (LAKE)

IETF Standardization Activities
IoT Connectivity

- Efficient and low power communication of constraint devices
  - Ipv6 over Networks of Resource-constraint Nodes (6Lo)
  - IPv6 over Low Power Wide-Area Networks (LPWAN) working group
    - considers CoAP/UDP/IPv6 SCHC compression and fragmentation
  - IPv6 over Time Slotted Channel hopping (6TiSCH) working group
    - Use of time synchronization for IoT devices to save battery
  - Lightweight Implementation Guidance (LWIG) working group
    - e.g. power efficiency or protocol usage such as TCP
  - IP Wireless Access in Vehicular Environments (IPWAVE)
- Constraint networking
  - Routing Over Low-power and Lossy network (ROLL)
  - Delay/Disruption Tolerant Networking (DTN)

Conclusions and Future Work

- The IETF covers a brought set of work on ***all layers of the stack***
  - (Re-)use and ***extension/adaption of existing, general purpose Internet protocols*** is preferred
- Beyond these building blocks there is also a needs for ***application enablement platforms*** and horizontalization of the solutions
  - To better scale the adoption of IoT application and improve security/secure operations
- More work needed on ***data management and data exchanges*** to enable compatibility of ecosystems and ***data hubs*** to expose and consume data from others.
  - E.g. automotive sectors where information from the cars can be enhanced with the infrastructure data (building, signals, streets,...)
- Also, need for ***intelligence orchestration*** and extended data models for local or cloud-based processing
- Generally, still more work needed on security to make it fit IoT needs, and improve ***privacy, identity and access management*** (e.g. of senor data)