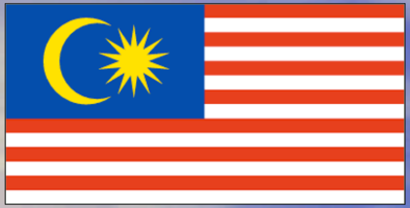
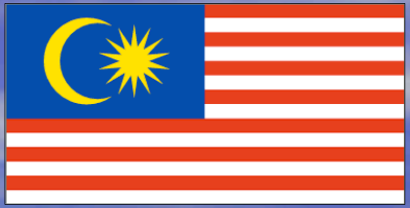




Phreaking in the 21st Century

Kuala Lumpur, Malaysia 2004

Disclaimer

- The speech is oriented towards the penetration testing methodology used while working with a telecommunications operator and its legal working framework.
- We do not recommend that you use this material for unauthorized access to operators' infrastructure or systems.
- We cannot be held responsible if you decide nevertheless to explore such systems, find it fascinating, start getting sloppy and leave tracks that finally get you busted.
- The information contained within this presentation does not infringe on any intellectual property nor does it contain tools or recipe that could be in breach with the laws of Malaysia.

Agenda

- Brief history of phreaking
- Review of digital telephony concepts
- Network Elements security
- Protocols security
- Future threats
- Conclusions / Q&A

Once upon a time…

John Draper aka Captain Crunch during the happy days of in-band signalling

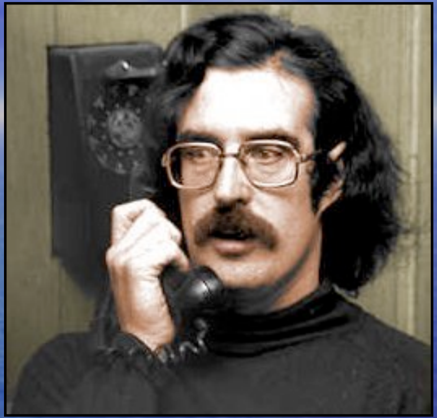
Definition of phreaking

- ***Phreaking*** is a slang term for the action of making a telephone system do something that it normally should not allow.

But… what is it?

- Discovery and exploration of features of telecommunications systems
- Controlling Network Elements (NE) in a way that was not planned by its designers
- Abusing weaknesses of protocols, systems and applications in telephone networks

Why would anyone do this??



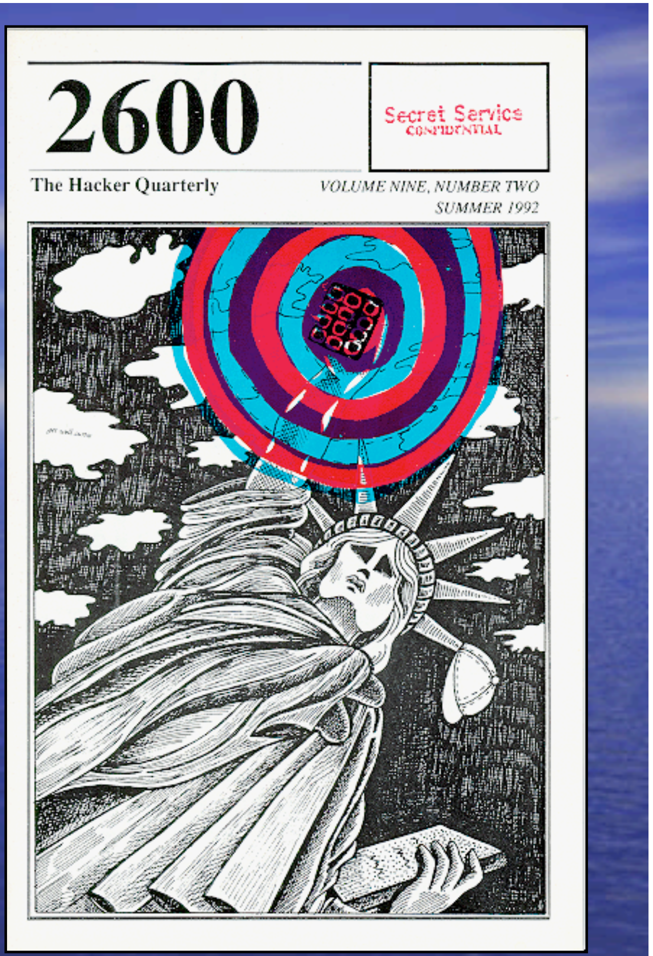
" I do it for one reason and one reason only. I'm learning about a system. The phone company is a System. A computer is a System, do you understand? If I do what I do, it is only to explore a system. Computers, systems, that's my bag. **The phone company is nothing but a computer**. "

Captain Crunch

From *Secrets of the Little Blue Box*
Esquire Magazine, October 1971

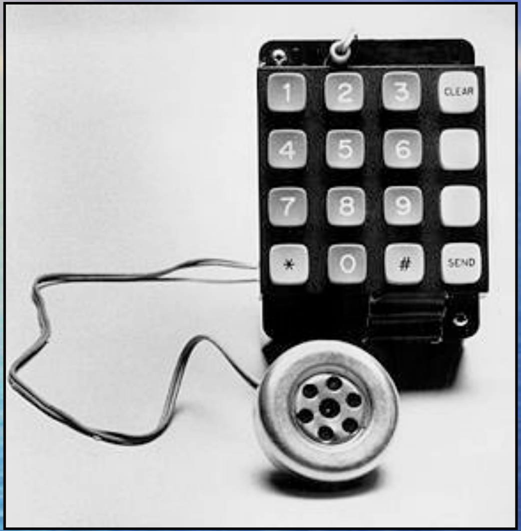
Beware!

Quote from 2600 magazine summer 1992
Phreaking in the nineties by **Billsf**



‟ If you live in a currently repressed area, such as the United States, you should beware that even the things that you consider "harmless exploring" could get you into lots of trouble (confiscation of computer, fines, probation jail, loss of job, etc.) ‟

The Blue Box



Steve Jobs and Steve Wozniak in 1975 with a bluebox

- CCITT#5 in-band signalling sends control messages over the speech channel, allowing trunks to be controlled
- Seize trunk (2600) / KP1 or KP2 / destination / ST
- Started in mid-60's, became popular after Esquire 1971
- Sounds produced by whistles, electronics dialers, computer programs, recorded tones

The end of the blueboxing era

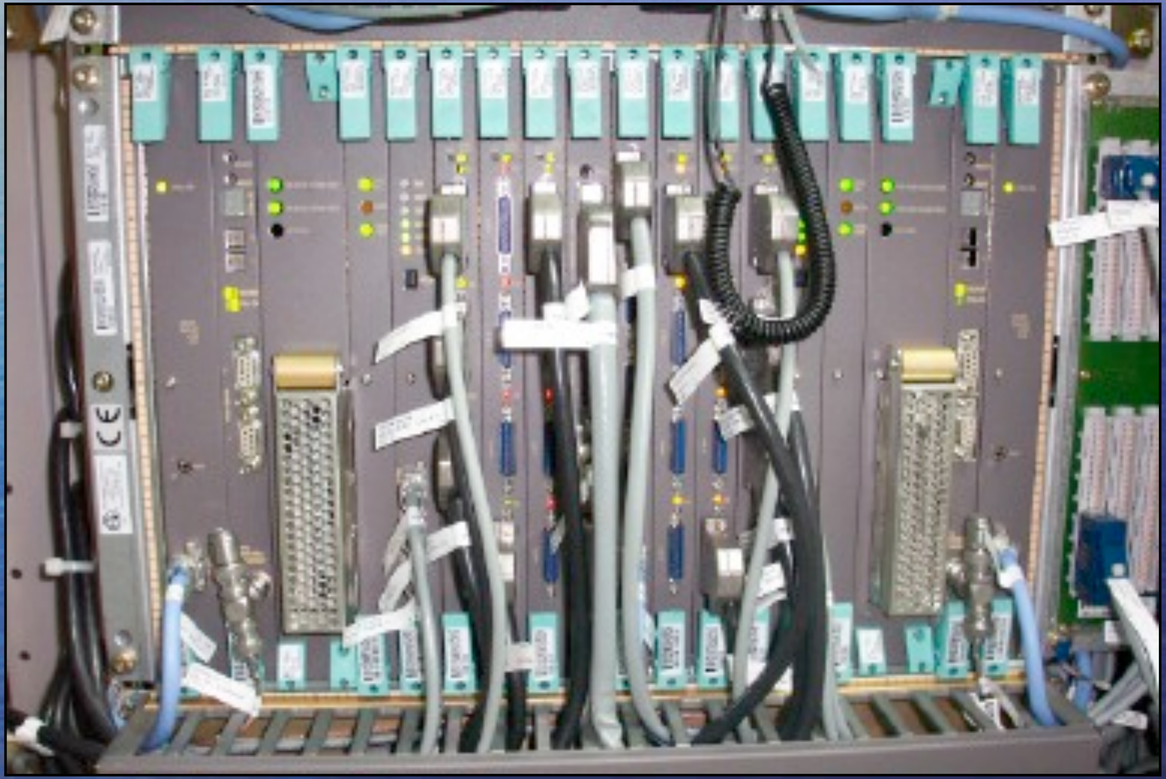
SS7 Network
SMS
HLR
SCP

- Telcos installed filters, changed frequencies, analyzed patterns, sued fraudsters
- The new SS7 digital signalling protocol is out-of-band and defeats blueboxing
- In Europe, boxing was common until the early nineties and kept on until 1997-1998
- In Asia, boxing can still be done on some countries. There were blueboxers in KL (at least in 1995-1996)

Hackers vs. Phreakers

- In the nineties, the Internet started its phenomenal growth and overshadowed other networks
- Underground activities quickly shifted from BBS, X.25 and boxing to Internet hacking
- Many phreakers reconverted to hacking (or kept on working for the local telcos)
- Phreaking is not about using someone else’s tools to automatically discover and exploit known bugs

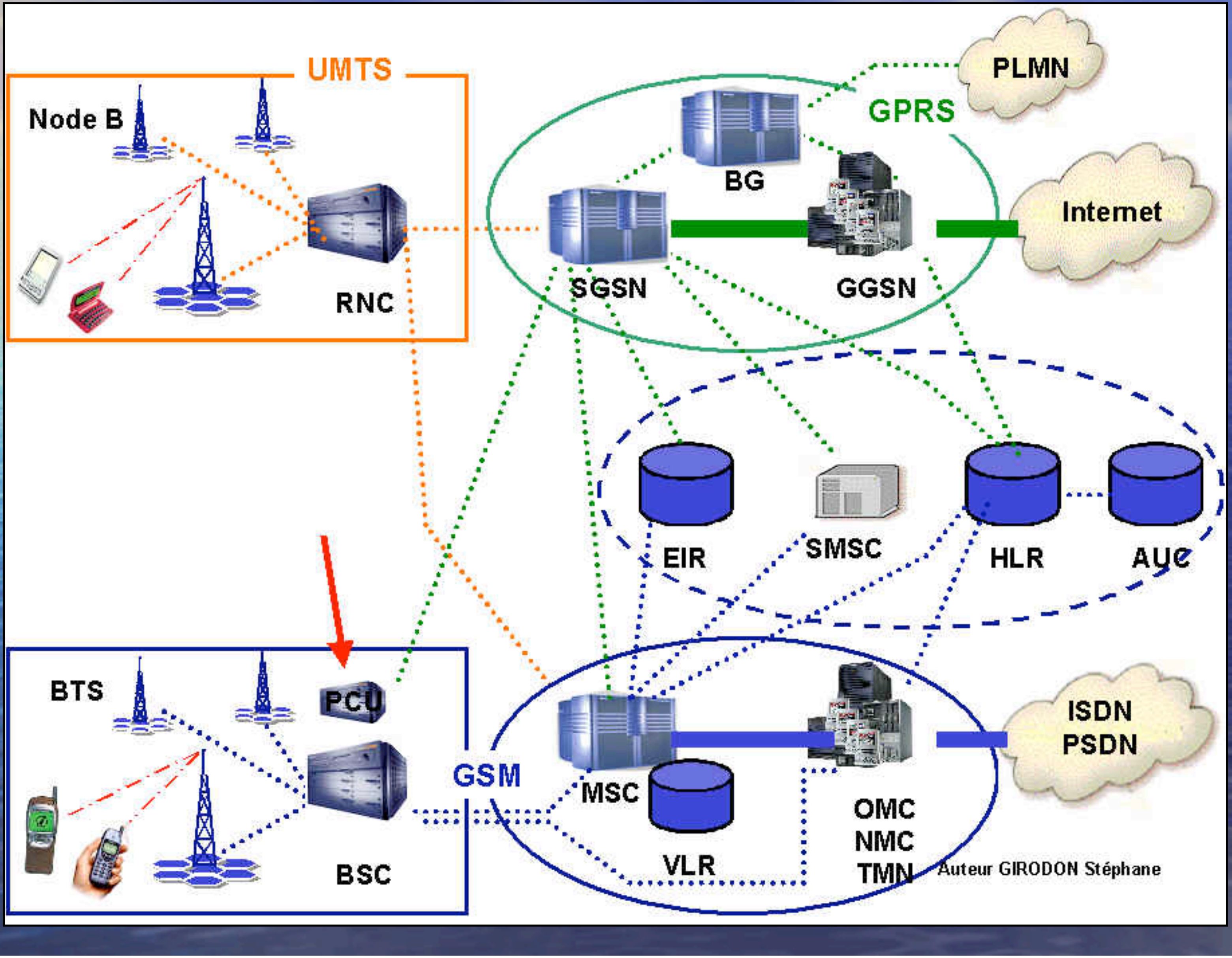
Digital Telephony



Telephony 101

- Fixed line (PSTN): analog, digital (ISDN)
- Mobile: analog (AMPS, NMT), digital (GSM, CDMA, 3G), private (PMR, Military)
- All switches now speak SS7 for signalling
- Speech and data convergence is increasing
- Services are growing (SMS, MMS, packet data, WLAN integration, etc.)

