IoT Security

Strong Security for Constrained Devices

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ICT
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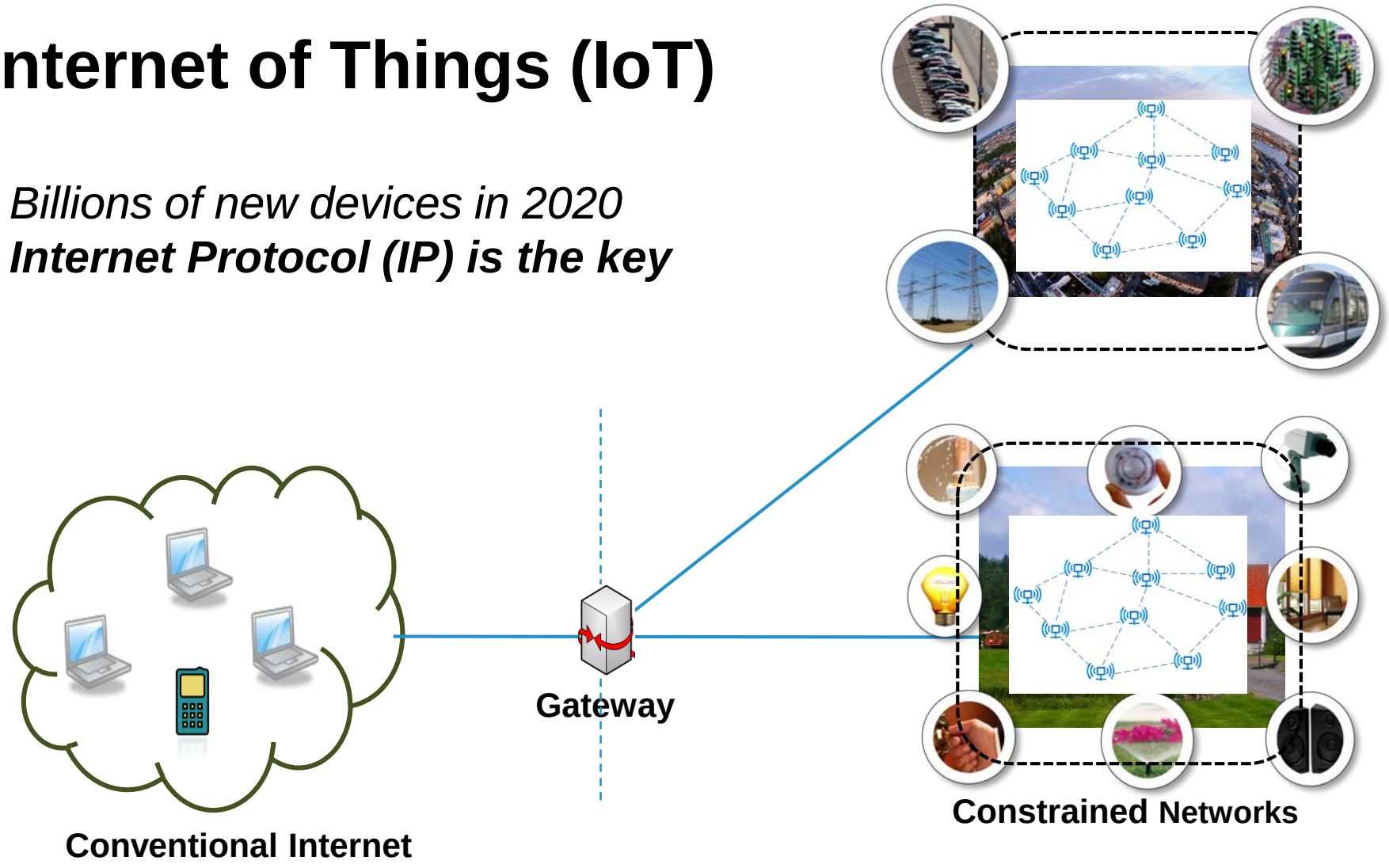
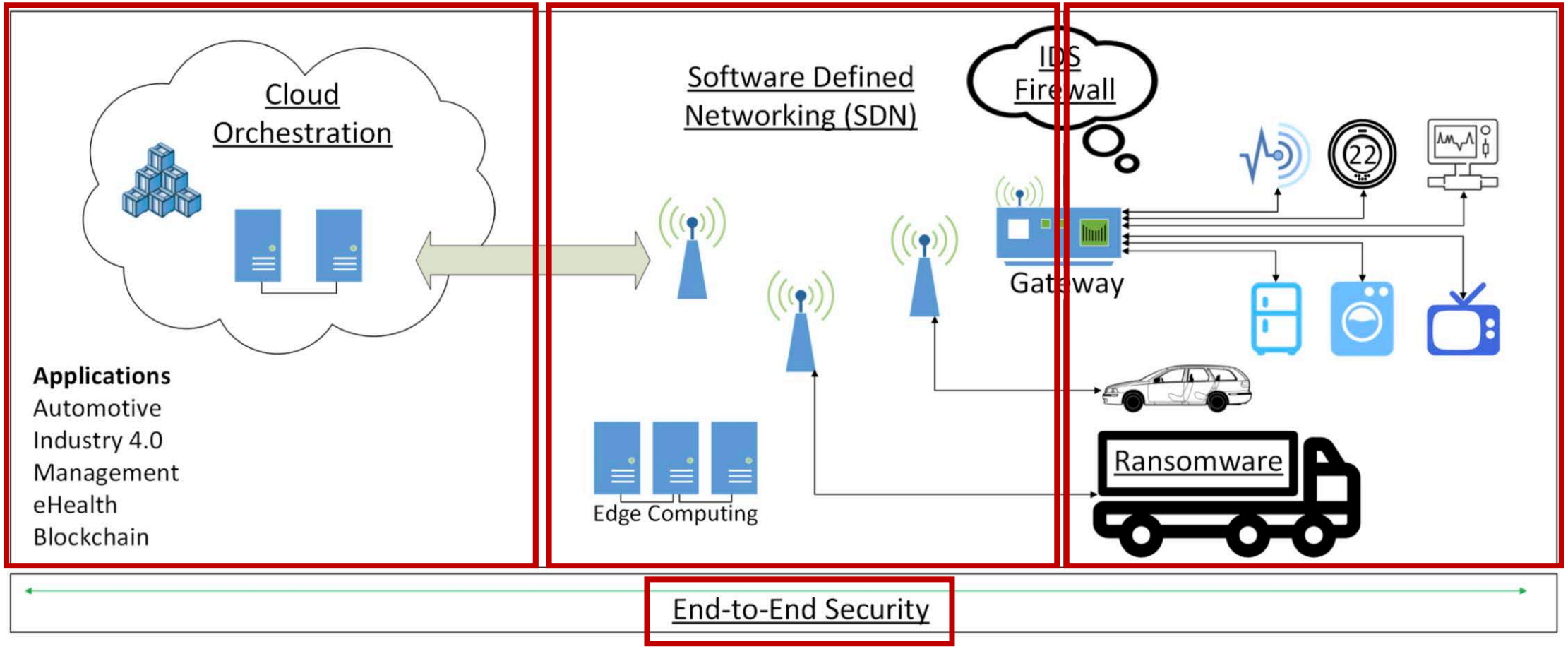
Internet of Things (IoT)

