Cyber Security:
Past, Present and Future

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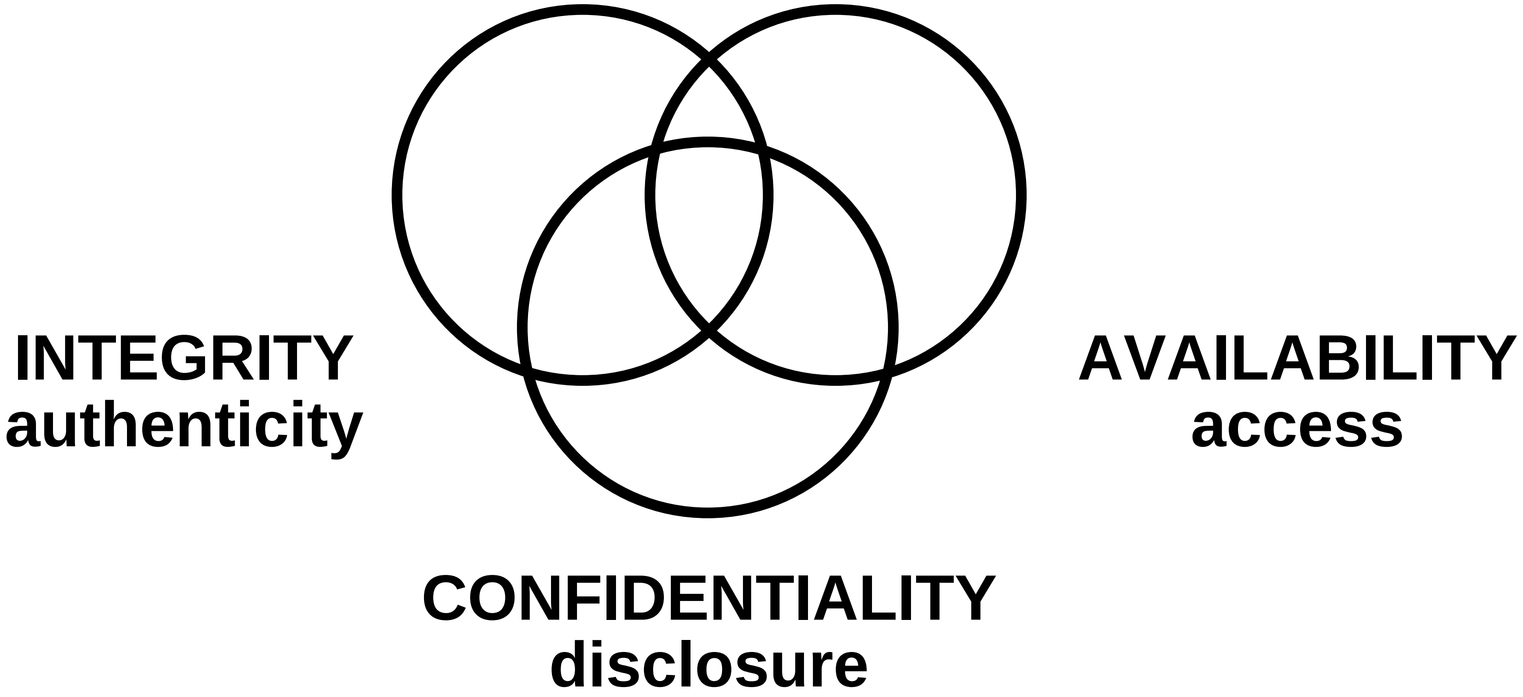
Institute for Cyber Security

- Founded June 2007: still in start-up mode

- World leading security modeling and analysis research
  - Role-Based Access Control (RBAC) Model: Commercially dominant model today
  - Usage Control (UCON) Model: Attribute-Based Access Control on Steroids
  - PEI Framework: Policy (what), Enforcement (how), Implementation (how exactly)
  - Group-Centric Information Sharing: Sharing metaphor of meeting room
  - Security for Social Networks
  - Botnet Analysis, Detection and Mitigation
  - Multilevel Secure Architectures
  - Secure Cloud Computing