GSM/3G Mobile Telephony



Network Elements

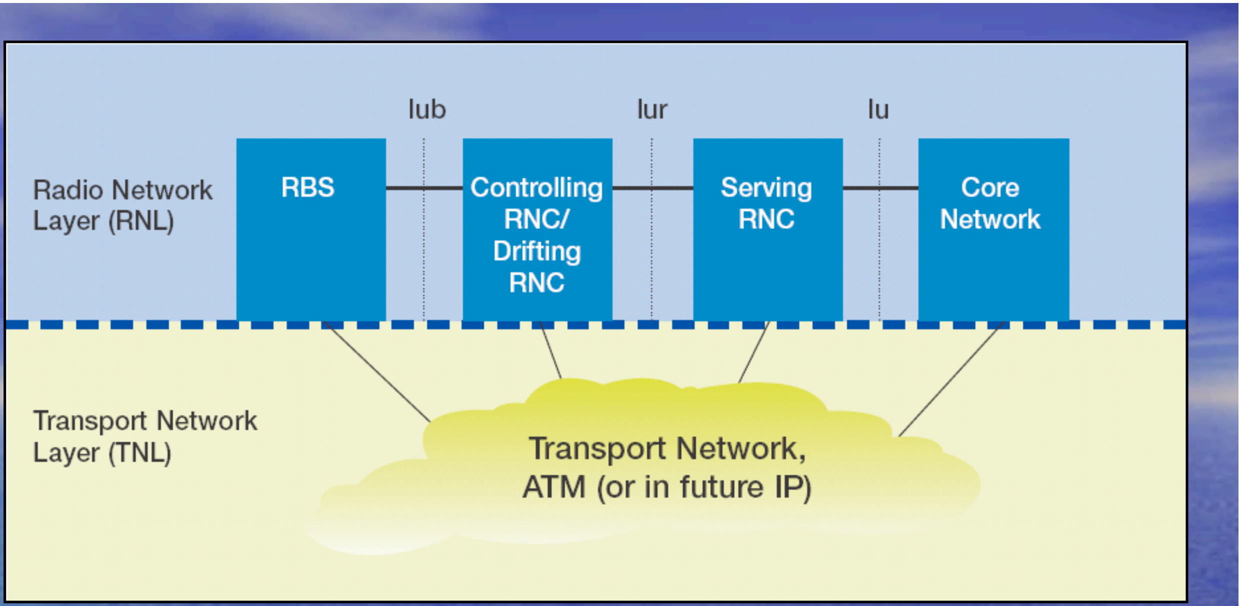
- Radio Access Network (BSS/RAN)
- Mobile Switching Center (MSC/NSS)
- Home Location Register (HLR/VLR)
- Intelligent Network (IN)
- Messaging (SMSC, MMSC, USSD, VMS)
- Packet data (GPRS, EDGE, 3G/UMTS)
- Network Management (NMS, OMC, OSS)
- Mediation, Billing, Customer Care, LIG

Radio Access Network

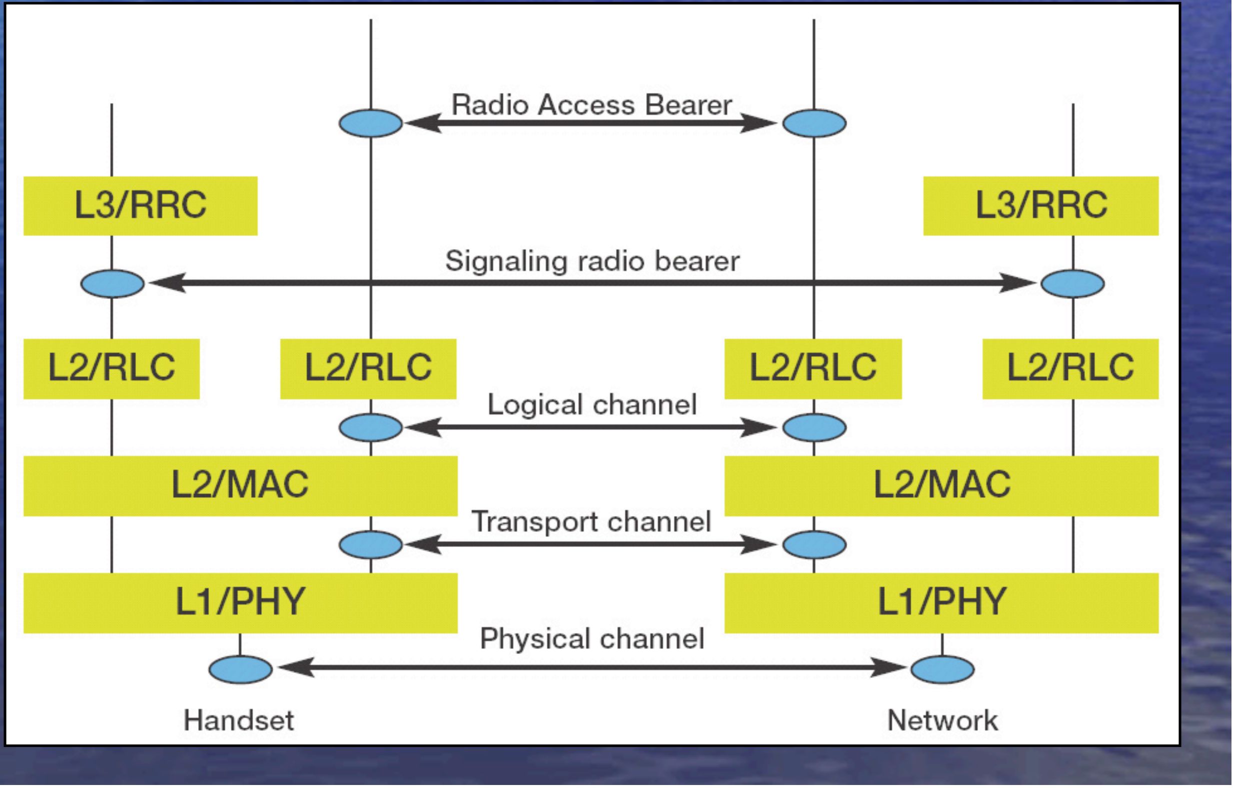
- In GSM and 3G, traffic is encrypted
- Multiple channels (FDMA) and timeslots (TDMA)
- Some signalling traffic in clear text

➔ *RAN Network Elements can be accessed over MML, Q.3, remote terminal and SS7*

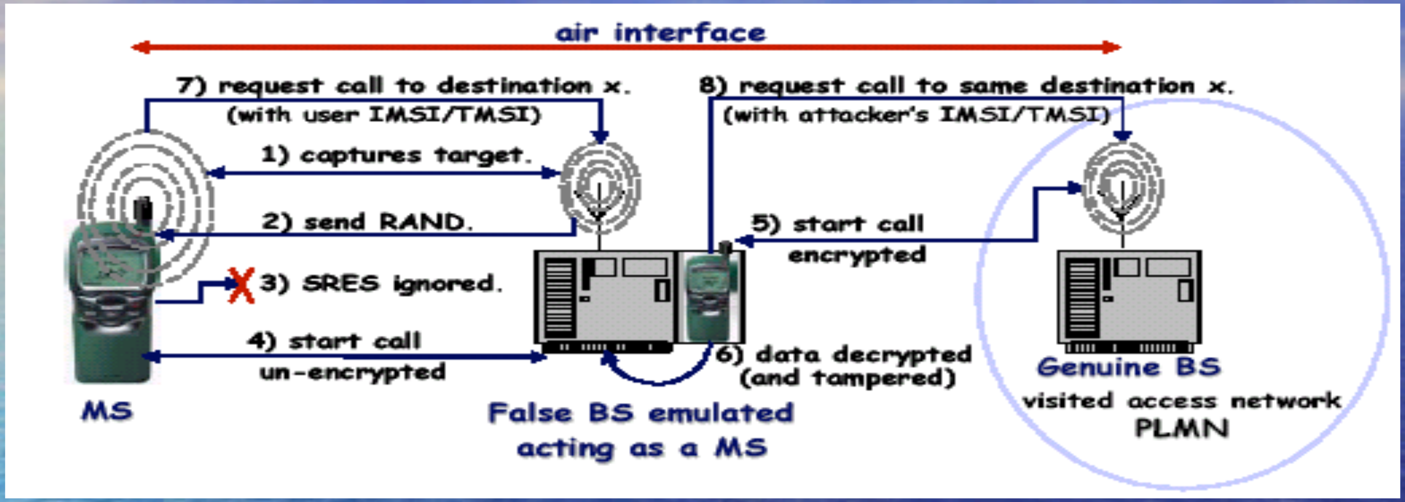
Transport Network


Iub
Iur
Iu
Radio Network Layer (RNL)
RBS
Controlling RNC/ Drifting RNC
Serving RNC
Core Network
Transport Network Layer (TNL)
Transport Network, ATM (or in future IP)

Radio Access Network



Examples of RAN attacks



- Fake BTS attacks (e.g. Man-in-the-Middle)
- Modified MS attacks
- Over-the-air SIM cloning
- DoS by MML configuration change

Fake BTS

Transmissions Network

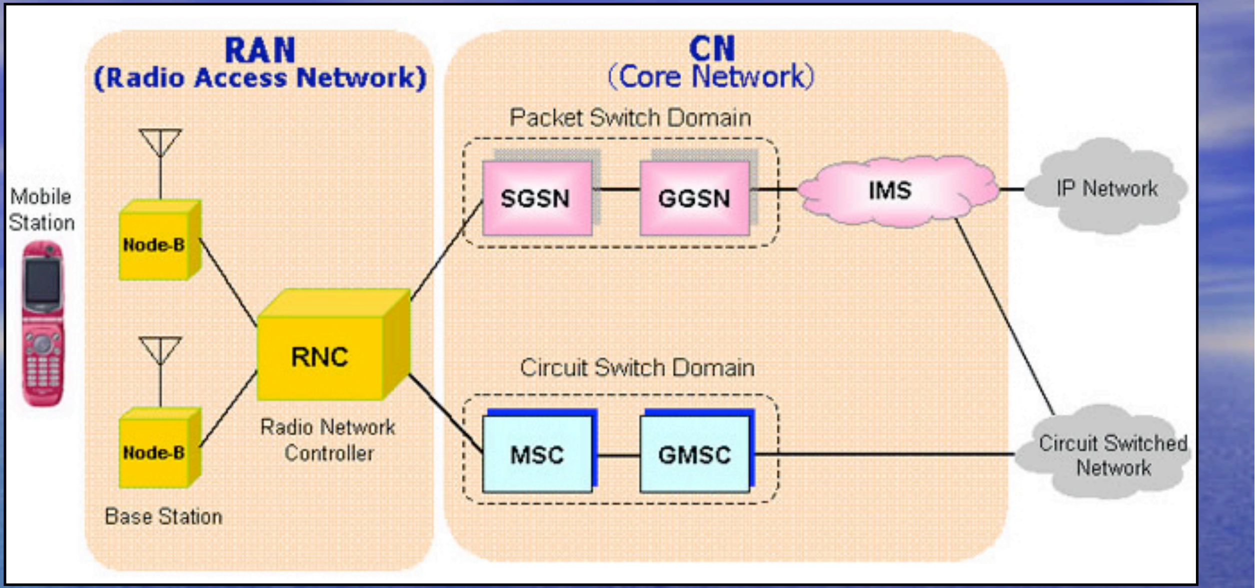
- It is the backbone of any digital network, links network elements together
- Can carry IP traffic but is not yet fully IP-based
- Mostly fiberoptics, SDH/PDH, ATM, dark fiber, microwaves, FSO

→ *NE accessed by MML, Q.3 and remote terminal*

Examples of TN attacks

- Mostly vulnerable to physical attacks
- Fiber splicing
- Microwaves radiation leak
- DoS by MML reconfiguration of transmission ring

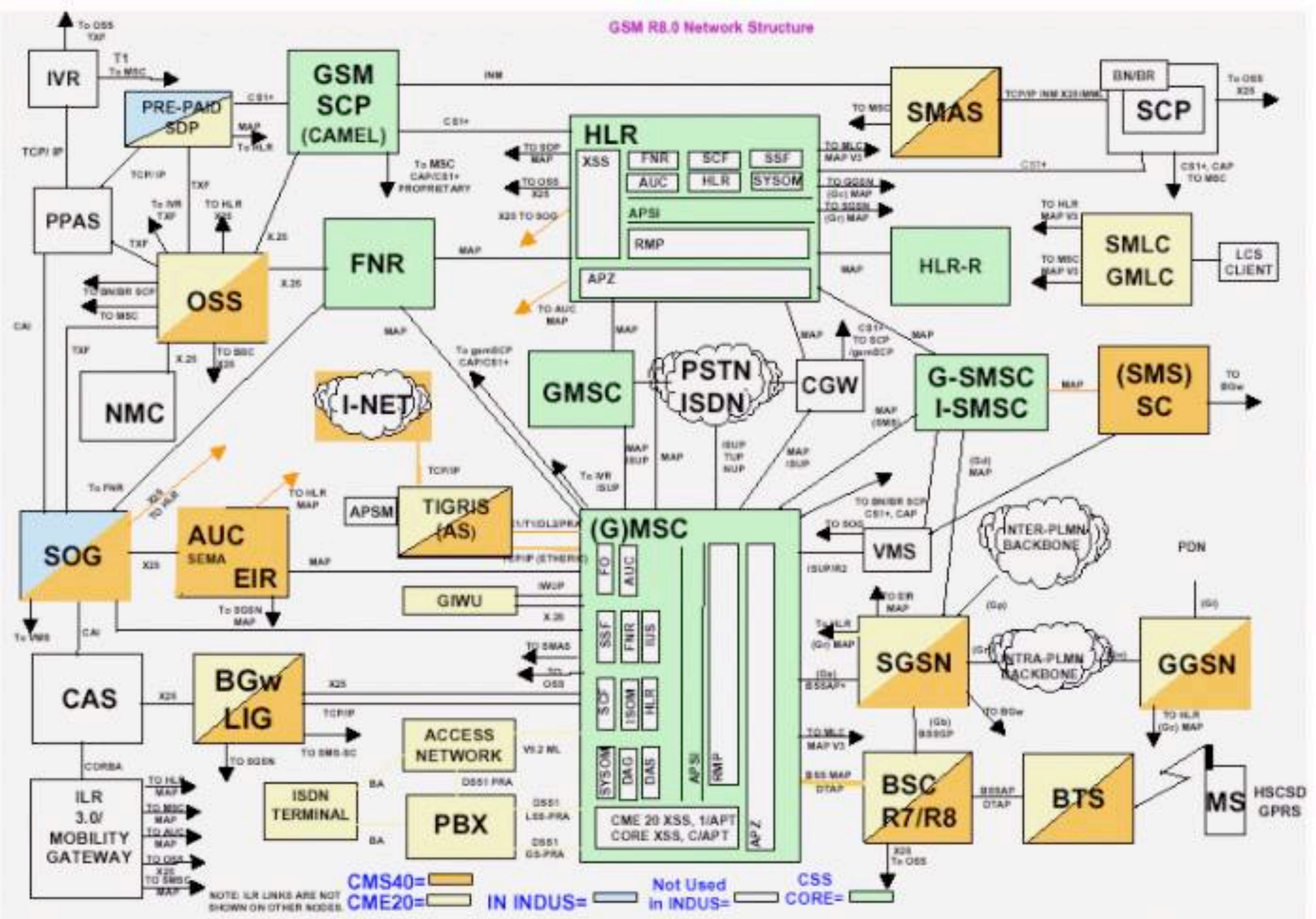
Switching Network



- Telephony is about circuit-switching
- In GSM, the MSC works with HLR/VLR (subscribers DB) and with BSS/RAN (access network)
- GSM uses TDMA (3G uses CDMA). The basic unit is E1 (2Mbps)