Billions of new devices in 2020

Internet Protocol (IP) is the key



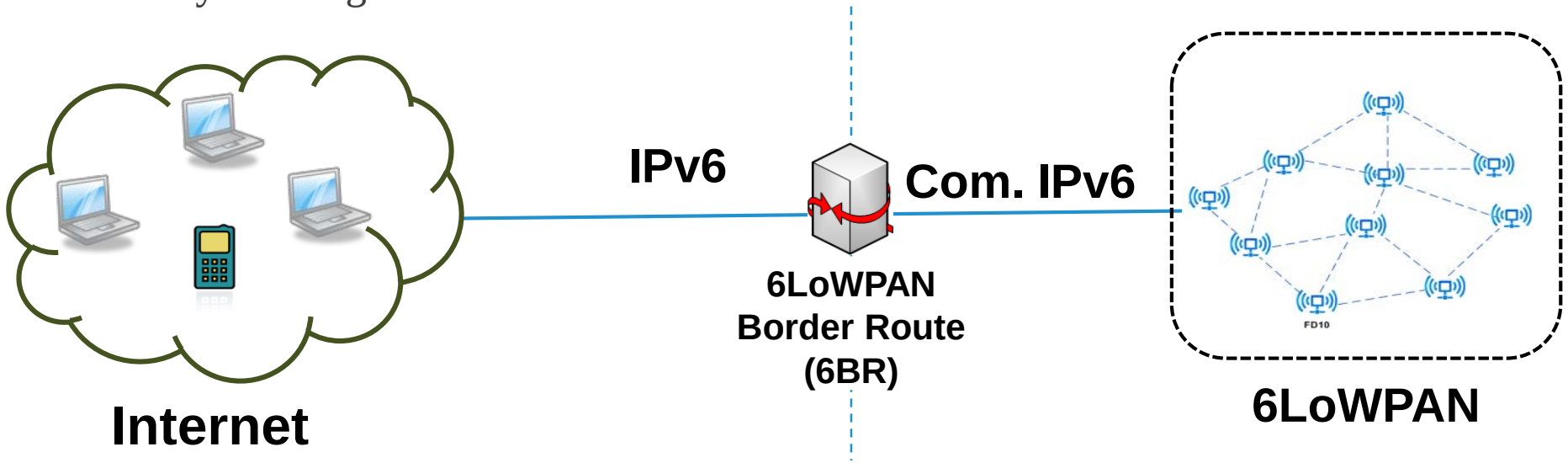
An typical IoT Architecture



Internet of Things (IoT)

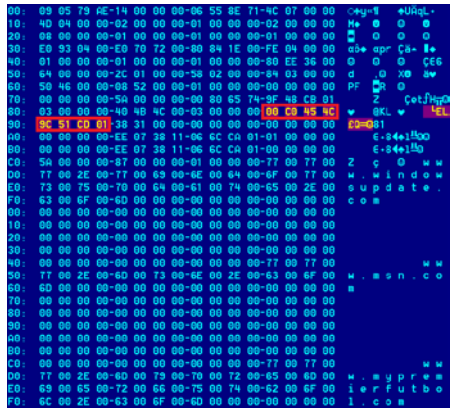
- Network of globally identifiable physical objects/things
  - Mostly resource-constrained, unreliable wireless links
  - Multi-hop
  - Unattended deployments
  - Extremely heterogeneous

- IPv6, an IoT enabling technology and integration layer
- IPv6 over Low power Wireless Personal Area Network (6LoWPAN)



The Reality of *deployed* IoT Security

- IoT security now is like IT security in the 1990s
- IoT manufacturers have been ignoring security in the rush to get to market first
- *"There is no Internet of Things, only other people's computers in your house."*
  -- Jacob Hoffman-Andrews
- Recent attacks are changing the mindset (*security is not an add-on*)



An Example IoT attack

- The Mirai Botnet
  - The most impactful attack by IoT devices [October 21, 2016]
  - DNS attack (Dyn)
    - Amazon, Spotify, Netflix, Twitter, etc. successfully attacks
- An eye-opener for vendors not considering cybersecurity as a built-in component in their systems/solutions.

