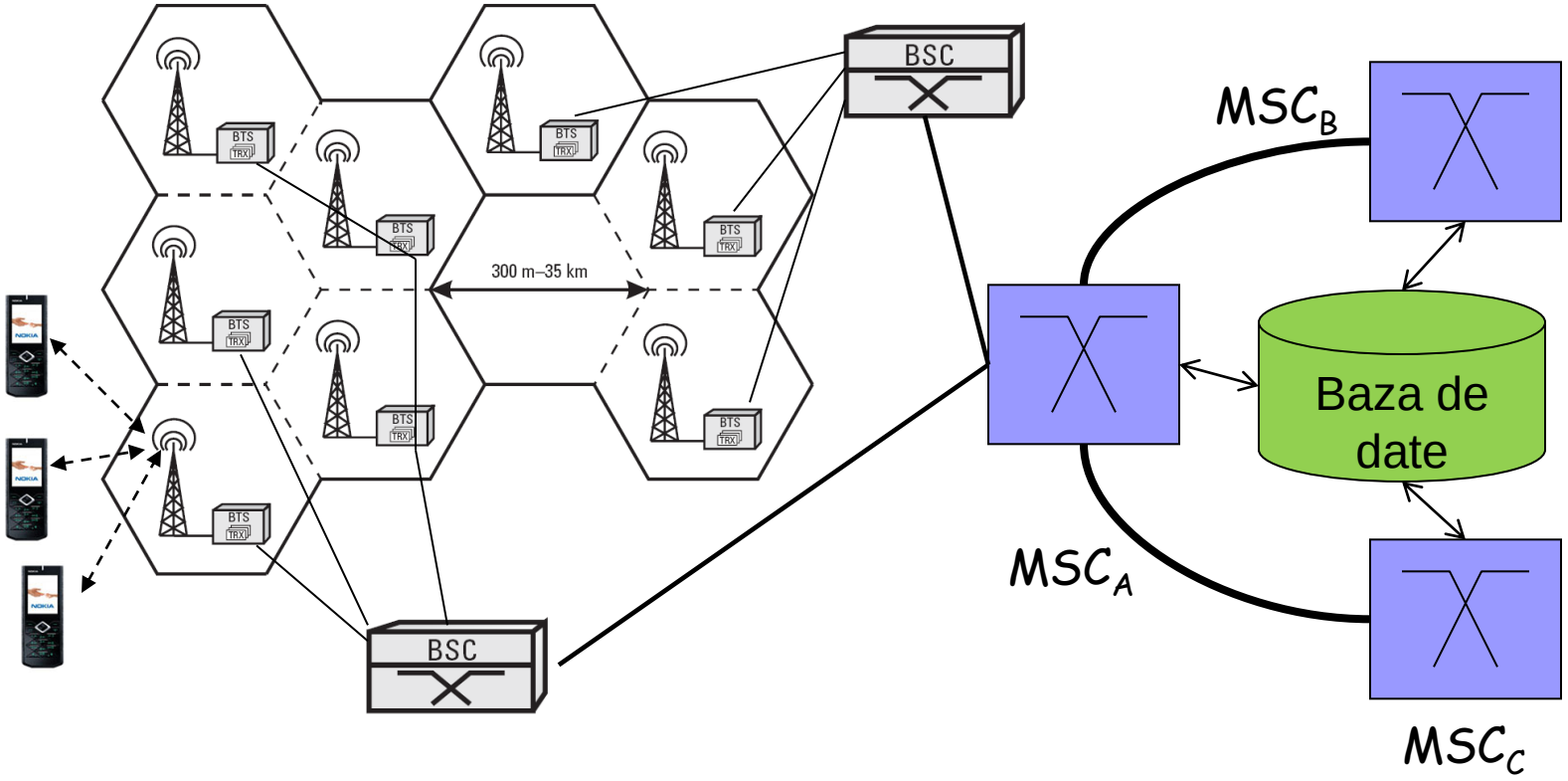
Sisteme de Comunicatii Mobile (SCMB)
- curs 3 -