➔ *MSC can be accessed by MML (over X.25 or IP), FTAM, CMISE, SS7 protocols. HLR over MML, SS7 and remote terminal.*

NSS – detailed view

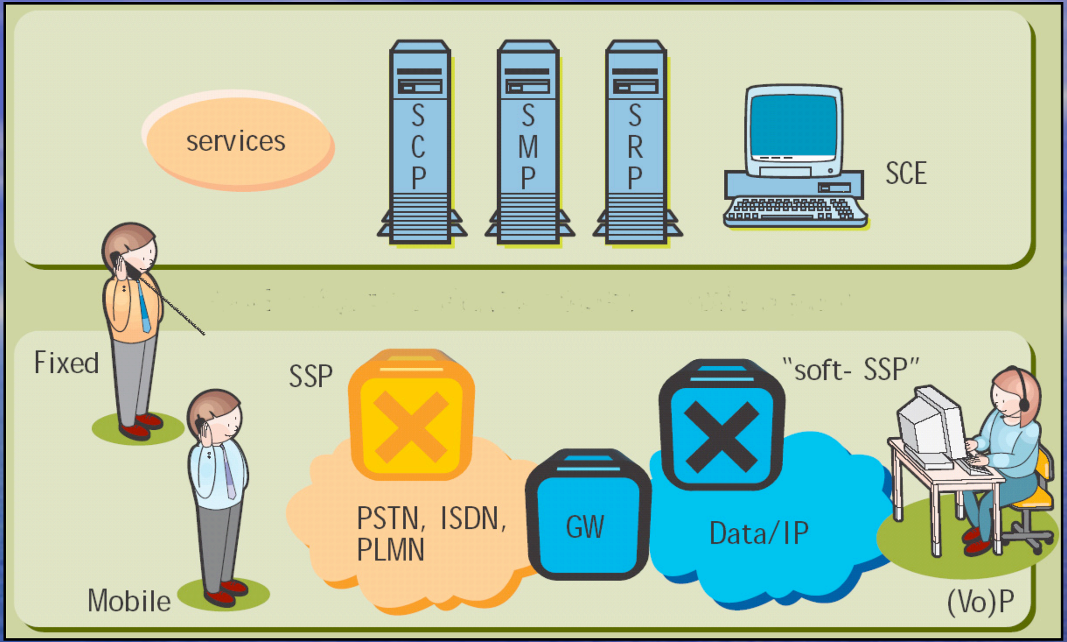


GSM R8.0 Network Structure

Examples of NSS attacks

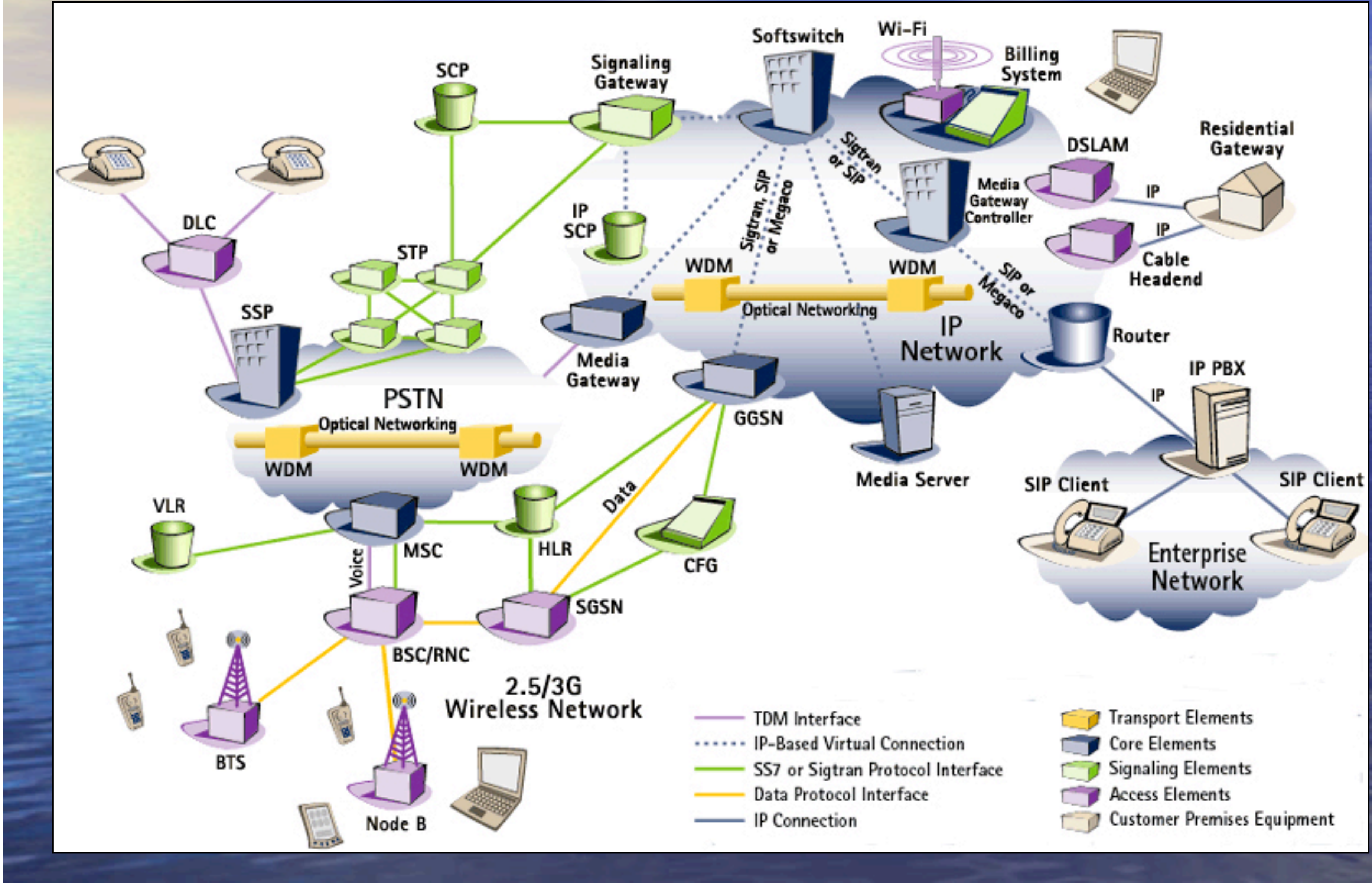
- Creation of ghost numbering trees
- Forwarding loops
- Modification of roaming profiles
- Creation of ghosts subscriptions on HLR
- Special CDR (Charging Data Record) generation rules
- DoS / harassment / pranks
- Injected SS7 protocol messages

Intelligent Network



- UNIX high-available clusters outside of core network (SCP, SMP, SCE)
- Interrupt call-control, execute logic, resume control
- Toll-free (e.g. +800), prepaid (real-time credit control), VPN (PABX-like), etc.
- Based on SS7 INAP and CAMEL protocols

IN Overview

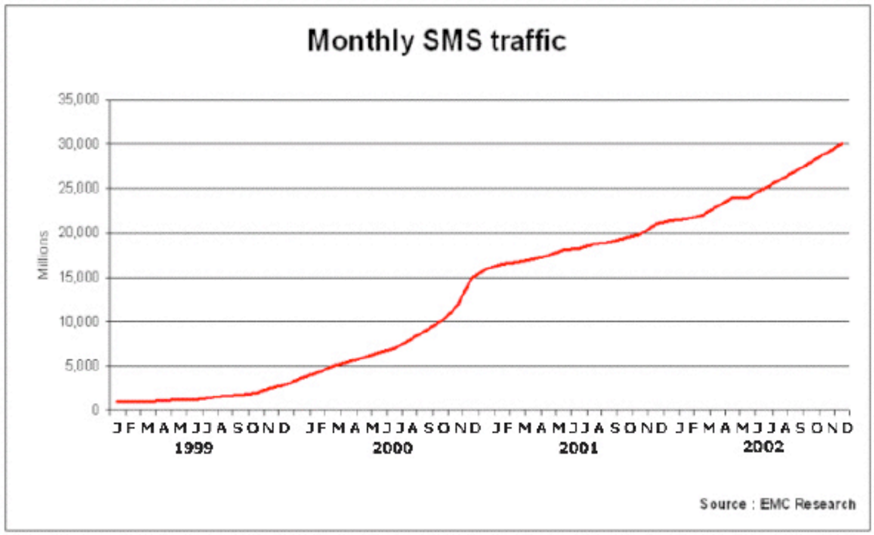

Softswitch
Wi-Fi
Billing System
Signaling Gateway
SCP
DSLAM
Residential Gateway
Sigtran or SIP
Media Gateway Controller
IP
IP
Cable Headend
DLC
STP
IP SCP
Sigtran, SIP or Megaco
WDM
WDM
SIP or Megaco
Optical Networking
IP Network
Router
SSP
Media Gateway
IP PBX
IP
PSTN
Optical Networking
GGSN
WDM
WDM
Media Server
SIP Client
SIP Client
VLR
Data
MSC
HLR
CFG
Voice
Enterprise Network
SGSN
BSC/RNC
2.5/3G Wireless Network
BTS
Node B
TDM Interface
IP-Based Virtual Connection
SS7 or Sigtran Protocol Interface
Data Protocol Interface
IP Connection
Transport Elements
Core Elements
Signaling Elements
Access Elements
Customer Premises Equipment

Examples of IN attacks

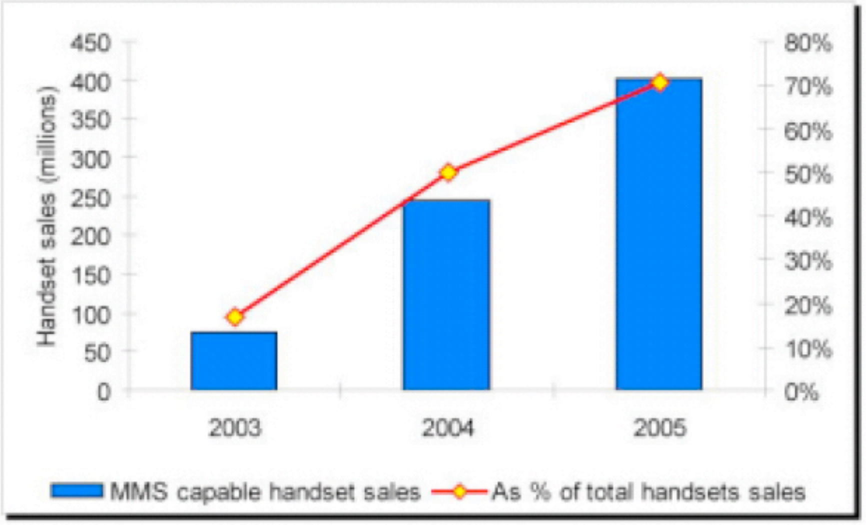
- Modification of Prepaid account DB
- Creation of ghost 800 numbers
- Tracing of subscriber activity
- Fake trigger in SSP + fake service in SCP
- CDR generation special rules
- Modification of charging tables
- Unauthorized forwarding
- Unauthorized supplementary services