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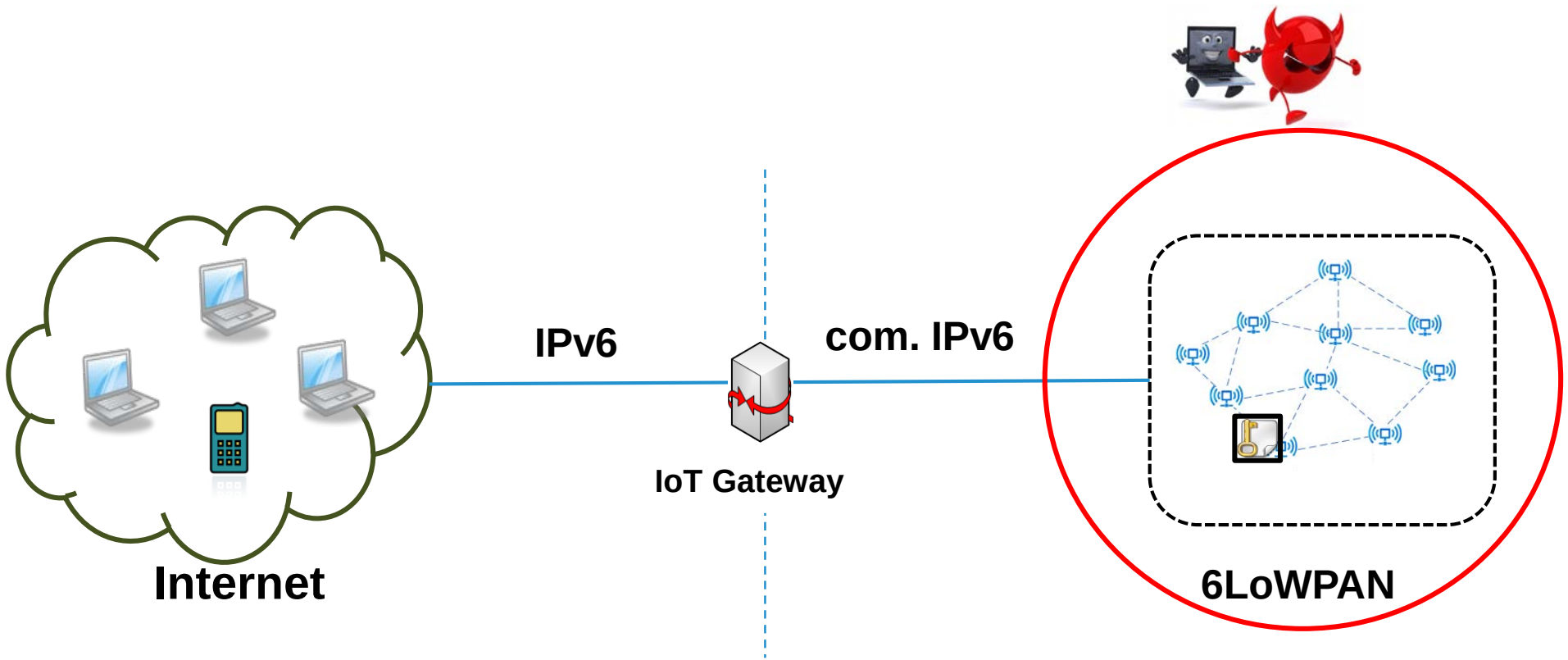
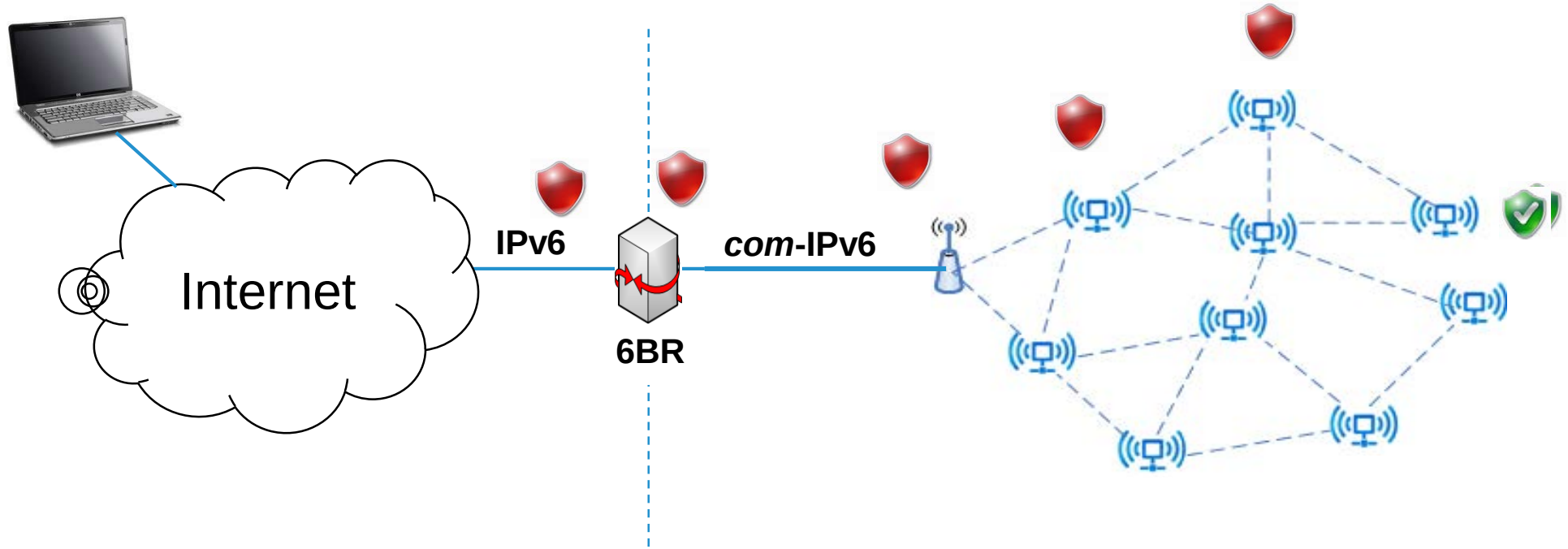
IoT Security

- **Communication Security**
  - Confidentiality
  - Integrity
  - Authentication
- **Network Security**
  - Availability
- **Data-at-rest Security**
  - Confidentiality
  - Integrity
  - Access Control

