

Mobile Devices Security: Evolving Threat Profile of Mobile Networks

MBS-W07

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Objectives

- ◆ Mobile Security Threat Landscape
- ◆ Mobile Network Security
- ◆ Cybersecurity Implications, Mitigations & Future Developments



THREAT LANDSCAPE

Current Threat Landscape

Players	Amateur Hacker	Cyber Activist	Cyber Criminal	Organized Crime	Global Terrorism	Nation-State
Objectives	Notoriety	Harassment	Fraud	Economic Disruption	Fear/Panic	Global Power
Capabilities	Basic Hacking Denial of Service		Phishing Malware	Social Engineering	Advanced Malware Insider Threats	
Targets	DDOS Attack	Bank	Large Global Bank		Supply Chain Critical National Infrastructure	
Peer Group	Regulated Banks		Financial Services	Industry Leaders		DoD

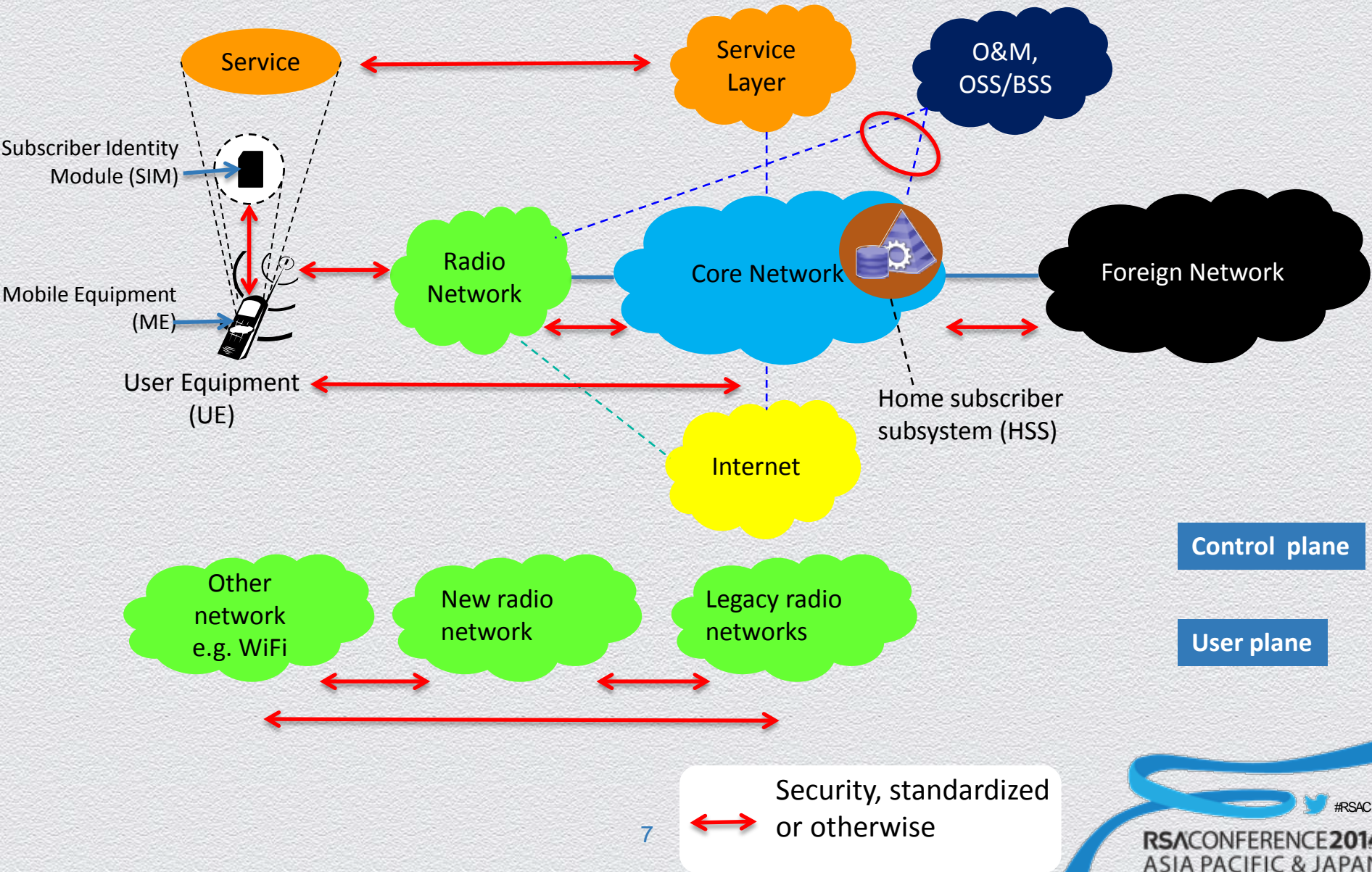
Top 15 Mobile Device Threats

ID	Mobile Threat	Threat Description
1	Malware Targeting Mobile Platforms	Malicious software such as viruses, Trojan horses, spyware, and malicious active content.
2	Mobile Spoofing	A malicious person or program could misrepresent as another in order to acquire sensitive personal information
3	Infected Applications	Application Downloads containing malicious software
4	Web Browser Attacks	Exploitation of malicious web applications to steal credentials, perform fraudulent transactions or compromise information.
5	SMS Redirection, SMS Hijack or SMS Exploit Forwarding	An SMS message can be used to redirect a mobile web browser to a malicious website
6	Vendor Breach	Compromise of a vendor's infrastructure could result in the loss of confidential information. Now includes Carriers
7	Transport/ Protocol Gap	Weakness in network or transport layer could allow eavesdropping or takeover
8	User Device Control	Mobile device could be lost, stolen or inappropriately borrowed or misused
9	Platform/Device Attacks	Utilization of known platform/device specific weaknesses to perpetrate malicious activities
10	Limited Control on App Stores	Market place enforces less constraints on applications hosted (Application that can automatically track spouse)
11	Cloning of Mobile Devices	Cloned smartphone/tablet mobile device built using feature phone/feature tablet ingredients.
12	Social Engineering of Mobile Device Data	Leveraging user's behavior of creating consistent username and password for all accounts,
13	Side-Load Physical Attacks	Leverage wired IO interfaces and wireless interfaces to launch side-loading attacks.
14	Rootkit Specific Anti-Virus/Anti-Malware Attacks	Kernel rootkit type attacks are increasing on the PC as well as the mobile device
15	Uncontrolled Context-Awareness Data Gathering	Limited control is enforced on applications accessing sensors.