Messaging

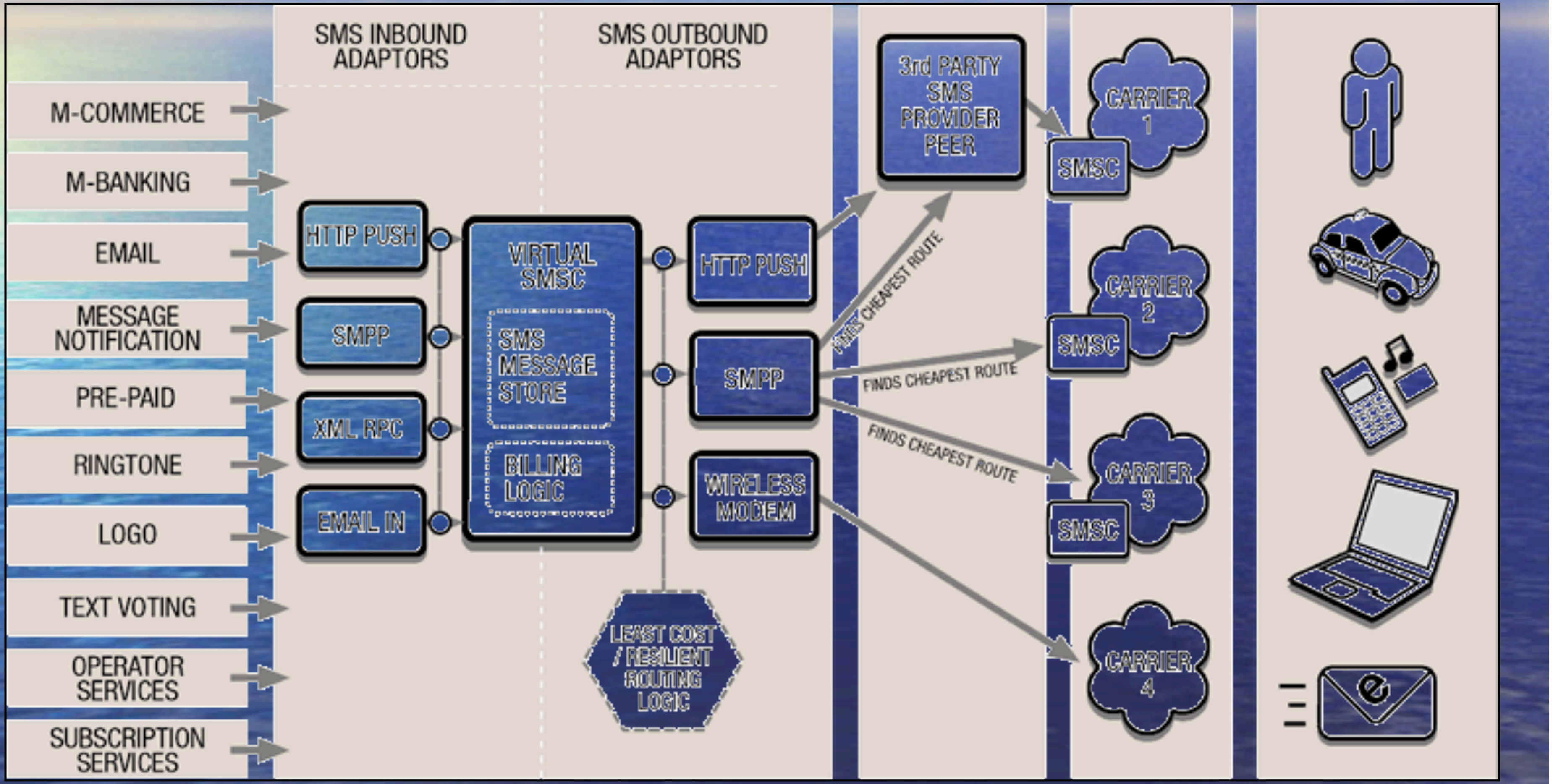
- SMS "after-thought" in GSM design, uses SS7 transport, involves MSC/HLR/VLR
- Messages are handled with "store and forward" mechanism on an SMSC
- MMS extends the concept with multimedia capabilities and uses MMSC for delivery
- USSD messages
- Voice Mail (VMS)


Monthly SMS traffic

Source : EMC Research



SMS growth

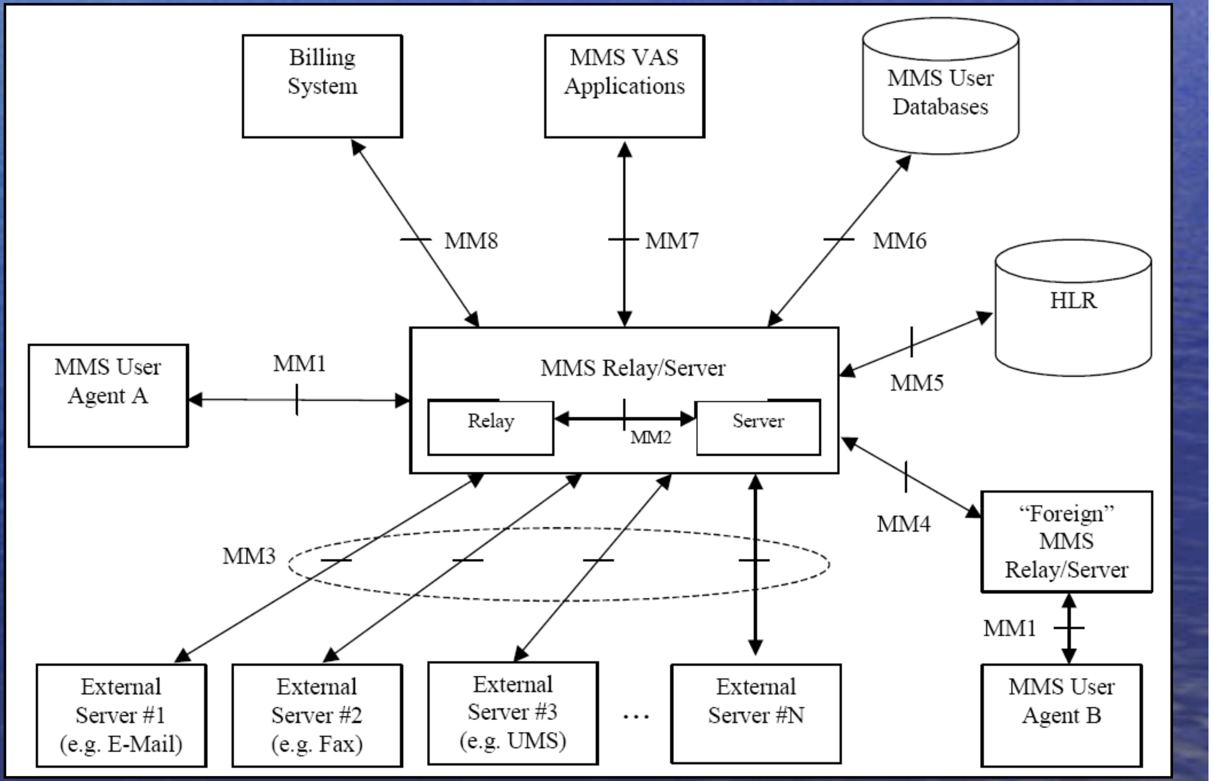

SMS INBOUND ADAPTORS
SMS OUTBOUND ADAPTORS
M-COMMERCE
M-BANKING
EMAIL
MESSAGE NOTIFICATION
PRE-PAID
RINGTONE
LOGO
TEXT VOTING
OPERATOR SERVICES
SUBSCRIPTION SERVICES
HTTP PUSH
SMPP
XML RPC
EMAIL IN
VIRTUAL SMSC
SMS MESSAGE STORE
BILLING LOGIC
HTTP PUSH
SMPP
WIRELESS MODEM
LEAST COST / RESILIENT ROUTING LOGIC
3rd PARTY SMS PROVIDER PEER
FINDS CHEAPEST ROUTE
FINDS CHEAPEST ROUTE
FINDS CHEAPEST ROUTE
CARRIER 1
SMSC
CARRIER 2
SMSC
CARRIER 3
SMSC
CARRIER 4

Examples of Messaging attacks

- Interception of messages on SMSC
- Injection of messages (spam…)
- Modified MS can craft evil messages
- SS7 and IP connectivity
- VMS hacks (e.g. callout)
- Special USSD sequences

MMS Architecture Model

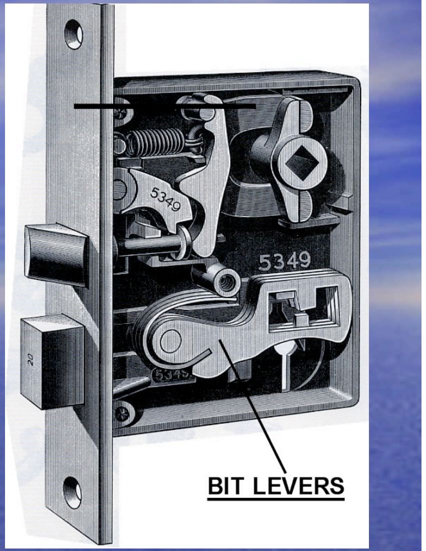
- MMS brings the IP world one step closer to the GSM/3G network core
- The MMSC connects to the HLR using SS7 and to the IP network for transport, billing and management
- MMSE can be deployed outside of network operators' infrastructures



MMS Security (from 3gpp)

- *The user shall be able to use and access MM in a secure manner. It shall be possible for the contents of MM to be read only by the intended recipient.*
- *A Recipient shall be informed of the reliability of the sender in case the sender has authorized his identity to be transmitted.*
- *The integrity of MM during transit shall be assured to the extent of the network capabilities.*
- *The MMS shall be intrinsically resistant to attempts of malicious or fraudulent use.*
- *The MMS shall have the ability to authenticate the user regardless of access technology.*
- *The MMS shall support data transport in a secure manner between the user and MMS The MMS authentication scheme shall use access specific information.*

MMS security in practice



- Not all communications encrypted and authenticated
- Vulnerabilities in GRX protocol
- MAP security not fully implemented
- DNS security not implemented
- WAP gap in WTLS sessions with UA
- Service Initiation Request can force another gateway
- SMS traffic not encrypted
- TLS/SSL on SMTP not always implemented
- No IPsec between MMSC and MMS brokers or VAS
- No proper certificates and keys management
- SOAP security not fully implemented
- Hostile UA and VAS can induce DoS, virus, faulty charging, spam
- SMIL and XHTML presentation and synchronization vulnerabilities

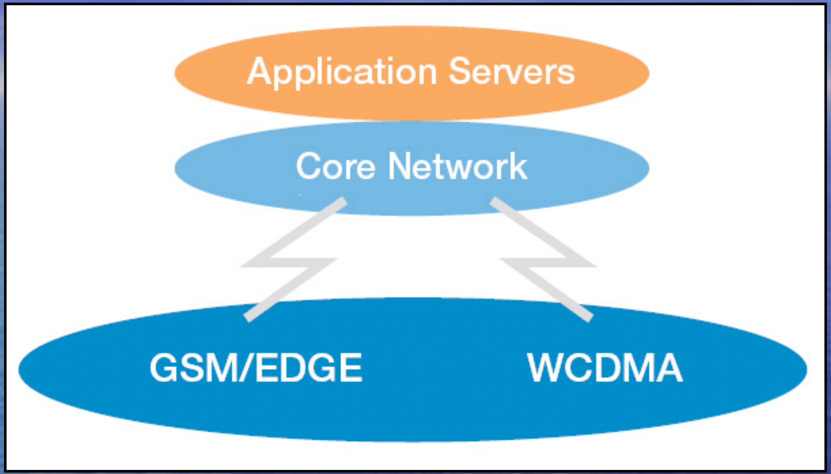
MMS as a viral vector

Quote from “MMS Security Consideration”

- Currently the majority of handsets are based on closed OS systems built on more or less proprietary hardware. To some extent this act as protection against buffer overflow attacks that try to execute a malicious application. ‟

Yeah, right !!

GPRS / EDGE / 3G



- Data rates evolution (CSD kb/s, 3G mb/s)
- Architecture evolution (Wideband CDMA)
- Internet integration (TCP/IP)
- New services (email, web, push/pull, etc.)

Examples of GPRS/3G attacks

- See Ollie Whitehouse: the best authority on the topic!

Network Management

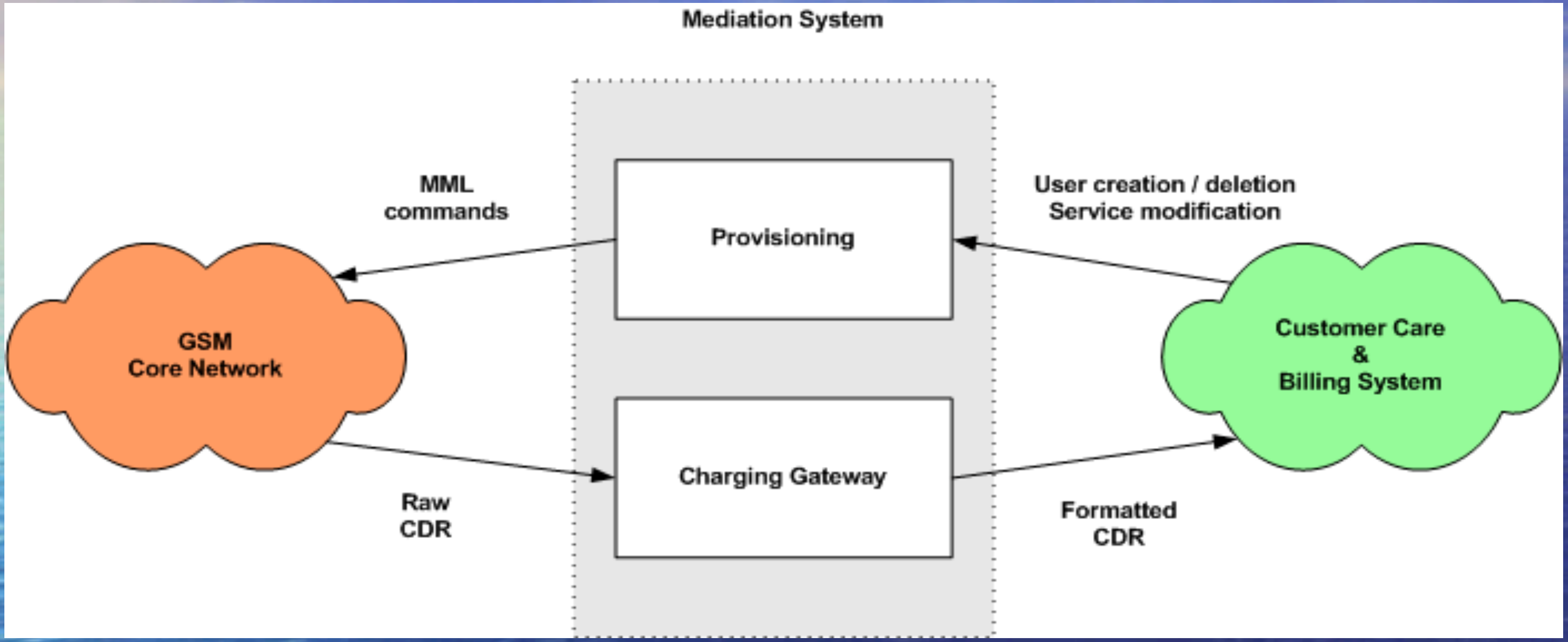
- UNIX clusters (comms, DB, applications)
- Events, Alarms, Measurements
- Software upload, configuration, integration, remote diagnostics
- Access to every single NE, parameter, option, frequency, power level, etc.