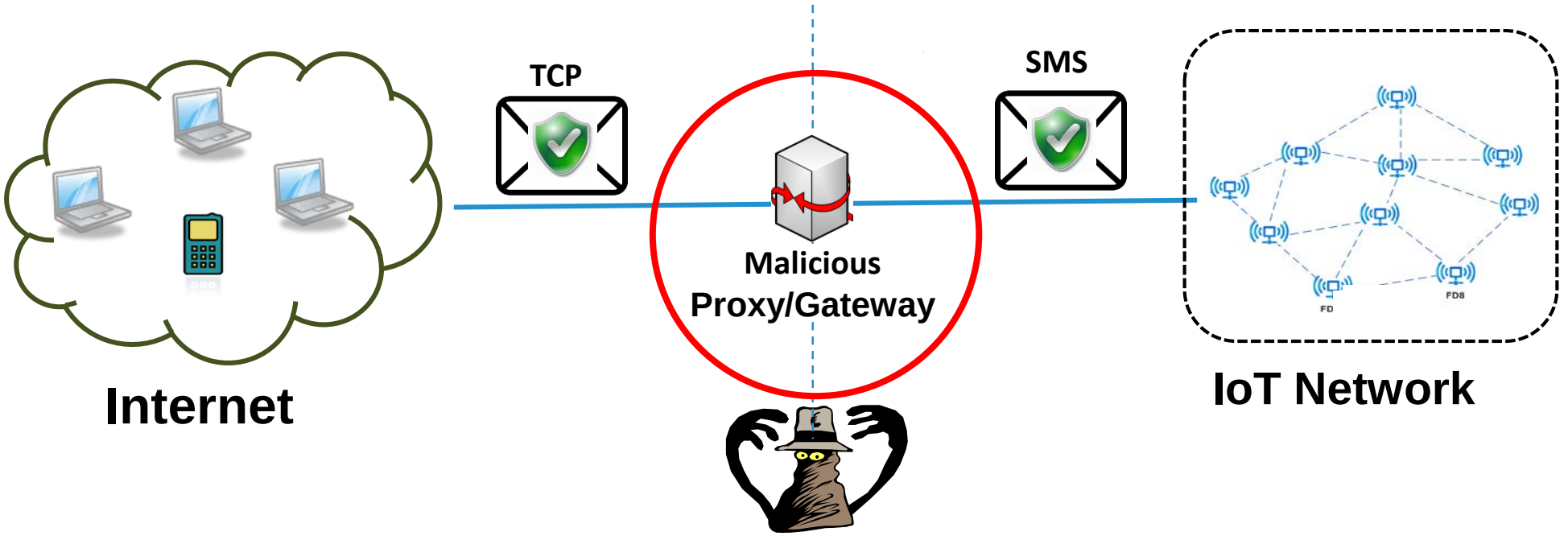


Communication Security in the IoT

- Per hop security
- End-to-End (E2E) security



IoT Security – **OSCORE**
E2E security with malicious gateways



Secure CoAP (CoAPs)

- CoAP enables secure web in the IoT
  - HTTP + TLS = HTTPS
    - Reliable and synchronous transport (TCP)
  - CoAP + DTLS = CoAPs
    - Unreliable and asynchronous transport (UDP)

coaps://mySite:port/myResource

https://mySite:port/myResource

IoT Security – what is really missing or being done?

- **Identity/Key Management**
  - IoT security is hard NOT because there exists no cryptographic protocols that meet communication security requirements, BUT because *management of secure identities/credentials (symmetric keys, passwords, PINs, certificates) using available solutions is simply not suitable for billions of heterogeneous devices.*
- **Personal data protection – e-privacy and GDPR**
- **DDoS protection**
  - IDS and firewalls
  - To/From IoT devices
- **Software Updates for IoT**
  - IETF SUIT WG

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Key Management in IoT

- **Security Modes**
  - Pre-shared key (PSK) – *State-of-the-art in sensor network*
  - Certificate-based - *State-of-the-art in Internet*

Digital Certificates for IoT

- **Certificate based cyber security protocols**
  - Datagram TLS (DTLS)
  - IKEv2/IPsec
  - Object security/EDHOC
- **IoT Standards specifying digital certificates**
  - CoAP
  - LwM2M
  - IPSO Objects
  - ETSI

PKI4IoT: Public Key Infrastructure (PKI) for IoT

- Lightweight X.509 certificates for IoT
  - *The digital certificate size is a bottleneck*

- Certificate Enrolments for IoT
  - *Existing process of getting a certificate from CAs is not feasible for IoT*