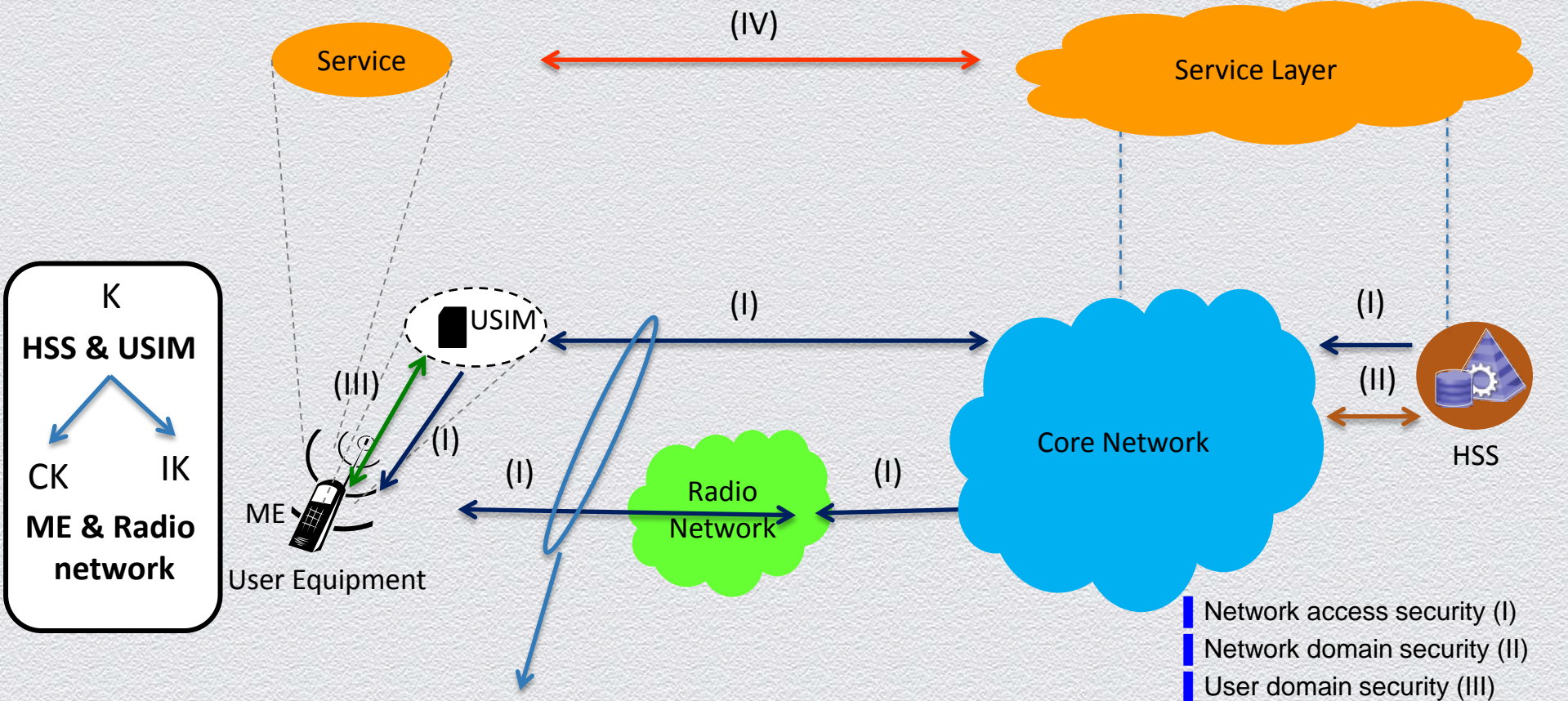


**MOBILE NETWORK
SECURITY**

Mobile Network Security – Helicopter View



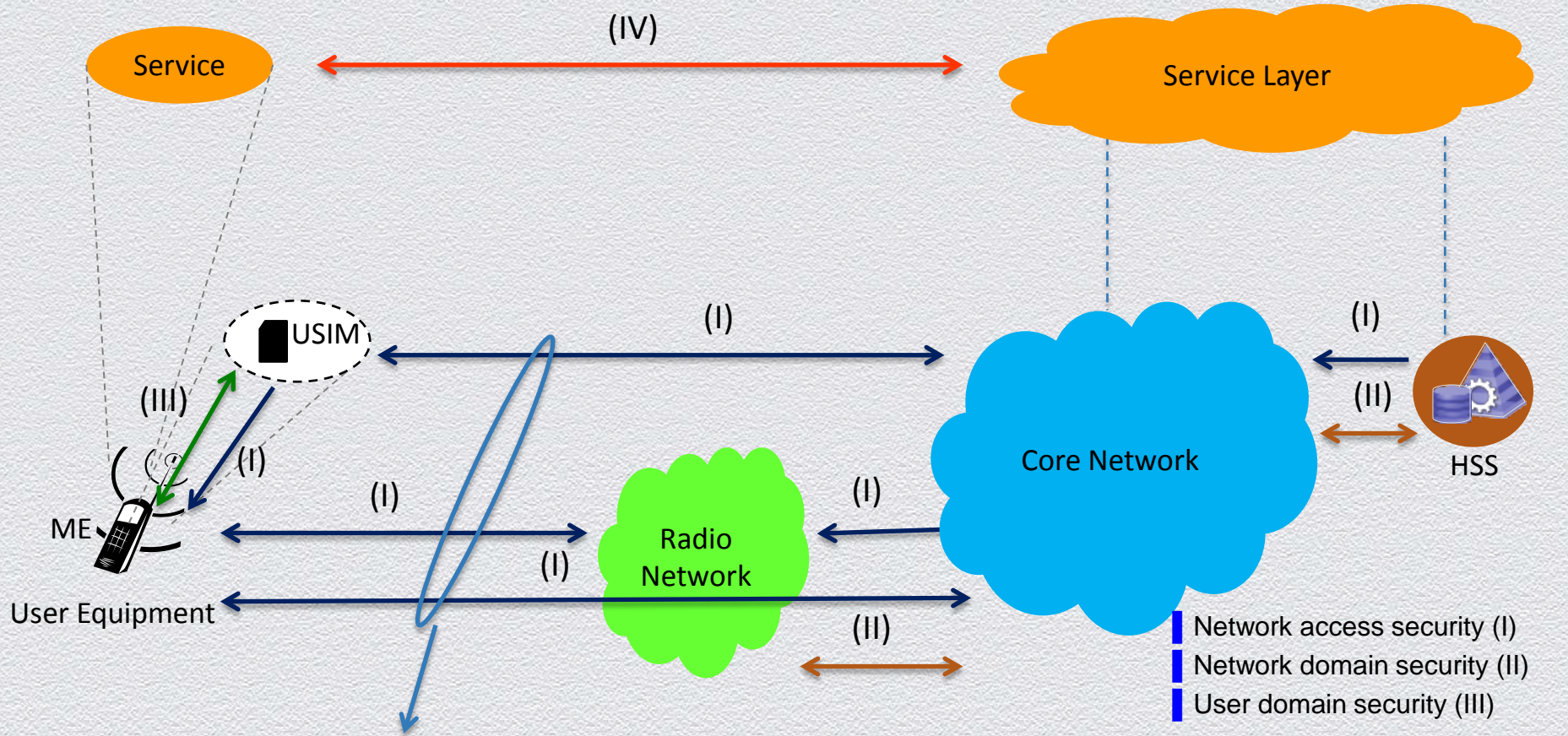
UMTS Security: Architecture



- Mutual authentication, confidentiality (optional) & integrity
- Separate keys for confidentiality & integrity
- Same keys for user and control planes