- World-leading research infrastructure
  - FlexCloud
  - FlexFarm

Cyber Security Objectives

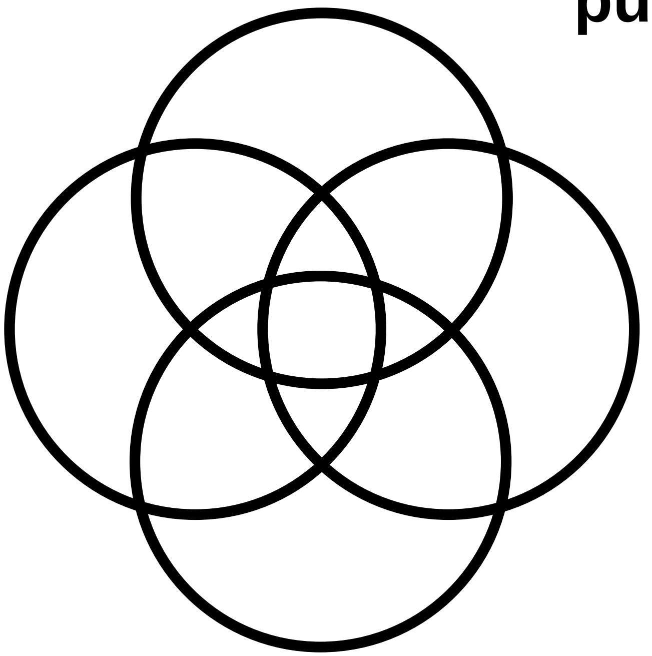


INTEGRITY
authenticity

AVAILABILITY
access

CONFIDENTIALITY
disclosure

Cyber Security Objectives



USAGE
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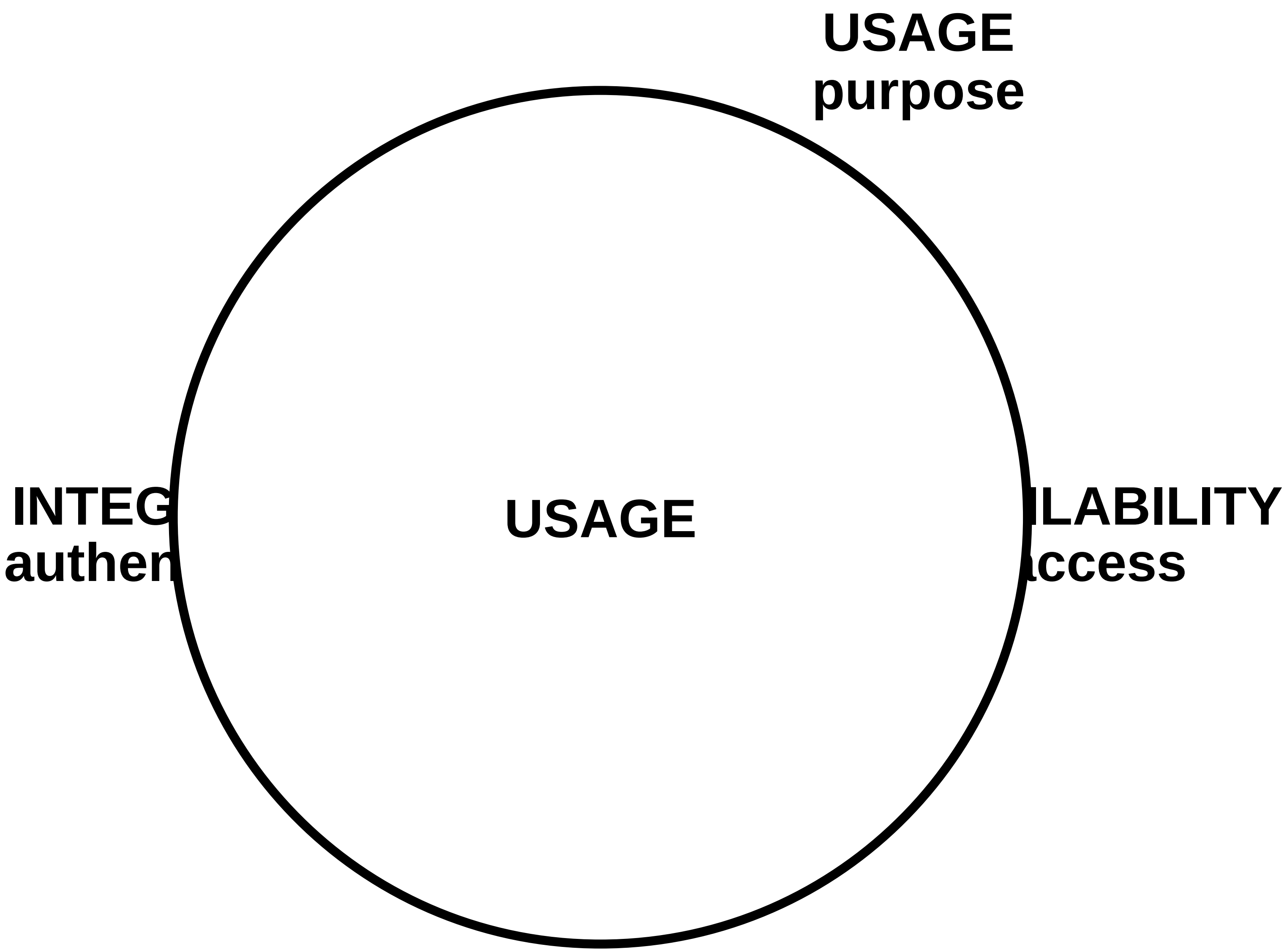
Cyber Security Objectives