→ *NMS/OSS systems can be access over IP, X.25 and remote access dialups*

Example of NMS/OSS attacks

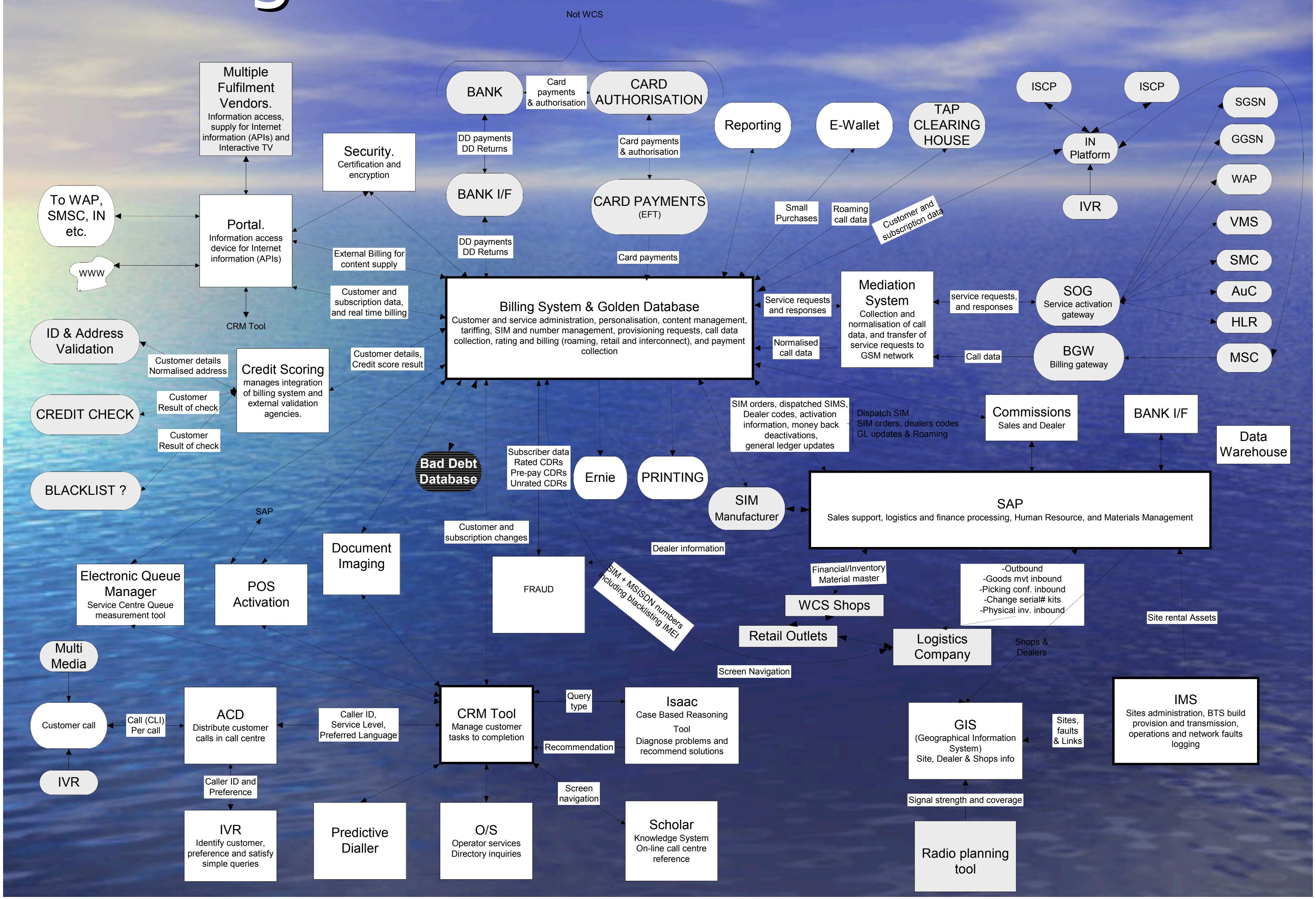
- DoS on any Network Element
- Confidential information leak (e.g. design)
- Easy access to all NE (cleartext password, config files, scripts, DB connections, etc.)
- Access to private X.25 and IP sensitive areas such as VAS clusters, IN, etc.
- User-friendly subscriber tracing

Mediation and Billing



- Mediation is the process that converts and transports raw CDR data
- It can also be used to translate provisioning commands to the NE
- It is a critical part of the provisioning and billing cycles.
- Most convenient place to commit fraud

Billing Processes



Not WCS

Multiple Fulfilment Vendors.
Information access, supply for Internet information (APIs) and Interactive TV

BANK

Card payments & authorisation

CARD AUTHORISATION

Reporting

E-Wallet

TAP CLEARING HOUSE

ISCP

ISCP

IN Platform

IVR

SGSN

GGSN

WAP

VMS

SMC

AuC

HLR

MSC

Security.
Certification and encryption

DD payments
DD Returns

BANK I/F

Card payments
& authorisation

CARD PAYMENTS
(EFT)

To WAP, SMSC, IN etc.

WWW

Portal.
Information access device for Internet information (APIs)

External Billing for content supply

DD payments
DD Returns

Card payments

Small Purchases

Roaming call data

Customer and subscription data

Customer and subscription data, and real time billing

CRM Tool

Billing System & Golden Database
Customer and service administration, personalisation, content management, tariffing, SIM and number management, provisioning requests, call data collection, rating and billing (roaming, retail and interconnect), and payment collection

Service requests and responses

Mediation System
Collection and normalisation of call data, and transfer of service requests to GSM network

service requests, and responses

SOG
Service activation gateway

Normalised call data

Call data

BGW
Billing gateway

ID & Address Validation

Customer details
Normalised address

Credit Scoring
manages integration of billing system and external validation agencies.

Customer details, Credit score result

CREDIT CHECK

Customer
Result of check

Customer
Result of check

BLACKLIST ?

SIM orders, dispatched SIMS, Dealer codes, activation information, money back deactivations, general ledger updates

Dispatch SIM
SIM orders, dealers codes
GL updates & Roaming

Commissions
Sales and Dealer

BANK I/F

Data Warehouse

Bad Debt Database

Subscriber data
Rated CDRs
Pre-pay CDRs
Unrated CDRs

Ernie

PRINTING

SIM Manufacturer

SAP
Sales support, logistics and finance processing, Human Resource, and Materials Management

SAP

Customer and subscription changes

Document Imaging

Dealer information

FRAUD

SIM + MSISDN numbers including blacklisting IMEI

Electronic Queue Manager
Service Centre Queue measurement tool

POS Activation

Financial/Inventory Material master

WCS Shops

Retail Outlets

-Outbound
-Goods mvt inbound
-Picking conf. inbound
-Change serial# kits
-Physical inv. inbound

Logistics Company

Shops & Dealers

Site rental Assets

Multi Media

Customer call

Call (CLI) Per call

ACD
Distribute customer calls in call centre

Caller ID, Service Level, Preferred Language

CRM Tool
Manage customer tasks to completion

Screen Navigation

Query type

Isaac
Case Based Reasoning Tool
Diagnose problems and recommend solutions

Recommendation

GIS
(Geographical Information System)
Site, Dealer & Shops info

Sites, faults & Links

IMS
Sites administration, BTS build provision and transmission, operations and network faults logging

IVR

Caller ID and Preference

IVR
Identify customer, preference and satisfy simple queries

Predictive Dialler

O/S
Operator services
Directory inquiries

Screen navigation

Scholar
Knowledge System
On-line call centre reference

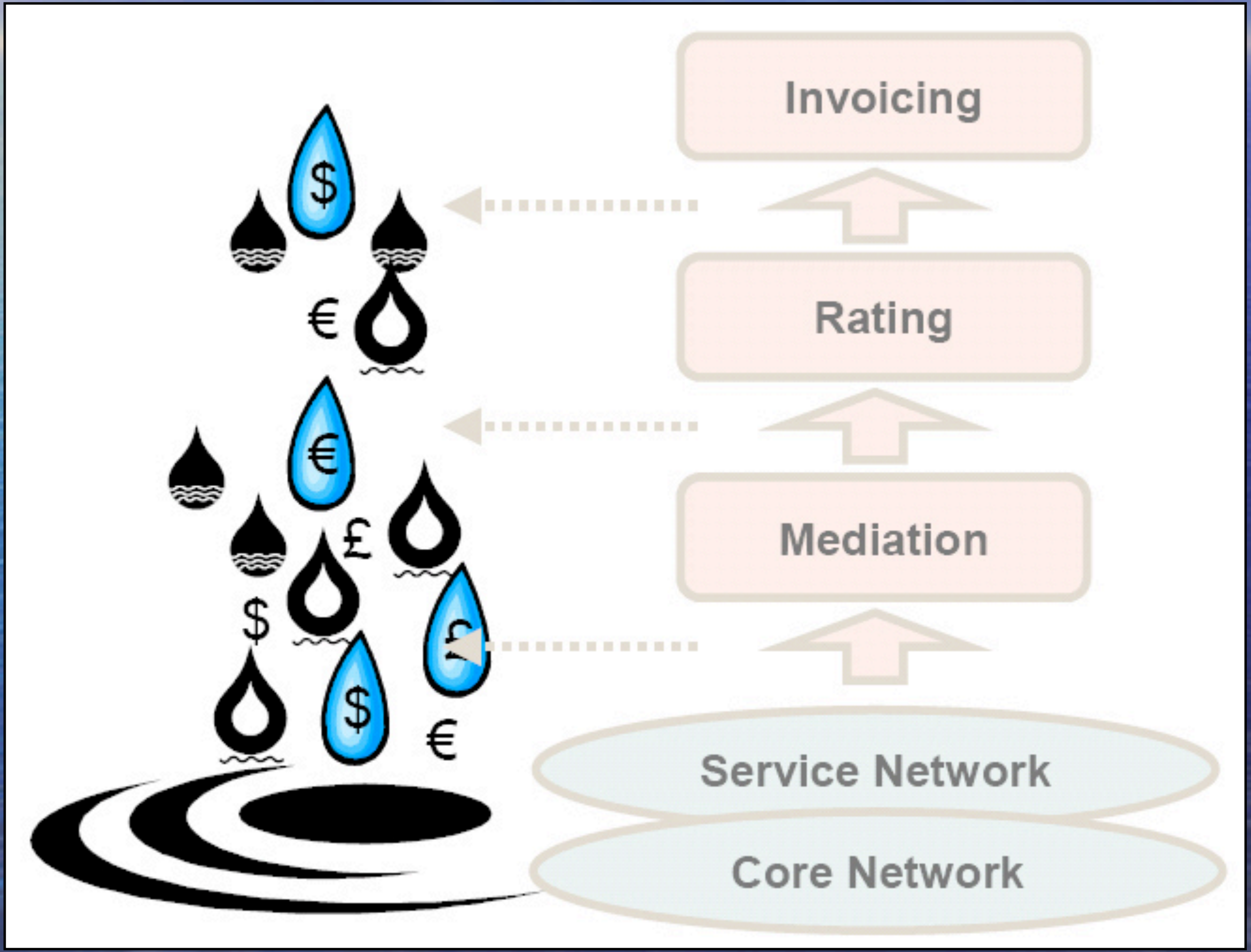
Signal strength and coverage

Radio planning tool

Attacks on Mediation / Billing

- Raw database edit. Conveniently deletes selected records containing billing data.
- Modification of the charging tables in the billing system
- Patching of the rater application to eliminate certain CDR e.g. belonging to a given MSISDN
- Backdoors in mediation gateways to remove CDR data
- Confidential information on subscribers activities (numbers called, received, SMS, data, etc.)
- Modification of CDR processing rules
- Modification of “test numbers” whitelist
- Live patching of CDR data while in mediation queue
- Patching of mediation application (e.g. loading scripts)
- GPRS packet aggregation rules modification

Revenue Leakage

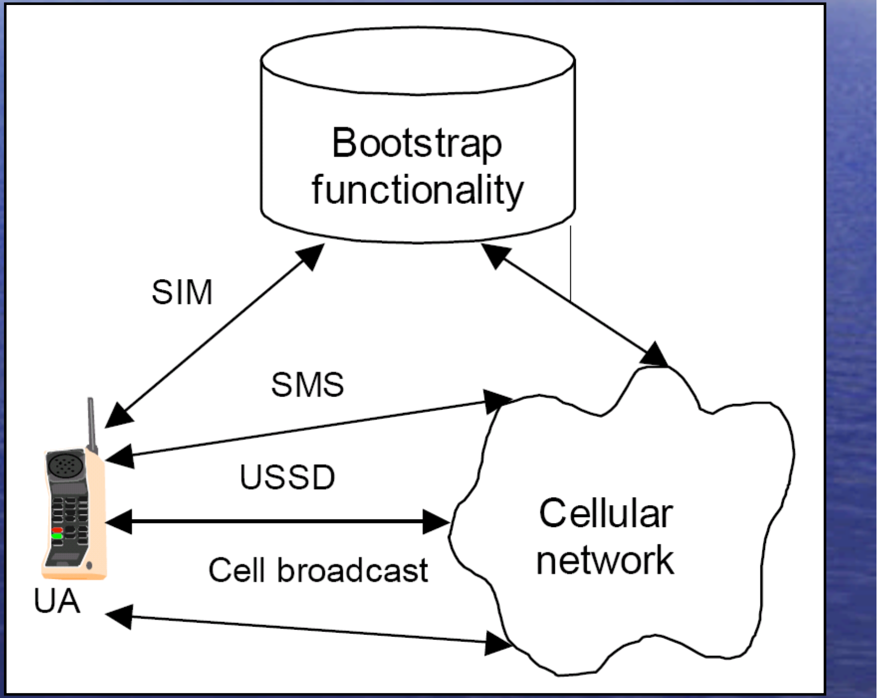


Legal Interception Gateway

- Legal Interception Gateway is used by police and intelligence agencies.
- Connected to MSC though special interface. Very user-friendly.
- Based on standard UNIX and TCP/IP so potentially open to common attacks
- Compromise of a LIG would allow real-time interception and call eavesdropping.
- Could compromise the agencies' own facilities.