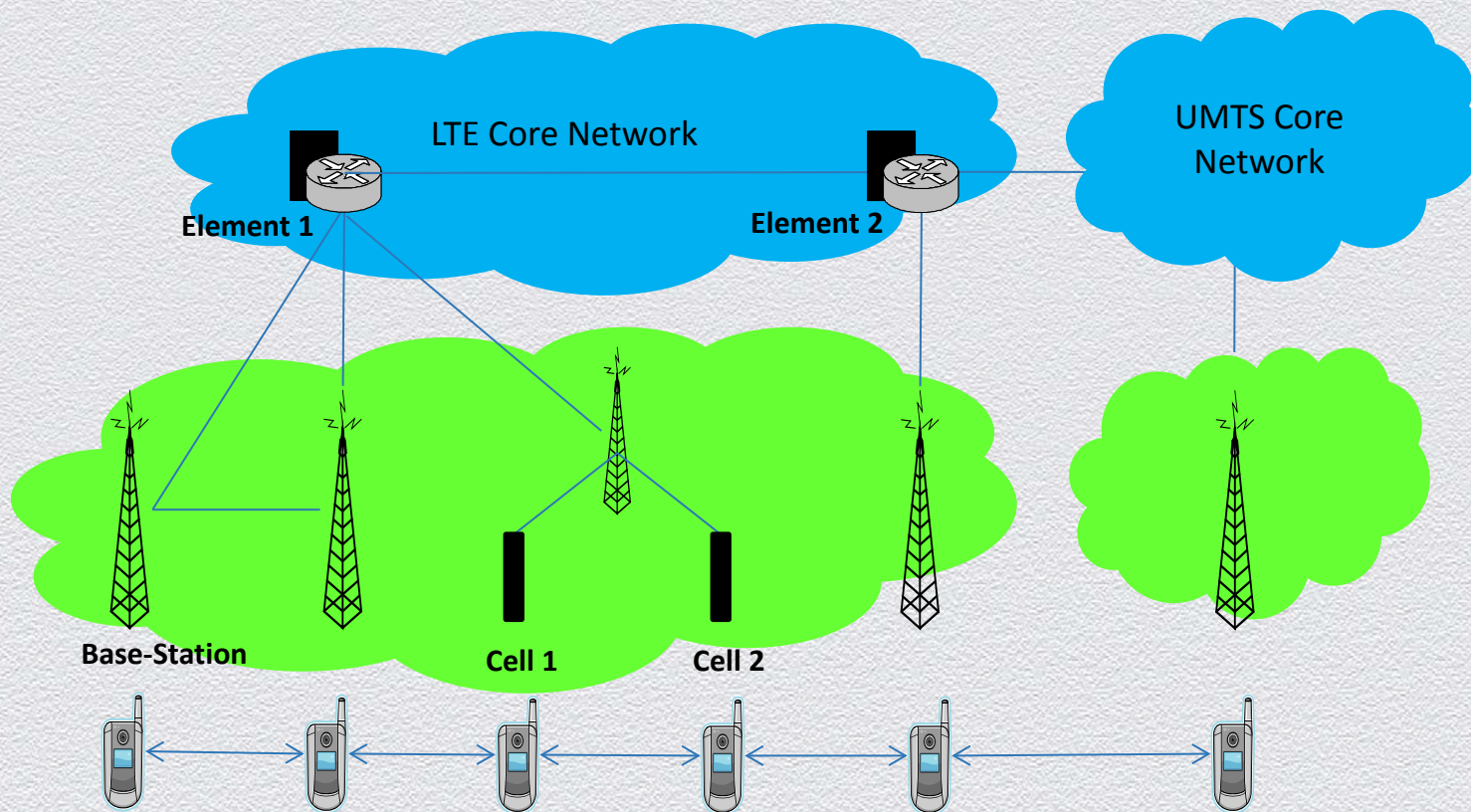
- Network access security (I)
- Network domain security (II)
- User domain security (III)
- Application domain security (IV)
- Visibility and configurability of security (V)