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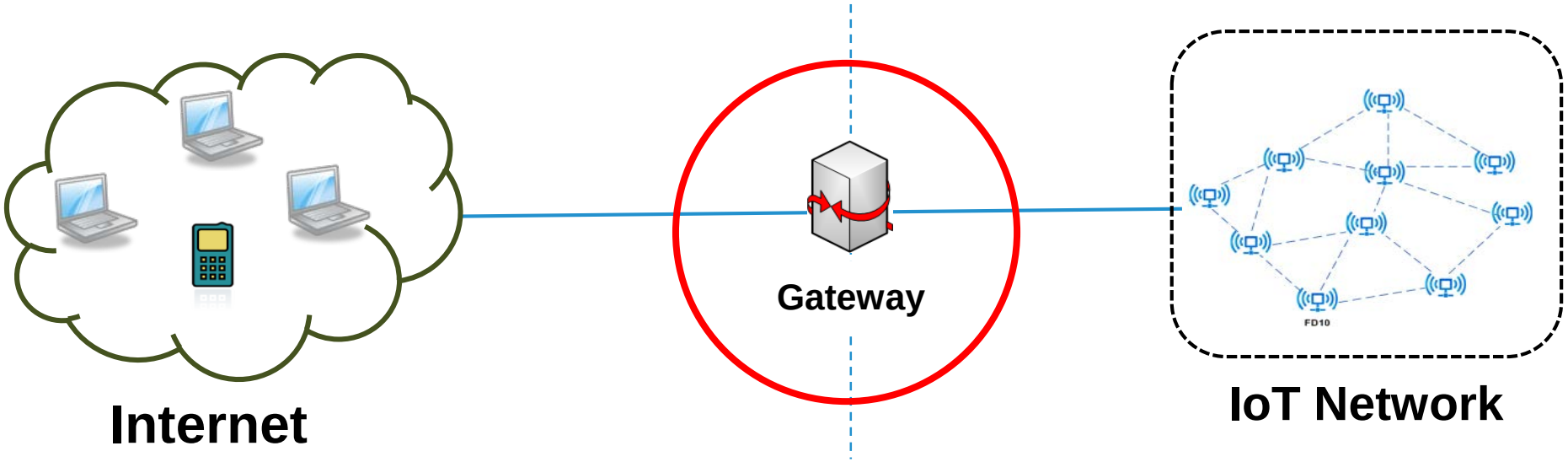
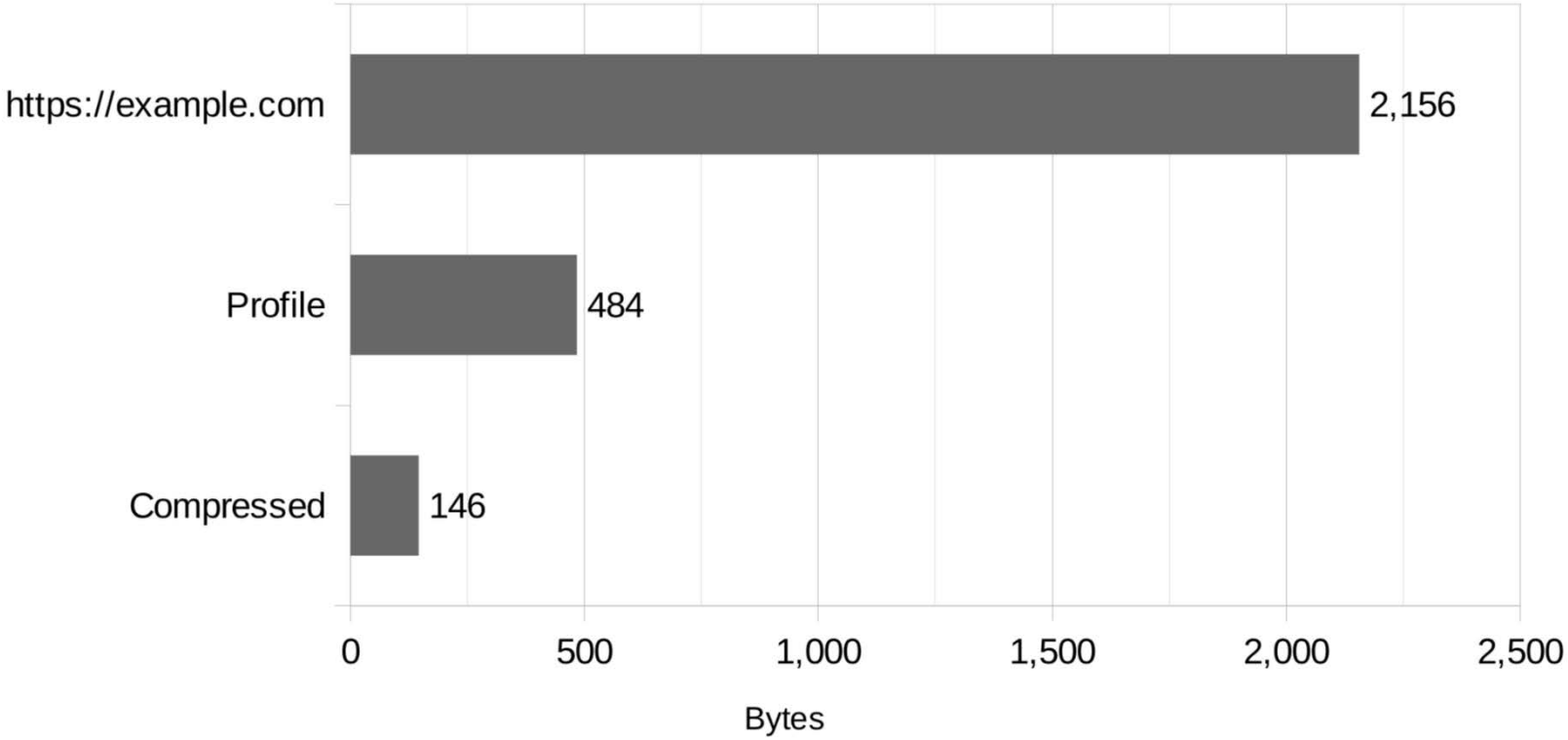
Current PKI offerings for IoT