OTA and SIM applications

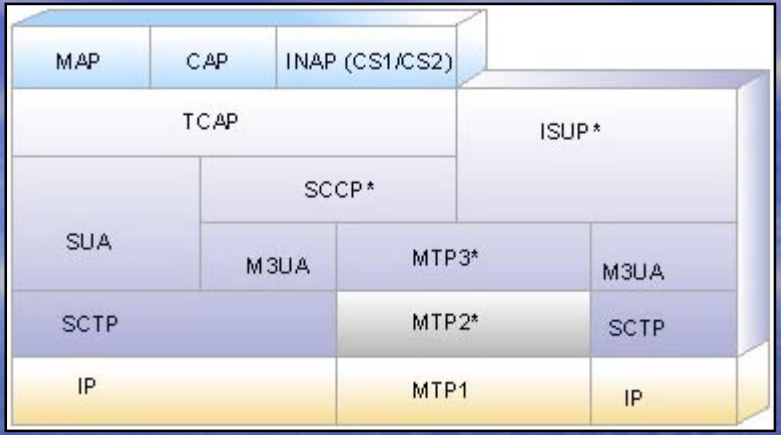
- Over-The-Air methods allow provisioning of new applications or modification of parameters
- Example: SIM Toolkit (STK) applications can be uploaded, new services numbers updated, email servers modified
- OTA server is a UNIX cluster located in VAS area. Reachable over IP.



Authentication Vectors

- GSM started with questionably weak crypto (weaknesses found in COMP-128 and A5 algorithm)
- Cloning of SIM cards is possible (first in hours, then minutes, now over-the-air)
- New algorithms e.g. A5/3 fixes vulnerabilities. 3G/UMTS security models introduce stronger cryptography
- However cryptographic secrets are stored in the AuC where they can generally easily be retrieved using MML commands or raw DB edit.
- The provisioning cycle of the SIM (e.g. loading Ki into the AuC) uses insecure methods (clear files, FTP transfers, multiple copies of files, etc.)

SS7 Signalling



- Mobile networks primarily use signalling System no. 7 (SS7) for communication between networks for such activities as authentication, location update, and supplementary services and call control. The messages unique to mobile communications are MAP messages.

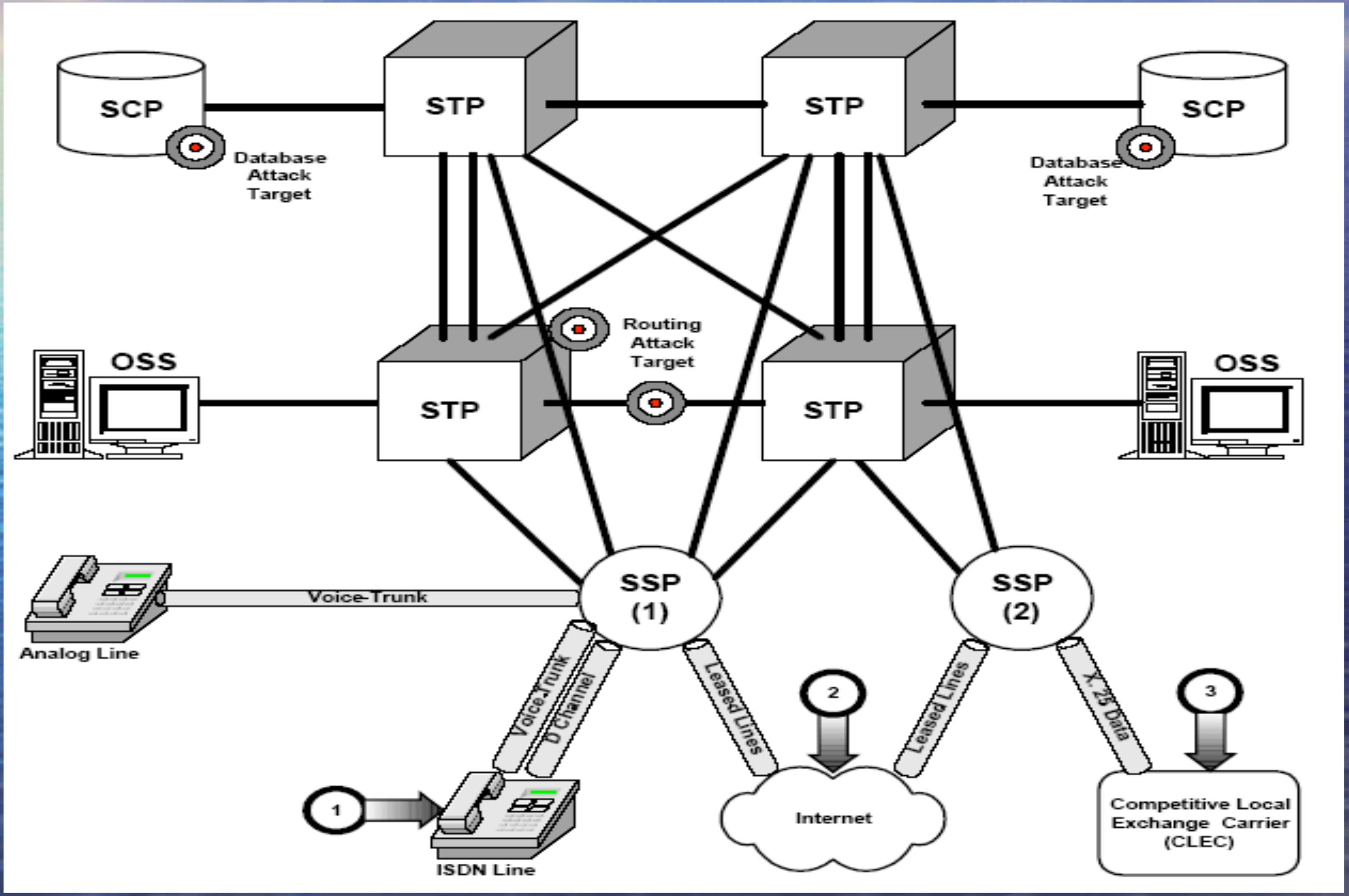
- The security of the global SS7 network as a transport system for signalling messages e.g. authentication and supplementary services such as call forwarding is open to major compromise.

- The problem with the current SS7 system is that messages can be altered, injected or deleted into the global SS7 networks in an uncontrolled manner.

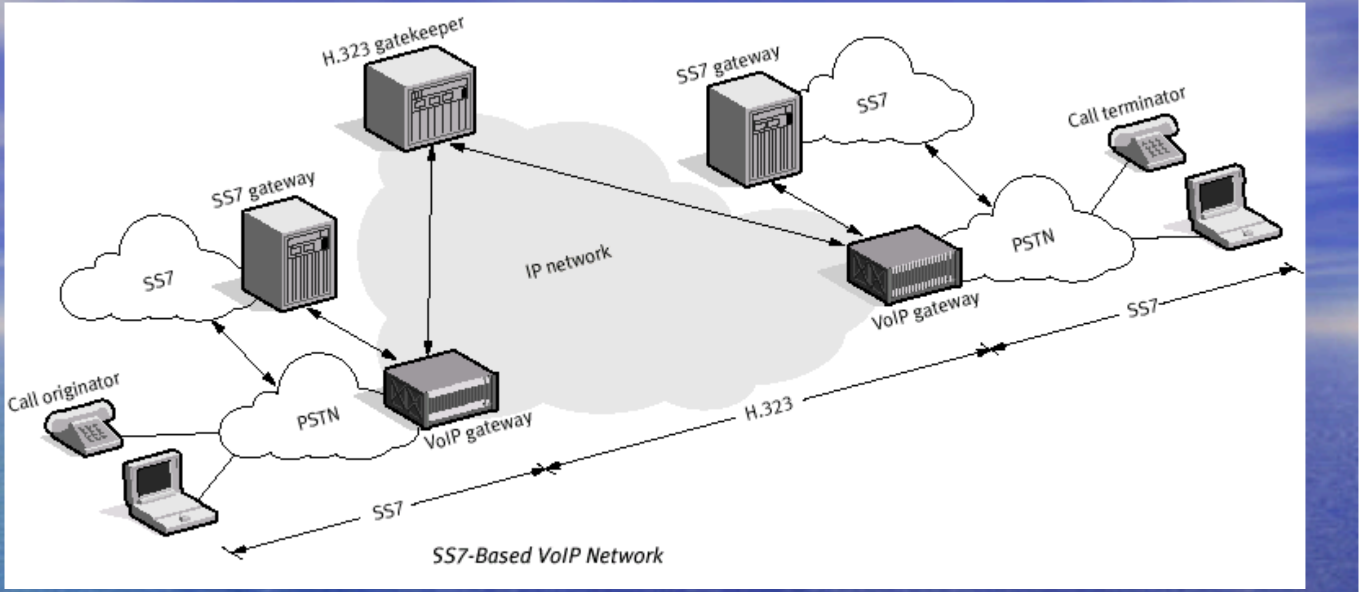
Examples of SS7 attacks

- Theft of service, interception of calling cards numbers, privacy concerns
- Introduce harmful packets into the national and global SS7 networks
- Get control of call processing, get control of accounting reports
- Obtain credit card numbers, non-listed numbers, etc.
- Messages can be read, altered, injected or deleted
- Denial of service, security triplet replay to compromise authentication
- Annoyance calls, free calls, disruption of emergency services
- Capture of gateways, rerouting of call traffic
- Disruption of service to large parts of the network
- Call processing exposed through Signaling Control Protocol
- Announcement service exposed to IP through RTP
- Disclosure of bearer channel traffic

SS7 entry points



SS7 Evolution



- There is also exponential growth in the use of interconnection between the telecommunication networks and the Internet, for example with VoIP protocols (e.g. SIP, SCTP, M3UA, etc.)
- The IT community now has many protocol converters for conversion of SS7 data to IP, primarily for the transportation of voice and data over the IP networks. In addition new services such as those based on IN will lead to a growing use of the SS7 network for general data transfers.
- There have been a number of incidents from accidental action, which have damaged a network. To date, there have been very few deliberate actions.

SS7 security exposure increases

- Increased number of access points and networking
- Increased number of interconnected inexperienced systems administrators and processes
- Embedded Operations Channels of Signaling and Transport Protocols (e.g., SONET DCC, ATM OAM Cells, SS7 Network Management Messages) gives virtually unlimited access to everything to them
- Internet and Intranet Exploitable technology used for access to Network Operations and Signaling Systems
- Added complexity, dependencies and single points of failure

Based on the success with which hackers and other (admittedly small-time) intruders have invaded or subverted parts of the network, it is not unreasonable to expect that a malicious assault upon the PSTN by a serious team of aggressors attacking multiple targets has a **realistic chance of forcing an outage of large scale** and broad geographic range.
The expertise required to pull off such an attack is not extreme, and is in fact within the capabilities of many technically competent, computer-literate people around the world. Because the service providers have no experience with this kind of forced outage, they may be **unprepared to recover from it** as promptly and successfully as they recover from natural disasters or equipment failures.

SS7 Security Solutions

- SS7 firewalls are introduced to become ‘packet cops’ like early IP firewalls

- Access Control modules on network elements ensure only authorized users can access

- SS7 scanners can help in identifying weaknesses in an operators’ infrastructure

After all, implementing IP firewalls was enough to stop all the IP hackers on the Internet, right??