LTE Security: Architecture



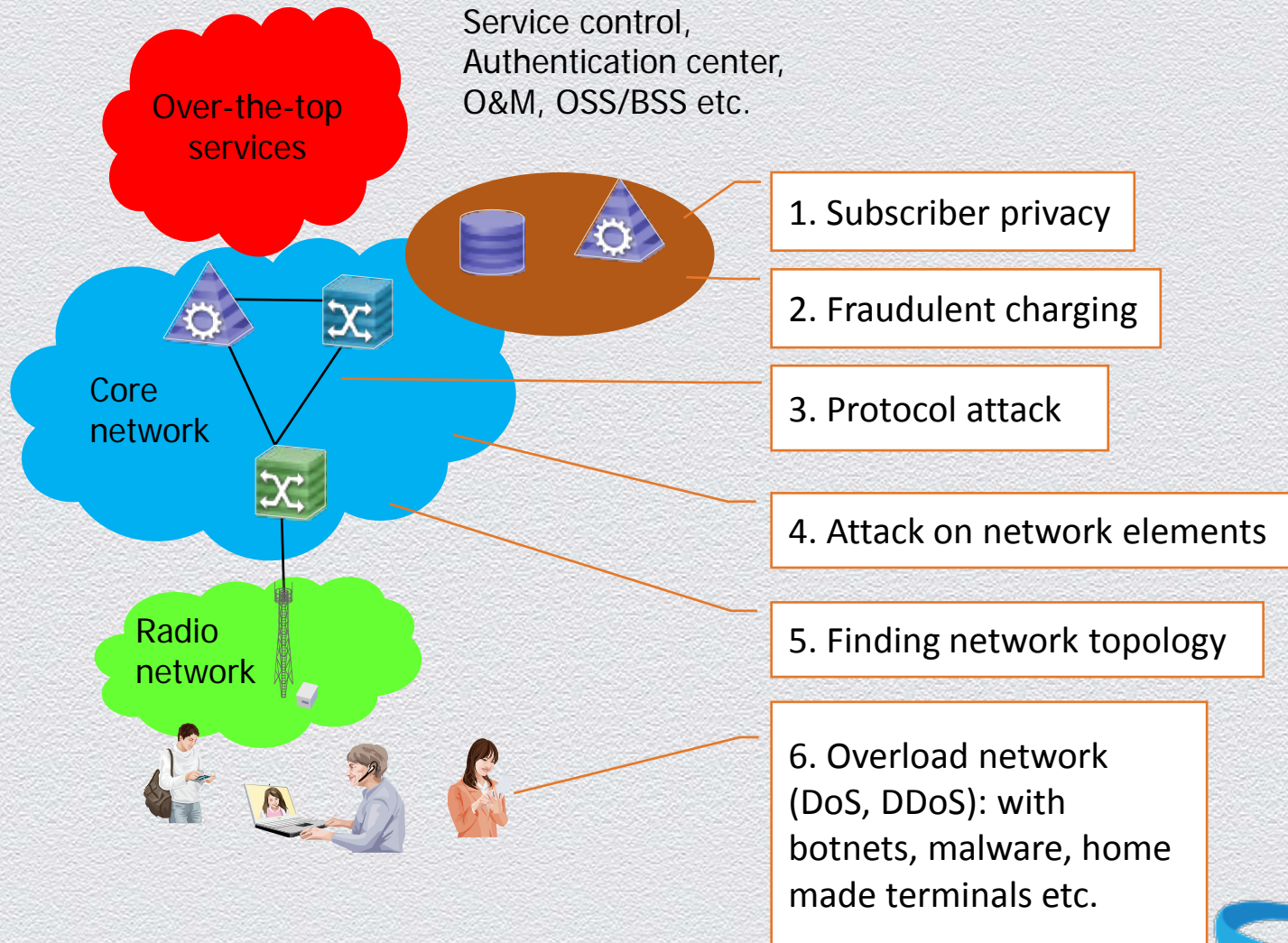
- Mutual authentication, confidentiality (optional) & integrity
- Separate keys for each purpose

LTE Security: Mobility aspects



- Forward & backward security: Cryptographically separate keys derived at each handover
- Keys mapped between different types of networks

Security Considerations





**CYBERSECURITY
IMPLICATIONS,
MITIGATIONS, AND
FUTURE DEVELOPMENTS**

Cybersecurity Implications

	GSM	GPRS	UMTS	SAE/LTE
Security Services	<ul style="list-style-type: none"> • Ciphering • User authentication • Equivalent to wired 	Ciphering User authentication	<ul style="list-style-type: none"> • Ciphering & integrity • Mutual auth. 	<ul style="list-style-type: none"> • Ciphering & integrity • Mutual auth.
Authentication	Authentication: 3 values		UMTS-AKA: 5 values	EPS-AKA: 5 values
Keys	Derivation of a ciphering key after auth.		Derivation of CK & IK	Separate keys for each purpose
Key Length	<ul style="list-style-type: none"> • Shared key 128 bits for auth. • Derived 64 bits out of which 54 used for ciphering 	<ul style="list-style-type: none"> • Shared key 128 bits for auth. • Derived 64 bits for ciphering 	128 bits	128 bits
Key handling	Changed on authentication			Changed on each handover
Algorithm	A5/1 / 2 /3; specification is confidential. A5/3 is based on Kasumi	GPRS Encryption Algorithm (GEA): GEA0/GEA1/GEA2/GEA3	Kasumi from Rel. 4	SNOW 3G, AES and ZUC
End-Point Security	BTS	SGSN	RNC / SGSN	<ul style="list-style-type: none"> • eNB for UP & RRC • MME for NAS
Network Security	None	None initially	MAPsec and IPsec	IPsec