- Delegated to a more powerful node, such as an IoT gateway
- Do not support IoT protocols



PKI4IOT - X.509 Certificates for IoT

- Lightweight but standard-compliant certificates



Filip Forsby et al.. *Lightweight X.509 Digital Certificates for the Internet of Things*. 4th International Conference on Safety and Security in Internet of Things, November 6, 2017, Valencia, Spain

PKI4IOT - Certificate Enrollment

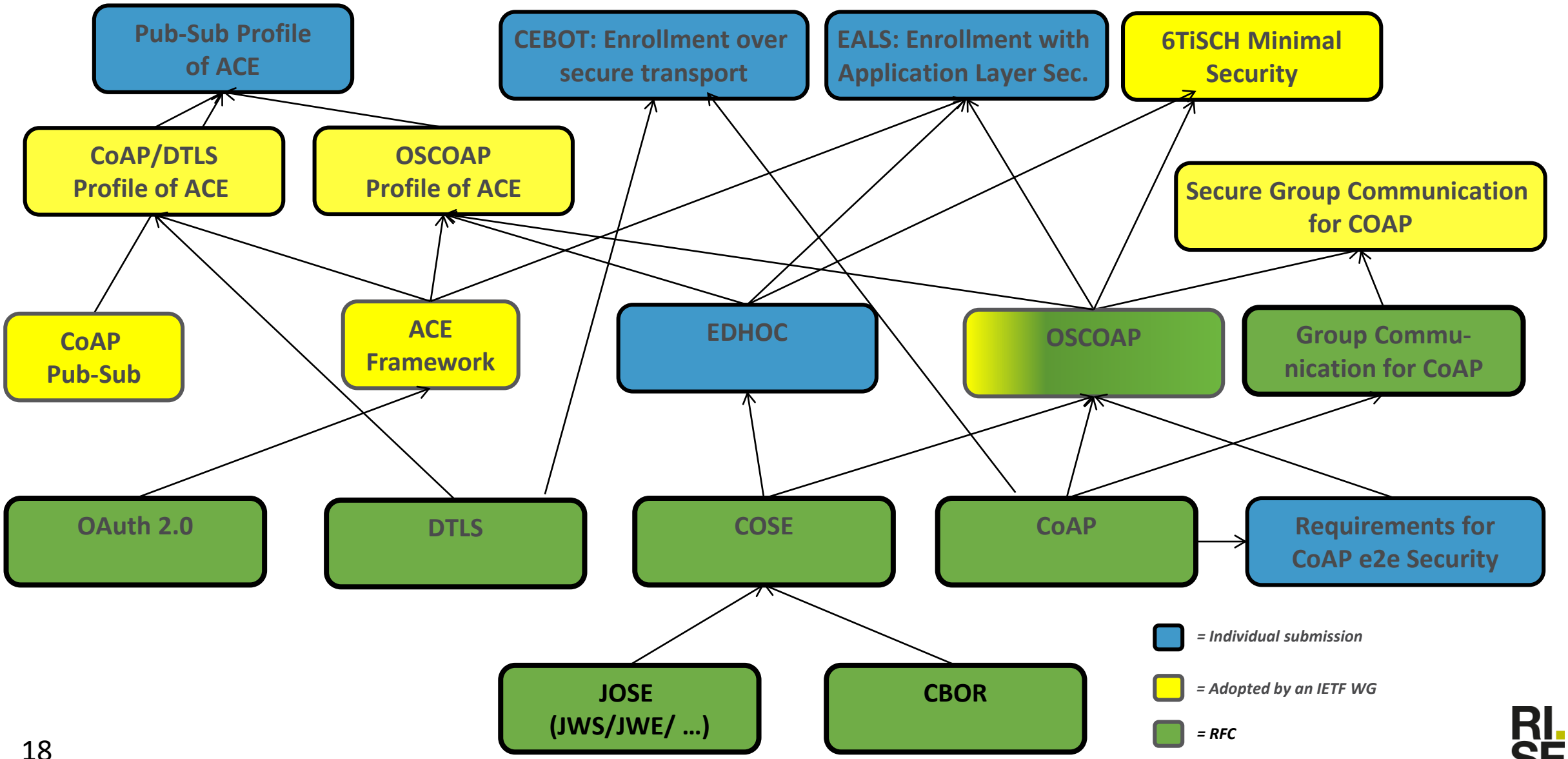
It equips IoT devices with capabilities that enables them to obtain digital certificate(s) in a secure and automated way and by using the communication protocols that these devices speak.