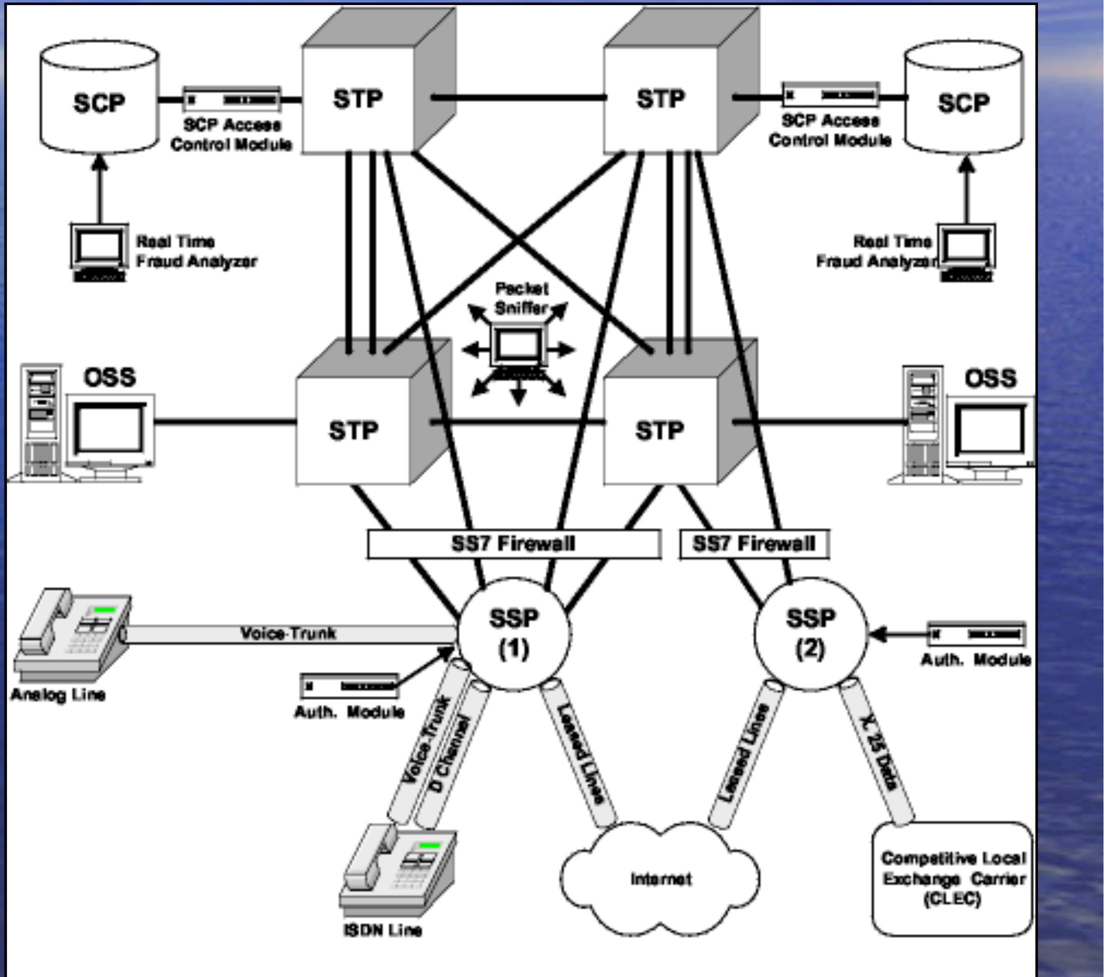
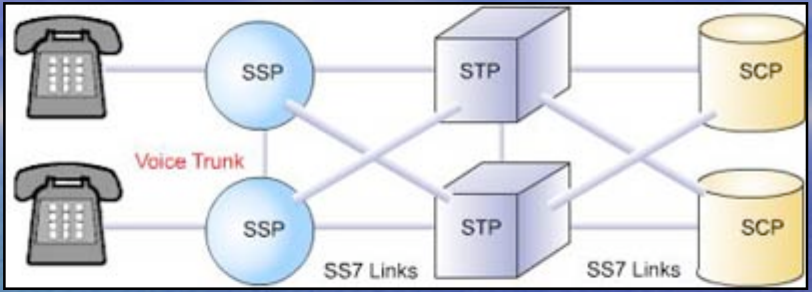


Figure 5. SS7 attack management system.

SS7: a closed network

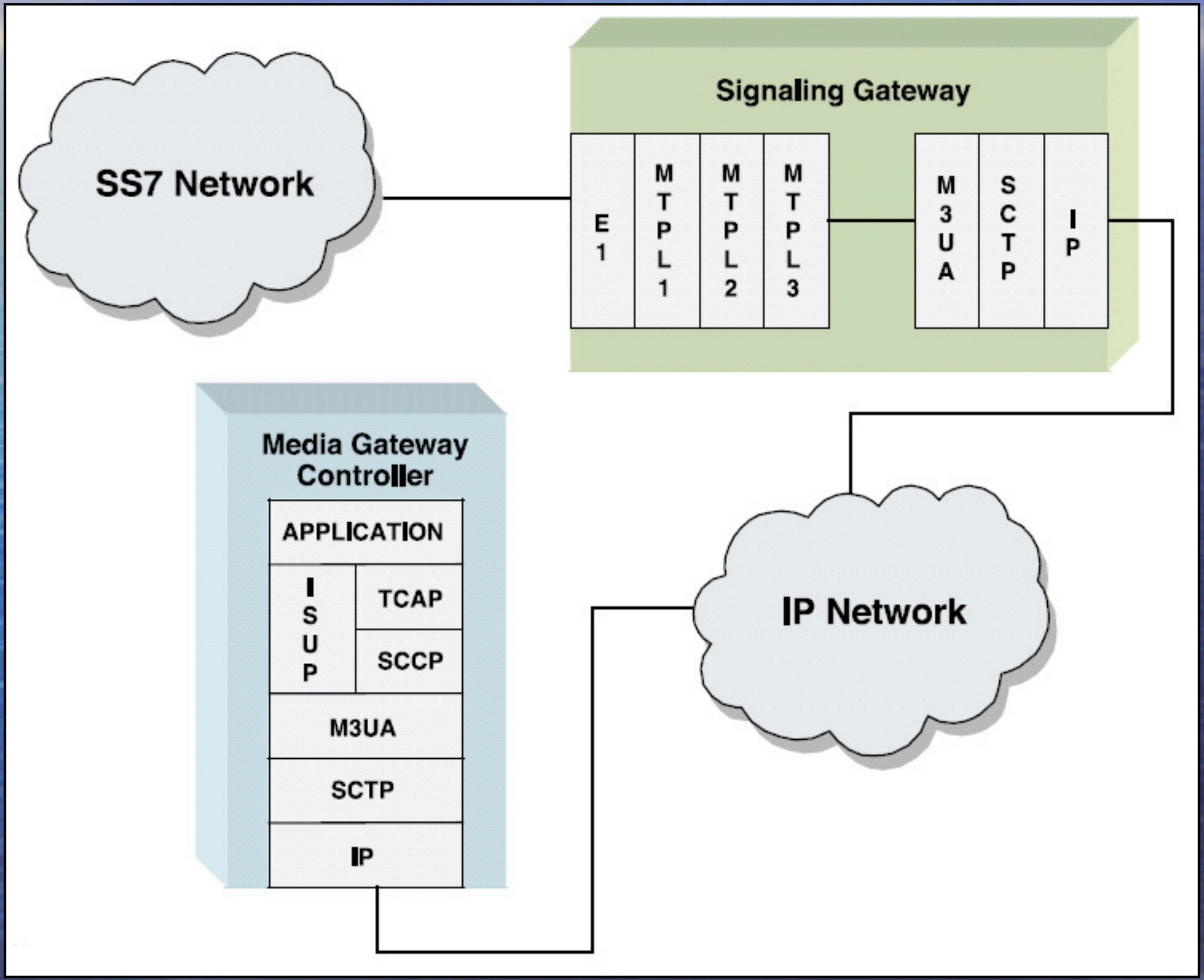


- With a limited number of carriers and limited points of interconnection, the operators could assume with fair certainty that all of the elements passing data were trusted sources.
- Unlike IP protocols, security features like authentication and encryption were not built into the SS7 protocol. Rather, the focus has been placed on creating secure physical environments for the network equipment rather than secure protocols.
- STPs, the routers of the SS7 network, perform gateway screening to prohibit inbound and outbound messages from unauthorized nodes. The addresses of individual nodes within a network are isolated.
- Global title translation (GTT) enables a network to receive messages from other networks without disclosing the unique addresses, called point codes, of its own nodes.

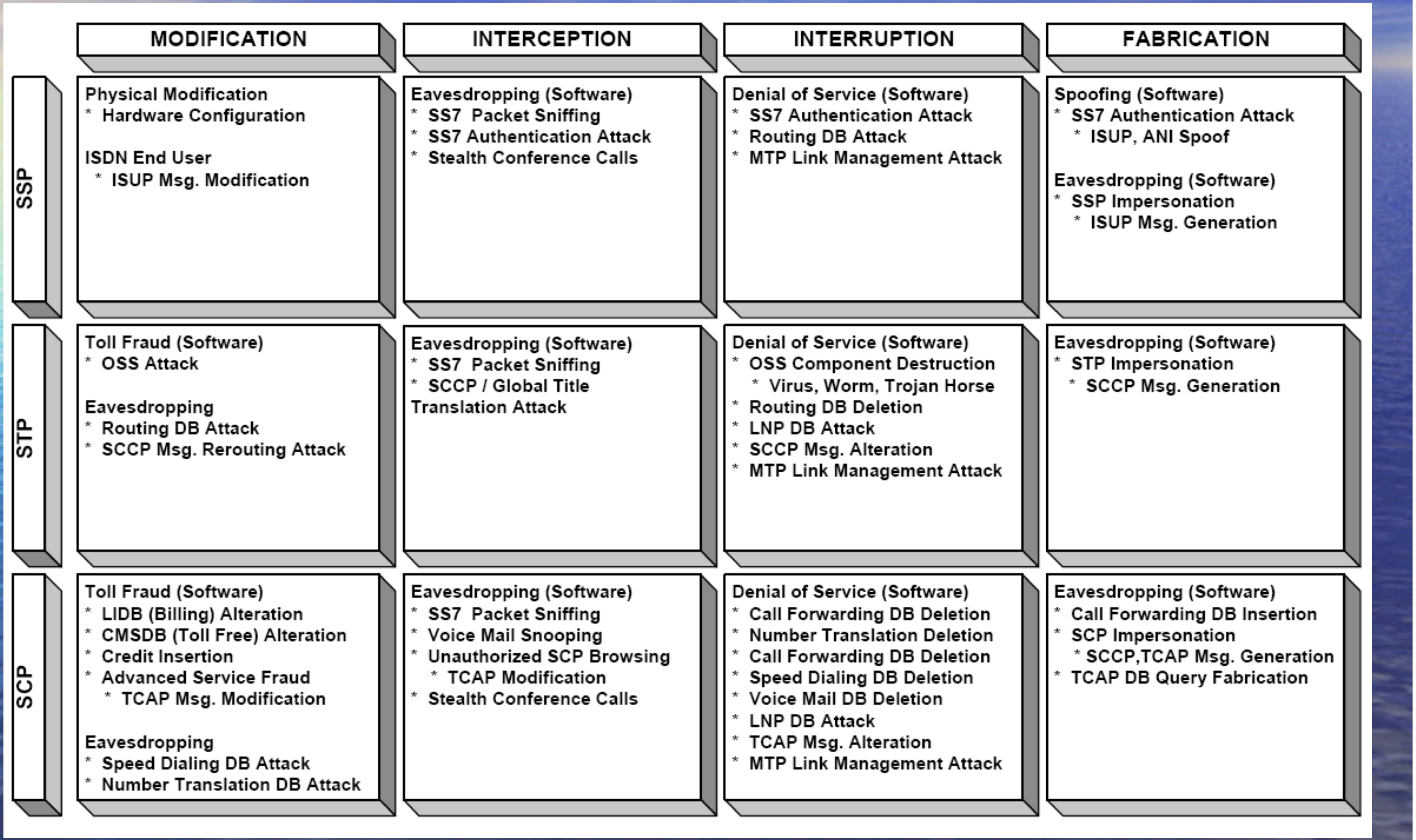
SS7: the landscape changes

- The increasing number and complexity of interfaces between SS7 and other networks increases its vulnerability to attack.
- Every point of interconnection is a potential point of access. The developing interdependence between SS7 and IP networks is increasing that vulnerability.
- If there is an IP network anywhere in the chain of interconnection, all the connected networks are vulnerable to some extent.
- There is no encryption or authentication in the signaling network to ensure the validity of sending nodes outside the network boundary. A rogue server in the IP network sending damaging management messages could seriously impair the signaling network.
- Anyone capable of generating SS7 messages and introducing them to the network could cripple the PSTN service.
- Each element in the SS7 network is engineered to handle a certain amount of traffic. A node could be flooded and call processing in that section of the network could come to a halt.

SS7 and VoIP

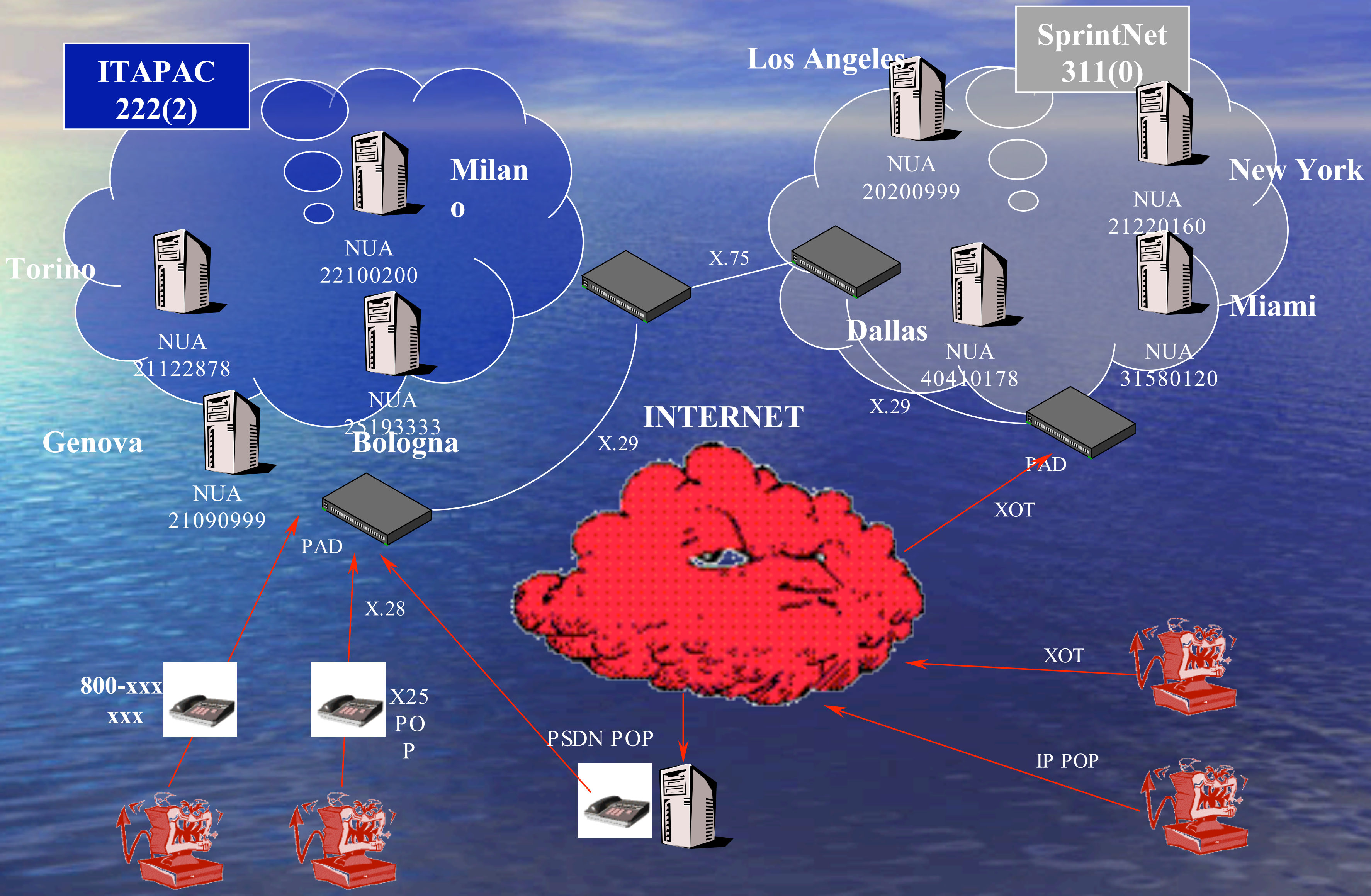

SS7 Network
Signaling Gateway
E1
MTPL1
MTPL2
MTPL3
M3UA
SCTP
IP
Media Gateway Controller
APPLICATION
ISUP
TCAP
SCCP
M3UA
SCTP
IP
IP Network

