5th Generation Crime-fighting in Cyberspace: Lawful Intercept in 5G Networks

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Information in this material was prepared to support an oral presentation and cannot be considered complete without the accompanying discussion.
Talk Outline

• Motivation
• Legal aspects (mainly Swedish point of view)
• LI standards and 5G LI architecture
• Some challenges
• Wrap-up

• Selected questions from Q&A
Motivation
Coercive measures

• Law enforcement based on voluntary co-operation from criminals is not feasible

• Various *coercive measures* necessary
  • conducting on-premise searches (including private homes)
  • confiscating weapons and evidence
  • arresting suspects
  • etc
Secret Coercive Measures

• Some coercive measures only effective if use is unknown

• Particularly, investigative measures (before arrest), e.g.
  • Put a tail on suspect
  • Hidden microphones, cameras
  • Telephone ”wiretapping” (focus in this presentation)
  • ...

• Measures tend to become privacy intrusive

• Rule of law ⇒ require legal authorization, a warrant
  • some exceptions, e.g. imminent danger, crime in progress
Telecommunication: Lawful Intercept

Tele- and datacom used by criminals, law enforcement needs matching tools:

• Intercept of (near) real-time communication or metadata
  • Content of communication (CC)
  • Intercept-related information (IRI)

• Collection of historical (possibly retained) data

• Active measures (implants on devices)
Legal Aspects

Disclaimer:
- following slides focus on Sweden and only gives a high level summary
- some aspects may have been lost in translations into English
Legal Framework in Sweden

• Law regulating **which communication service providers** that are required to provide LI-related information,
  – “Law on electronic Communication” (2003:389)\(^1\)

• Three frameworks regulating **when/how LI may be used**
  – ”Code of judicial procedure” (1942:740)\(^2\), the general LI framework
  – ”Law on prevention of serious crime” (2007:979)\(^4\), if imminent risk of committing serious crime
  – ”Collection act” (2012:278)\(^3\), to prevent/detect serious crime

• Recently also “Secret reading of data” (2020:62)\(^5\)
General Prerequisites for LI Usage*

18 §, 19 §: crime under investigation must be serious
- a certain penal value (IRI: 6 months prison, CC: 2 years)
- some specifically listed crimes (espionage, terrorism, ...)

20 §: a specific suspect is normally needed

20 §: of exceptional importance to investigation

1 §: must outweigh conflicting interests (e.g. privacy)

21 §: warrant by court (or public prosecutor) normally required

25 §: authorization to use necessary technical means

33 §: notification to individual after usage (some exceptions though)

* (Law 1942:740, Ch 27)
Note on Data Retention

• EU Data Retention Directive 2006/24/EG

• Implemented in Sweden 2012

• Overturned: EU Court (2016), Swedish Court of Appeal (2017)

• This affected CSP:s obligation to retain data, but warrants still possible for historical data
  • e.g. presence of phones in a certain area at a certain time
Swedish Authorities with LI Mandate
Other Countries

- Finland’s law (www.finlex.fi/sv/laki/ajantasa/2011/20110806)*
  similar, perhaps a bit “richer”
  - based mainly on length of text...

- EU: Council Resolution 17/1/1995 on Lawful Interception of Telecommunications

- USA: Omnibus Crime Control Act, CALEA, Patriot Act

- International: the Budapest Convention on Cybercrime (2001)
  - Accession by EU, Australia, Canada, Japan, USA and a few others

*) replace “sv” by “fi” to get version in finnish
Service Providers and Obligations

• CSP* = operator of: public communication network, public fixed telephony service, or public mobile communication service
  • proposed amendment (Dec 2020): interpersonal communication services based on number-plans

• Two main obligations
  • Non-disclosure of intercept activation
  • Facilitating information handover
    • could mean providing decryption keys, if available

*) in Sweden
LI Standards and 5G Architecture
LI Standards

- Many vendors, many CSP:s, and many law enforcement agencies ⇒ need to standardize also LI functions and interfaces

- Interfaces between network and law enforcement are called *Handover Interfaces*

- Network-internal, LI-related interfaces called *X-interfaces*

- Standardized by ETSI TC LI (fixed) and 3GPP SA3LI (mobile)
  - For 5G LI, some dependencies to ETSI TC NFV

- (Also national and non-3GPP related standards)
HI and X Interfaces: High Level View

Law Enforcement Agency (LEA)

Law Enforcement Monitoring Facility (LEMF)