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Cyber Security: Major Trends

- Major driver is the **Internet** which itself is in continuous transition
- **Attackers**: Morphed from
  - A nuisance

  to

  - Highly organized criminal ecosystem motivated by money
  - Stealthy infiltrators, spies and saboteurs driven by nation states and terrorists
- **Defenders**: Morphed from
  - Closed Enterprise-Centric era

  to

  - Open Application-Centric/Technology-Centric era
- **Dinosaurs**: Mired in old-think
  - Industry: mired in FUD (fear, uncertainty, doubt)
  - Academia: mired in fairy tales

Internet Architecture

Layer 5+	IM email web social nw VOIP collaboration twitter ……
Layer 4 **Layer 3**	Transport: TCP, UDP Routing: IP
Layer 2 **Layer 1**	Ethernet WiFi Cable-modem Wide-area network ……

Internet Architecture

INNOVATION

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Internet Architecture

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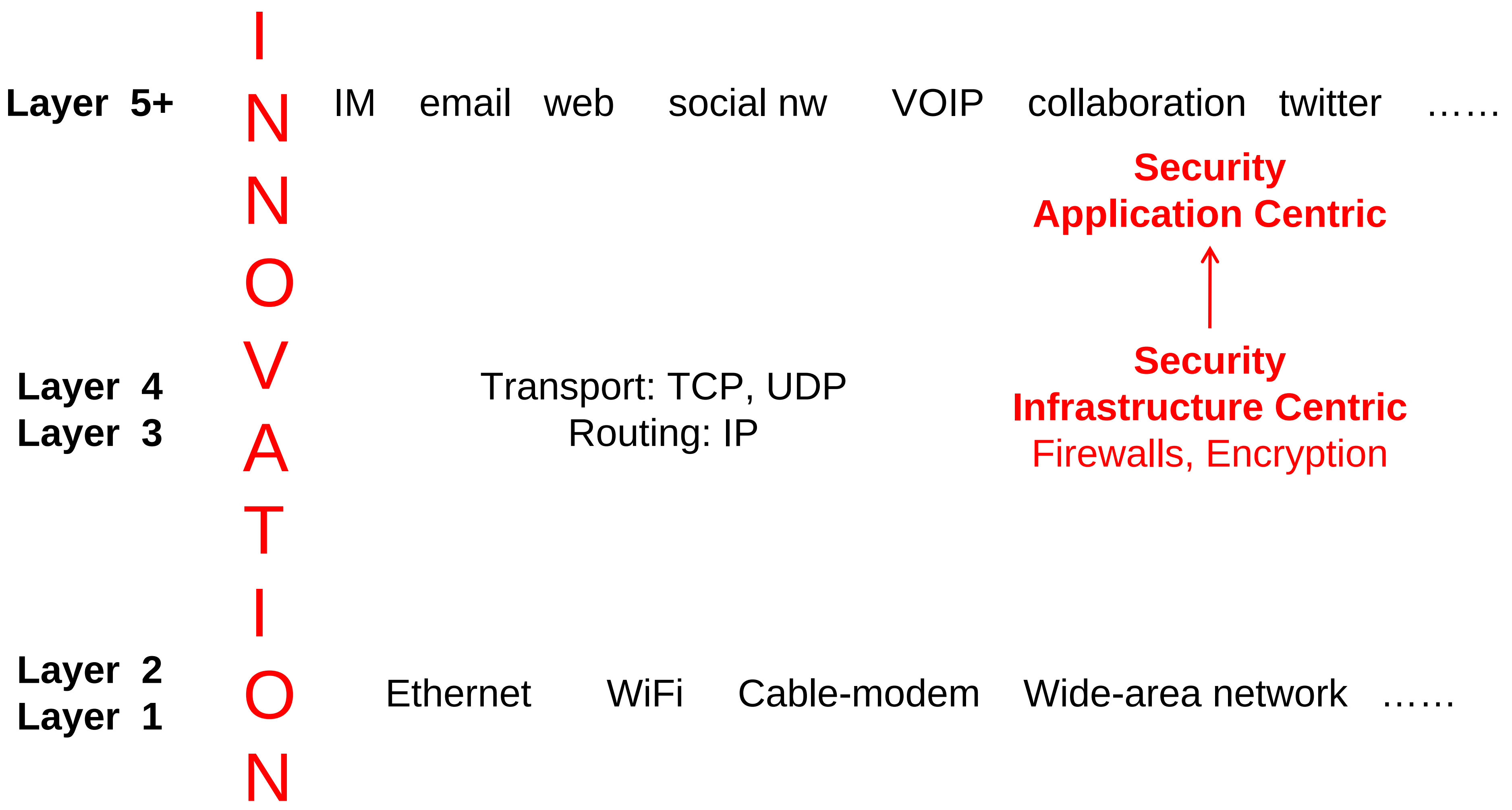
Internet Architecture



INNOVATION

Layer 5+ IM email web social nw VOIP collaboration twitter ……

Security
Application Centric

↑

Security
Infrastructure Centric
Firewalls, Encryption

Layer 4
Layer 3

Transport: TCP, UDP
Routing: IP

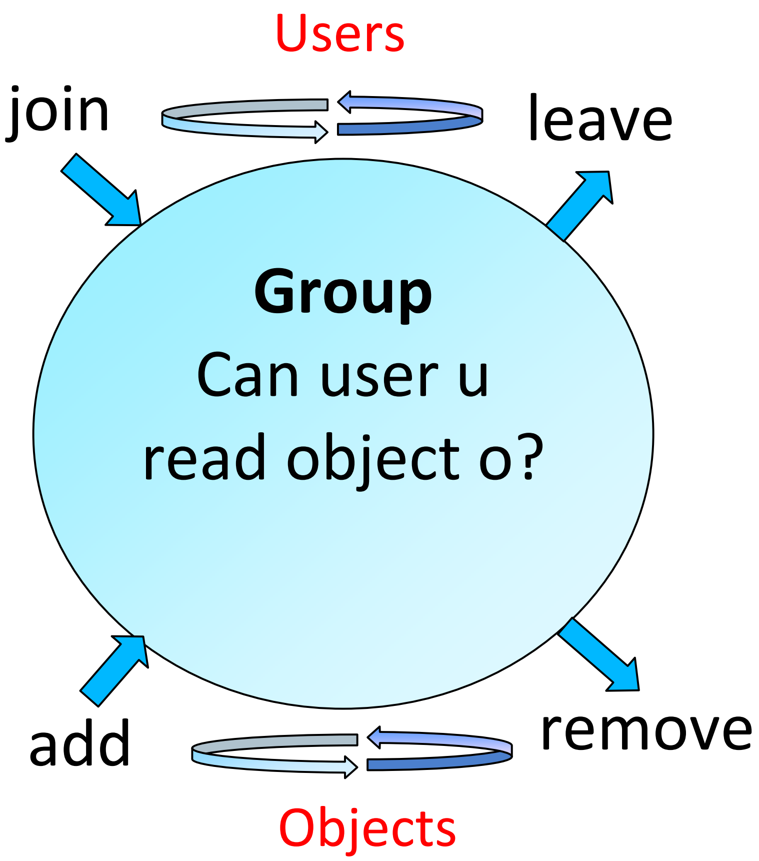
Layer 2
Layer 1

Ethernet WiFi Cable-modem Wide-area network ……

Policy (What)