SS7 attacks taxonomy

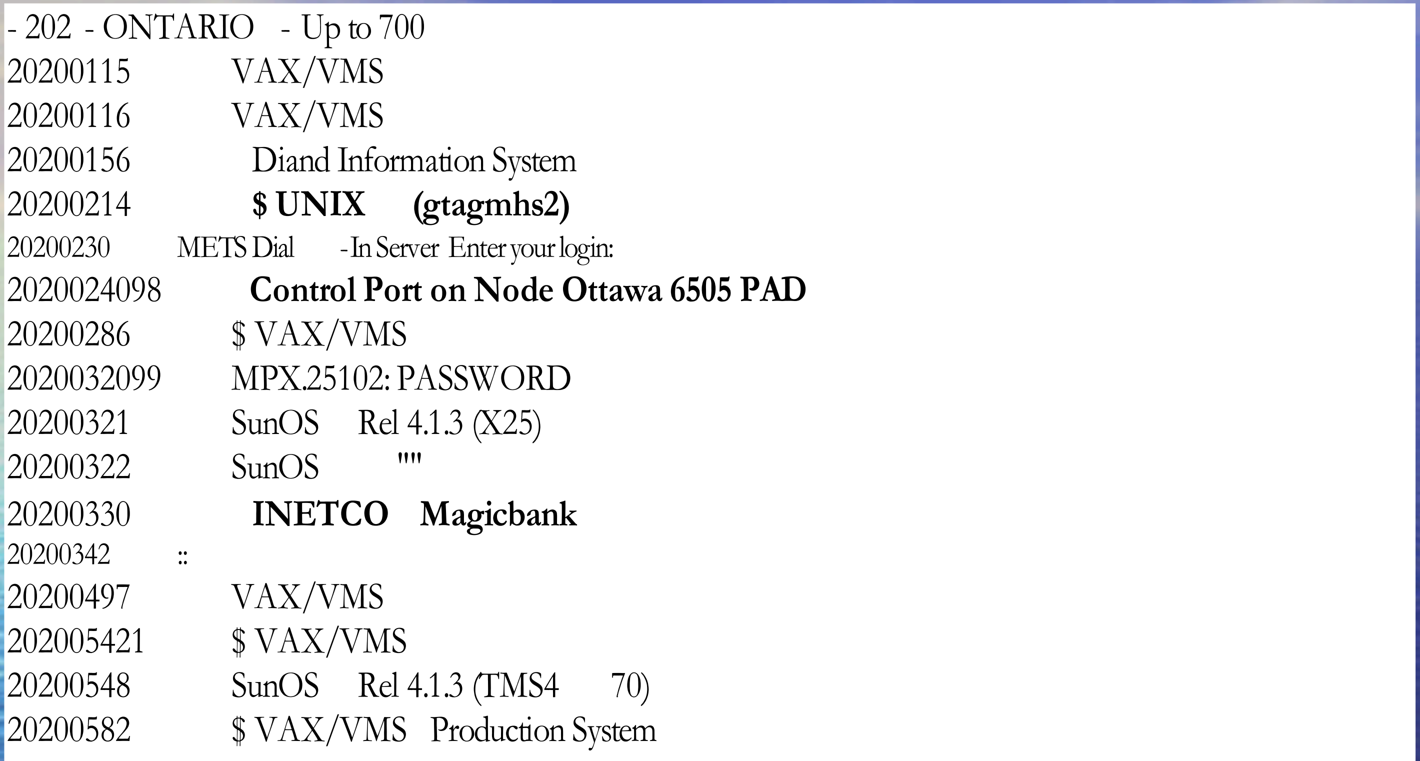


	MODIFICATION	INTERCEPTION	INTERRUPTION	FABRICATION
SSP	Physical Modification * Hardware Configuration ISDN End User * ISUP Msg. Modification	Eavesdropping (Software) * SS7 Packet Sniffing * SS7 Authentication Attack * Stealth Conference Calls	Denial of Service (Software) * SS7 Authentication Attack * Routing DB Attack * MTP Link Management Attack	Spoofing (Software) * SS7 Authentication Attack * ISUP, ANI Spoof Eavesdropping (Software) * SSP Impersonation * ISUP Msg. Generation
STP	Toll Fraud (Software) * OSS Attack Eavesdropping * Routing DB Attack * SCCP Msg. Rerouting Attack	Eavesdropping (Software) * SS7 Packet Sniffing * SCCP / Global Title Translation Attack	Denial of Service (Software) * OSS Component Destruction * Virus, Worm, Trojan Horse * Routing DB Deletion * LNP DB Attack * SCCP Msg. Alteration * MTP Link Management Attack	Eavesdropping (Software) * STP Impersonation * SCCP Msg. Generation
SCP	Toll Fraud (Software) * LIDB (Billing) Alteration * CMSDB (Toll Free) Alteration * Credit Insertion * Advanced Service Fraud * TCAP Msg. Modification Eavesdropping * Speed Dialing DB Attack * Number Translation DB Attack	Eavesdropping (Software) * SS7 Packet Sniffing * Voice Mail Snooping * Unauthorized SCP Browsing * TCAP Modification * Stealth Conference Calls	Denial of Service (Software) * Call Forwarding DB Deletion * Number Translation Deletion * Call Forwarding DB Deletion * Speed Dialing DB Deletion * Voice Mail DB Deletion * LNP DB Attack * TCAP Msg. Alteration * MTP Link Management Attack	Eavesdropping (Software) * Call Forwarding DB Insertion * SCP Impersonation * SCCP,TCAP Msg. Generation * TCAP DB Query Fabrication

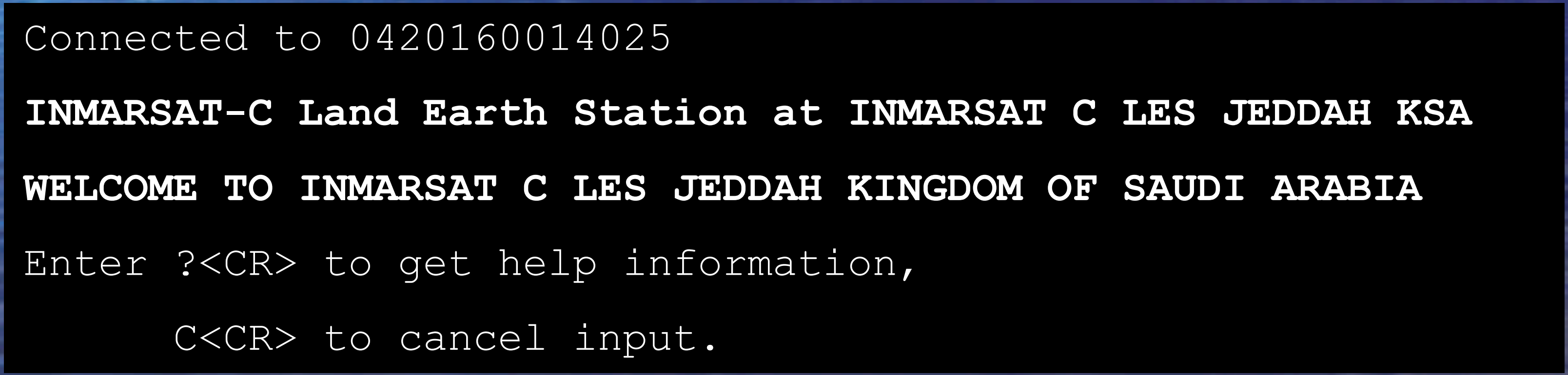
X.25 “out of band” transport



X.25 wardialing

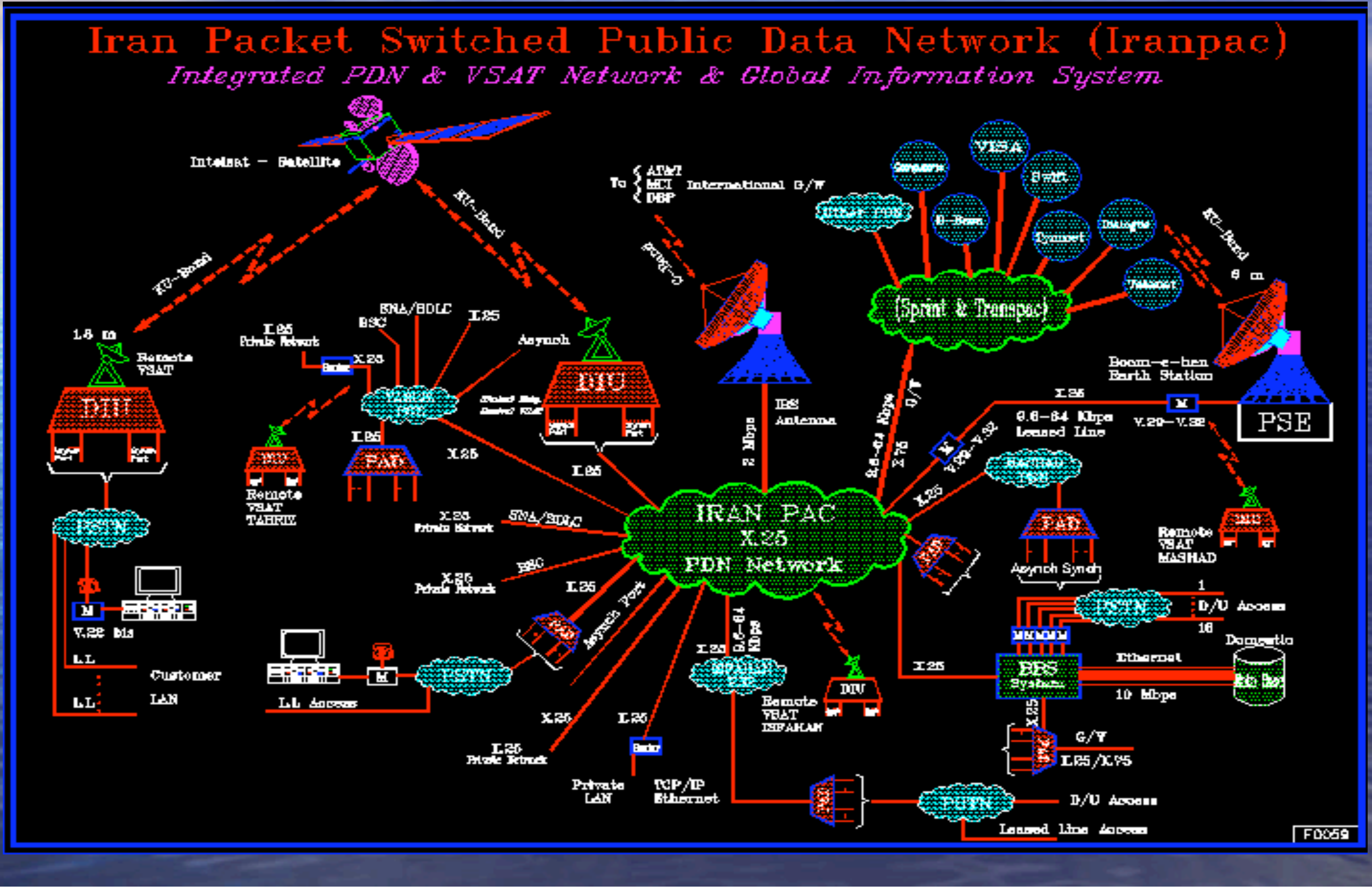


```
- 202  - ONTARIO   - Up to 700
20200115          VAX/VMS
20200116          VAX/VMS
20200156            Diand Information System
20200214            $ UNIX     (gtagmhs2)
20200230       METS Dial     -In Server  Enter your login:
2020024098          Control Port on Node Ottawa 6505 PAD
20200286          $ VAX/VMS
2020032099        MPX.25102: PASSWORD
20200321          SunOS      Rel 4.1.3 (X25)
20200322          SunOS          ""
20200330            INETCO    Magicbank
20200342       ::
20200497          VAX/VMS
202005421         $ VAX/VMS
20200548          SunOS      Rel 4.1.3 (TMS4       70)
20200582          $ VAX/VMS   Production System
```



```
Connected to 0420160014025
INMARSAT-C Land Earth Station at INMARSAT C LES JEDDAH KSA
WELCOME TO INMARSAT C LES JEDDAH KINGDOM OF SAUDI ARABIA
Enter ?<CR> to get help information,
     C<CR> to cancel input.
```

X.25 reaches everywhere!



X.25 – the forgotten frontier?

- Quote from Raoul Chiesa, after 15 years of X.25 exploration:

> *1% of the Top 1.000 companies and nation's critical infrastructures with X.25 links worldwide are somehow "not penetrable"*

Conclusions

- The systems, protocols and networks found in mobile telephony could become an exciting playground for sophisticated hackers
- Increasing complexity with GPRS, 3G and VAS applications leads to many further opportunities for attackers
- The threat of hostile user agents hasn’t really started yet, but it is looming
- Telcos are traditionally “closed environment” and relay upon this obscurity to ensure their security

THANKS

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