Cybersecurity Implications

- ◆ Threat landscape and computational power have evolved much faster, with no significant updates in the overall security architecture
- ◆ Local DoS attack against the cell service
- ◆ Heterogeneous networks (Metrocells, Femtocells and WiFi)
- ◆ Local radio jamming attacks
- ◆ Complex DDoS threats targeting essential EPC elements, such as the HSS

Cybersecurity Implications

Attack Mode	Local (Femto/RAN/eNB/WiFi)	EPC (Core)	PDN (Global)
DoS	<ol style="list-style-type: none"> Jamming Attack <ul style="list-style-type: none"> DL-LP UL-LP Femto-based BS Vulnerabilities 	<ol style="list-style-type: none"> Femto-based Attack Core Network Vulnerabilities in GW, MME 	<ol style="list-style-type: none"> APT Malware
DDoS	<ol style="list-style-type: none"> LP Jamming Attack BS saturation with SMS Protocol Misbehavior 	<ol style="list-style-type: none"> Botnet of MEs Amplification Attacks HSS Saturation EPC Saturation 	<ol style="list-style-type: none"> Botnet of MEs Attack against Internet Nodes
Insider	<ol style="list-style-type: none"> Jamming with a BS BS Shutdown 	<ol style="list-style-type: none"> Node Damage HSS Saturation EPC Saturation 	<ol style="list-style-type: none"> HSS Saturation

Mitigations & Future Developments

	HSS Saturation Attacks	EPC Amplification Attacks	Scalability Attacks	Jamming Attacks
Flexible/Distributed Load Balancing (SDN)	X			
Flexible/Adaptive Management of the EPC (SDN)		X	X	
Advanced Anti-Jamming Techniques (e.g., Multi-Antenna Jamming Mitigation)				X
Distribution/Optimization of EPC Functions	X	X	X	
Optimization of Radio Resource Management		X	X	
Advanced Data Mining Techniques to Detect Attacks	X	X	X	X

Summary

- ◆ Mobile Network Security
- ◆ Cybersecurity Implications
- ◆ Mitigations & Future Developments

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Q&A

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APPENDICES

References

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- ◆ Security in Next Generation Mobile Networks: SAE/LTE and WiMAX, Anand R. Prasad and Seung-Woo Seo, River Publishers, August 2011.
- ◆ 3GPP TS 33.210: "3G security; Network Domain Security (NDS); IP network layer security".
- ◆ 3GPP TS 33.401: "3GPP System Architecture Evolution (SAE); Security architecture".
- ◆ 3GPP TS 33.102: "3G security; Security architecture".

Definitions

	Definitions
APT	Advanced Persistent Threat
BS	Base Station
BTS	Base Transceiver Station
DDoS	Distributed Denial of Service (Attack)
DL	Down Link
DoS	Denial of Service (Attack)
EDGE	Enhanced Data rates for GSM Evolution
EPC	Evolved Packet Core
GERAN	GSM EDGE Radio Access Network
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GW	Gateway
eNB	Evolved NodeB

Definitions

	Definitions
EPS	Evolved Packet System
IMS	IP Multimedia Subsystem
KDF	Key Derivation Function
LP	Low Power
LTE	Long Term Evolution
ME	Mobile Equipment
MME	Mobility Management Entity
NAS	Non-Access Stratum
NCC	Next hop Chaining Counter
NGMN	Next Generation Mobile Networks
NH	Next Hop

Definitions

	Definitions
PCI	Physical Cell Identity
PDG	Packet Data Gateway
PDN	Packet Data Network
PLMN	Public and Mobile Network
PSTN	Public Switched Telephone Network
RAT	Radio Access Technology
RNC	Radio Network Controller
RRC	Radio Resource Control
SAE	System Architecture Evolution (3GPP)
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
SMS	Short Message Service

Definitions

	Definitions
UE	User Equipment
UL	Upward Link
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
UTRAN	Universal Terrestrial Radio Access Network
WiFi	Wireless Fidelity, Wi-Fi is a trademarked term meaning IEEE 802.11x
WLAN	Wireless Local Area Network