Group-Centric Information Sharing

- Metaphor: Secure Meeting Room
- Operational aspects
  - What is authorized by join, add, etc.?
- Administrative aspects
  - Who authorizes join, add, etc.?
- Multiple groups
  - Inter-group relationship

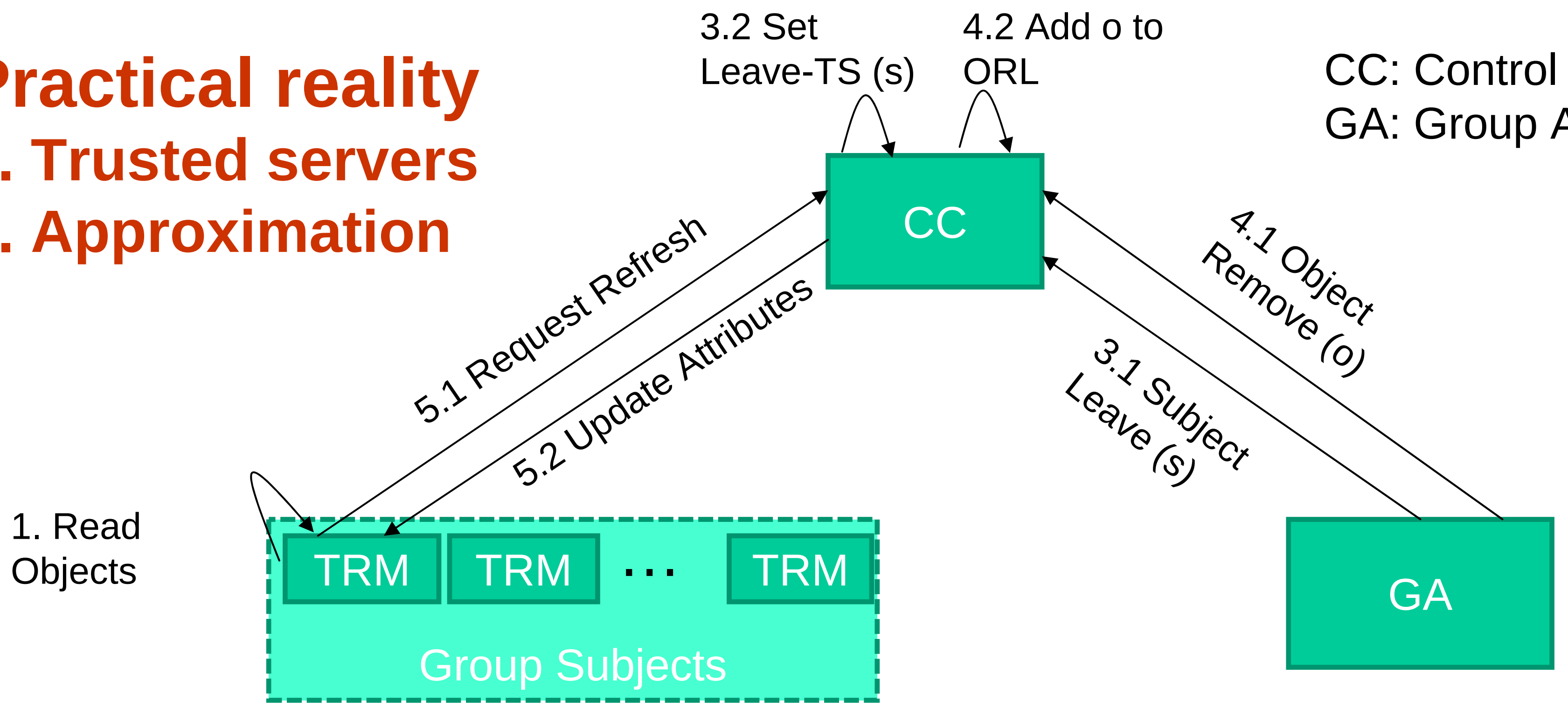


g-SIS Enforcement (How?)