HI1, X1: Intercept management and provisioning
HI2, X2: IRI (e.g. comm. monitoring, metadata)
HI3, X3: CC (communication content)
HI4: LI status notification

warrant (target)

Admin Function

MDF

Mediation/Delivery Function

X1 (Provisioning)

Comm. Service Provider (CSP)

Target

HI1

HI2 (IRI)

HI3 (CC)

HI4

Mediation/Delivery Function

MDF

X2 (IRI)

NF

X3 (CC)

NF

Law Enforcement Monitoring Facility (LEMF)
5G LI Standards

Requirements
3GPP TS 33.126 V16.2.0 (2020-07)
3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Security; Lawful Interception requirements (Release 16)

Architecture & Functions
3GPP TS 33.127 V16.5.0 (2020-09)
3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Security; Lawful Interception (LI) architecture and functions (Release 16)

Protocols & Procedures
3GPP TS 33.128 V16.4.0 (2020-09)
3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Security; Protocol and procedures for Lawful Interception (LI); Stage 3 (Release 16)
Crucial Requirements

• The handover interfaces must be secure, avoiding misuse

• The intercept only done for the specified target

• Avoid both under-collection and over-collection
  – Warrant can be limited e.g. to only IRI, and/or only for specific service
  – Must be possible to activate/deactivate LI under ongoing “call”

• LI must not be detectable by: target, non-authorized CSP personnel, etc
  – E.g. activating LI must not affect the service

• Independence between jurisdictions
  – E.g. home/serving network cannot depend on each other to provide LI
33.127 Architecture
Administration Function

• Receives warrant from LEA
  • Often manual handling, e.g. over crypto-fax

• LI Control Function (LICF)
  • Master record of LI information (e.g. list of targets)
  • Authorizes LI-related operations (e.g. deploying new function with intercept capabilities)
  • Implemented on LI-specific Infrastructure

• LI Provisioning Function (LIPF)
  • Provisions functions to carry out intercept
Point-of-Intercept (POI)

• Network Function (NF) that may have LI-relevant info has a Point-of-Intercept
  • IRI-POI or CC-POI depending e.g. on control plane or user plane

• POI normally pre-provisioned by LIPF to collect data associated with LI Target

• ”one-way” access into state machine of NF
  • to meet undetectability requirements
Mediation/Delivery Function

• Deliver “well-formatted” LI-product to LEMF

• Attaches LI specific metadata
  • LIID (Lawful Intercept ID)
  • Timestamp
  • Network ID
  • Other correlation information
Intercept Control Flow

1. Derives network specific info from warrant

2. Provisioning request

3. Which NFs relevant for this target?
   (Target connected? Session Established?)

4. Provisioning(ID’)

NF

POI

LICF

LIPF

ADMF

SIRF

NRF

Network Repository Function (5GC)

System Information Retrieval Fn.
(Service topology)

Registration

Warrant
(Target ID)
Triggered POIs and Triggering Functions

Control- and user-plane split

1. PDUSess_Est_Req
2. Is ID an LI-target? (Map ID to IP-adr)
3a. Trigger: start capture (IP adr)
3b. Sess_Est
4. data

SMF: Session Mgmt Fn.
UPF: User plane Fn.

Law Enforcement

SMF -> IRI-POI

Through AMF

MDF

CC-POI

UPF

HI3

X3

TF

CP

UP

LI
Examples of 5G LI Considerations
1. Notify: e.g. VNF instantiation
2. Authorization of VNF
3. Provisioning, e.g. LI-specific certificates

Virtualization – LI Interaction

(ETSI NFV)
SUPI Encryption and Steering of Roaming

key ↔ SUPI binding, prevents home network "cheating": $K_{AMF} = F(K_{SEAP}, SUPI, ...)$

LI-unacceptable: "covert" channel from home network to unauthenticated subscriber
UDSF: Unstructured Data Storage Function

• 5G architecture includes UDSF, means for network functions to outsource storage

• Several LI implications:
  • (shared) UDSF should not be used for LI-specific data
  • Li-relevant UDSF must not be located in other jurisdiction
  • LI-specific access to UDSF must not be "out of the ordinary" to avoid exposing LI activation
Some Challenges
Non-traditional Telecom Providers

• More and more user traffic moving to NTT messaging apps

• These apps almost always use end-to-end encryption

• May fall outside LI obligations and/or cannot aid in providing cleartext content

• A main motivation behind new Swedish law “secret reading of data” (2020:62)
  – crimes which give at least 2 years in prison (or other specifically listed crimes)
  – applies to information systems used by the suspect or which the suspect can reasonably be assumed to contact
  – cannot be used on system regularly in use by lawyer, doctor etc
  – allowed technical means include “circumventing security measures and exploiting vulnerabilities”
  – (Finnish legal framework in principle supports similar LI functionality)

*) Lagrådsremiss: Hemlig dataavläsning, 24 oktober 2019
Recent Example of Active Measures

How Police Secretly Took Over a Global Phone Network for Organized Crime

Police monitored a hundred million encrypted messages through Encrochat, a network used by career criminals to conduct drug deals, murders, and extortion plots.