Certificates for constrained IoT devices (CEBOT)

- EST designed for CoAP using DTLS and IPv6

  https://www.ietf.org/id/draft-ietf-ace-coap-est-00.txt

IoT Security Standardization at IETF



THANKS…

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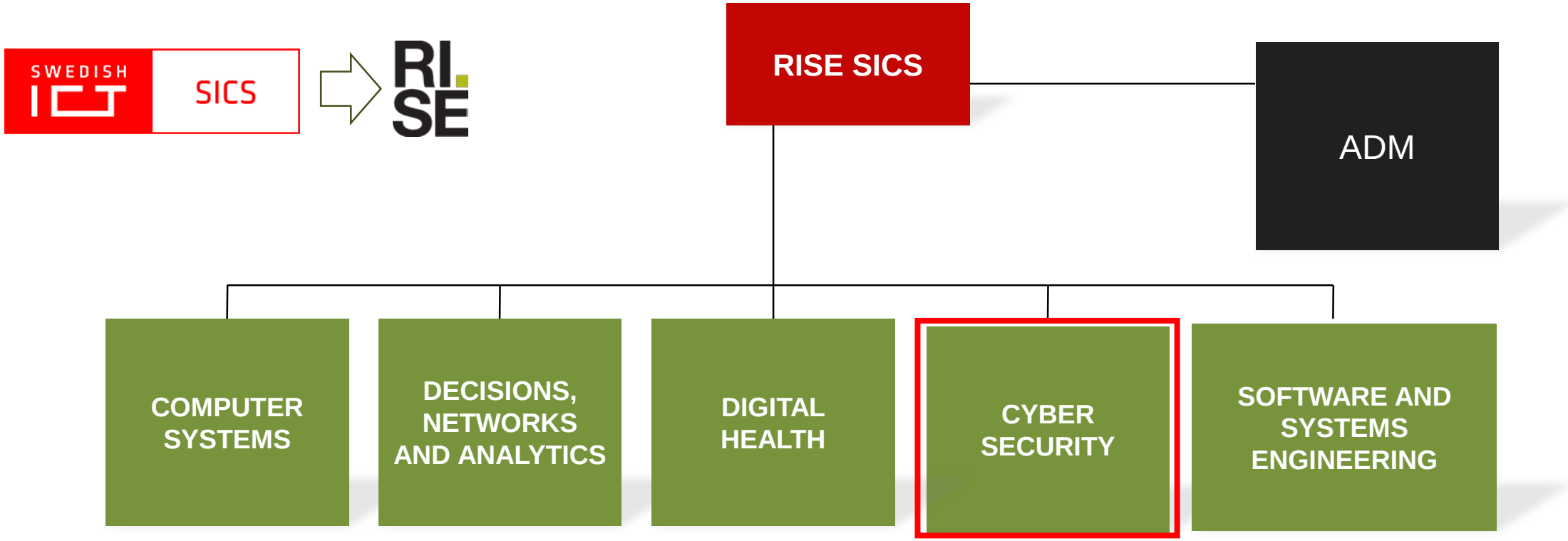

Among the largest security groups in Sweden

- 16 members
- Two locations (Stockholm, Lund)

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