Practical reality

1. Trusted servers

2. Approximation



CC: Control Center
GA: Group Administrator

Subject Attributes: {id, Join-TS, Leave-TS, ORL, gKey}

ORL: *Object Revocation List*

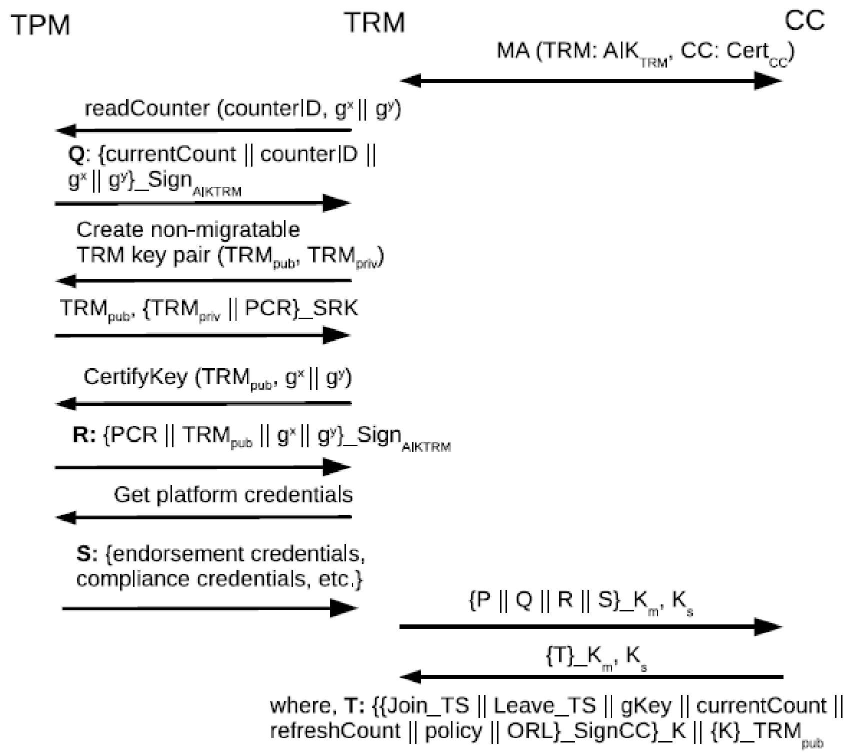
gKey: *Group Key*

Object Attributes: {id, Add-TS}

Refresh Time (RT): TRM contacts CC to update attributes

Implementation (How Exactly?)

- Detailed protocol and algorithm specifications



TPM

TRM

CC

MA (TRM: AIK_{TRM}, CC: Cert_{CC})

readCounter (counterID, g^x || g^y)

Q: {currentCount || counterID || g^x || g^y}_$\text{Sign}_{\text{AIKTRM}}$

Create non-migratable TRM key pair (TRM_{pub}, TRM_{priv})

TRM_{pub}, {TRM_{priv} || PCR}_SRK

CertifyKey (TRM_{pub}, g^x || g^y)

R: {PCR || TRM_{pub} || g^x || g^y}_$\text{Sign}_{\text{AIKTRM}}$

Get platform credentials

S: {endorsement credentials, compliance credentials, etc.}

{P || Q || R || S}_K_m, K_s

{T}_K_m, K_s

where, **T:** {{Join_TS || Leave_TS || gKey || currentCount || refreshCount || policy || ORL}_SignCC}_K || {K}_TRM_{pub}

Conclusion

PAST, PRESENT

- Cyber security is a young and immature field
- The attackers are more innovative than defenders
- Defenders are mired in FUD and fairy tales

FUTURE

- Cyber security will become a scientific discpline
- Cyber security will be application and technology centric
- Cyber security will never be “solved”