By David March 2

July 2, 2020, 12:34am

Euro police forces infiltrated encrypted phone biz – and 'criminal' EncroChat users are being rounded up

Something wasn’t right. Starting earlier this year, police kept a close watch on Encrochat, a network used by drug dealers to conduct business on custom, encrypted phones made by a company called Encrochat. For legal reasons, Motherboard is referring to Mark as Encrochat. For legal reasons, Motherboard is referring to Mark as a "network-side “implant”"

(Seems to have been a network-side “implant”)

(Security)

Euro police forces infiltrated encrypted phone biz – and ‘criminal’ EncroChat users are being rounded up

rs lead to 750 UK arrests

[Image of a police officer and a gun]

Slog till mot gangstervärlden – så knäckte polisen koderna

Metropolitan Police

FOTO: POLISEN


27.09.2019

Så här köpte polisen det första Encrochat

Enligt rapporten från operationen har närmare 7 500 000 enkätkort lagts upp i EU. Avgifterna kan bli så höga att de största borgarna inte kan betala dem.

1.07.2019

Så här används Encrochat

Det är inte bara enkätkort som kan användas för att skicka meddelanden, det är också möjligt att överföra pengar via Encrochat.

3.08.2019

Så här fungerar Encrochat

Encrochat är ett exempel på hur man kan bygga ett eget krypterat nätverk av telefoner.

7.08.2019

Så här kan man spionera Encrochat

Enligt rapporten från operationen har närmare 7 500 000 enkätkort lagts upp i EU. Avgifterna kan bli så höga att de största borgarna inte kan betala dem.
New Standard: ETSI TS 103 707

- LI standard for messaging services (March 2020)

- Based on HTTP/XML (instead of ASN.1)

- Several of the large NTT:s have been involved in standardization effort
Some (Difficult) Open Problems

• Further 5G developments
  • E.g. edge computing: how to secure LI “far out”?  
  • Home-routed services: currently can’t activate encryption

• “Active LI” has advantages but also disadvantages
  • A kind “handover interface” between end-user and LEA
  • Impossible to standardize
  • Acceptable alternatives with better long-term efficiency?

• Can we improve transparency without jeopardizing effectiveness?
  • Technical means for auditing LI usage?
Summary

- Lawful Intercept: Important tool for law enforcement
  - Governed by law(s), authorized by warrants
  - Real-time or historical data
  - Metadata (IRI) or communication content (CC)

- Technical standards: ETSI and 3GPP

- 5G LI has specific technical considerations (virtualization etc)

- Encrypted services currently handled by “active LI”
Selected Q&A:s (1/3)

• Q: Are there any LI functions defined for the roaming interfaces?
  • A: No, LI interfaces are only defined internal to the core network.

• Q: Can there be conflicts between GPDR and LI regulations?
  • A: GDPR makes an exception to allow LI. There are however regulations stating how law enforcement needs to handle personal data after it has been handed over from the CSP, e.g. EU directive 2016/680.
Selected Q&A:s (2/3)

• Q: Does LI apply to SIM-specific functions such as OTA?
  • A: The 3GPP standards do not cover things such as SIM OTA. Since OTA would be difficult to use for general purpose communication it is currently not seen as important to enable LI for it.

• Q: If a person is notified about having been a target for intercept, are also persons who have communicated with the target notified?
  • A: The way the law is formulated, it seems to apply only to the target itself.
Selected Q&A:s (3/3)

• Q: How are the requirements on undetectability of LI handled, do the standards cover it or is it left to implementation?

• A: Both. The standards are written to avoid bad designs that would imply a risk that activation of LI can be noticed by users. For example, the standards avoid relying on LI-specific signalling taking place outside of the protected LI-domain. Then there will be some things left to implementation, e.g. the implementation has to be done to avoid that undesired extra delays imposed by LI functions could be detected outside the LI-domain.