Continutul prezentarii

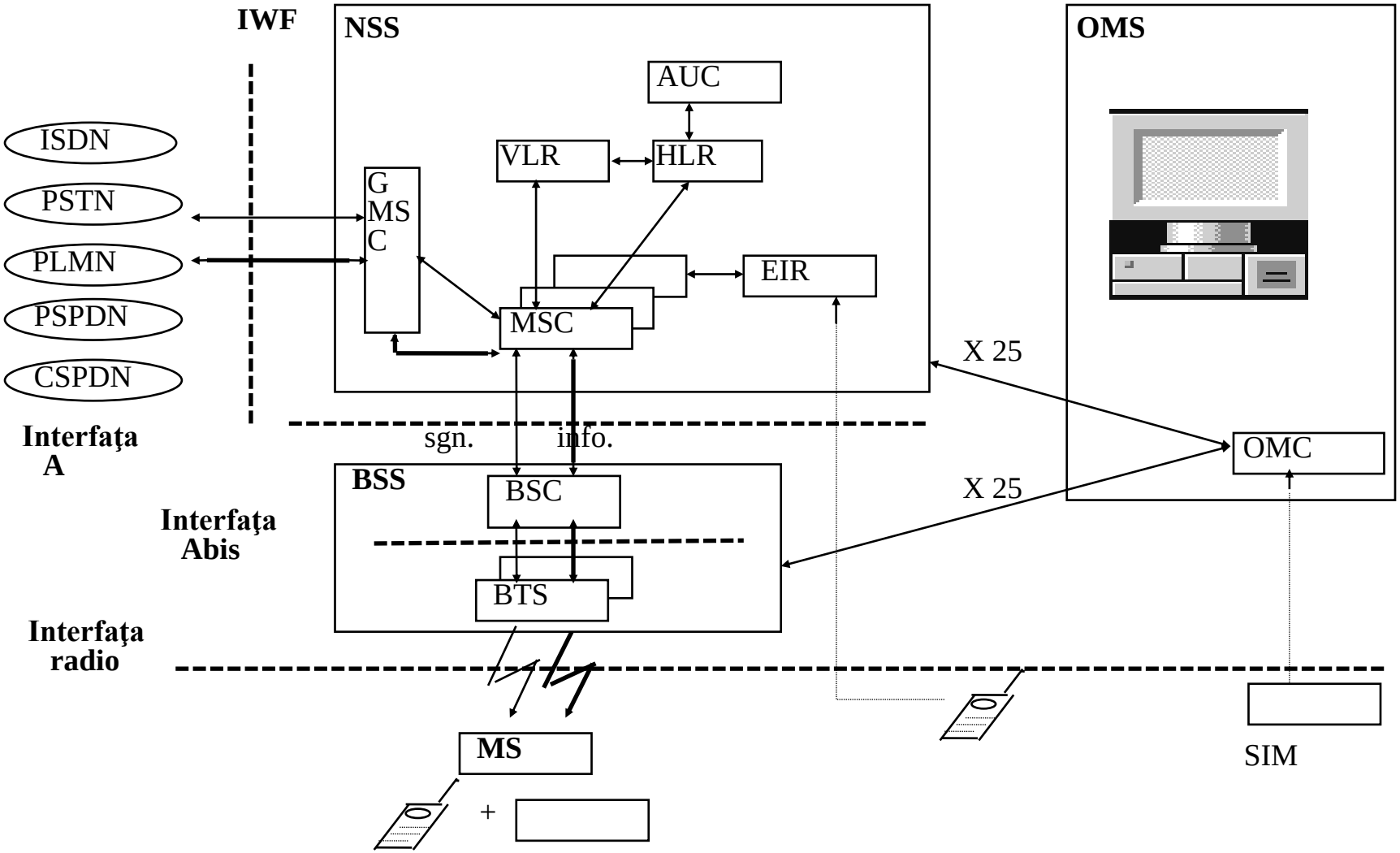
- Arhitectura GSM
  - Topologie
  - Subsisteme si blocuri componente
  - Distributia geografica a blocurilor
  - Subsistemul BSS (Base Station Subsistem)
  - Subsistemul NSS (Network and Switching Subsistem)
  - Subsistemul OMS (Operating and Maintenance Subsistem)
- Ilustratii ale unor echipamente reale

Arhitectura GSM (1)

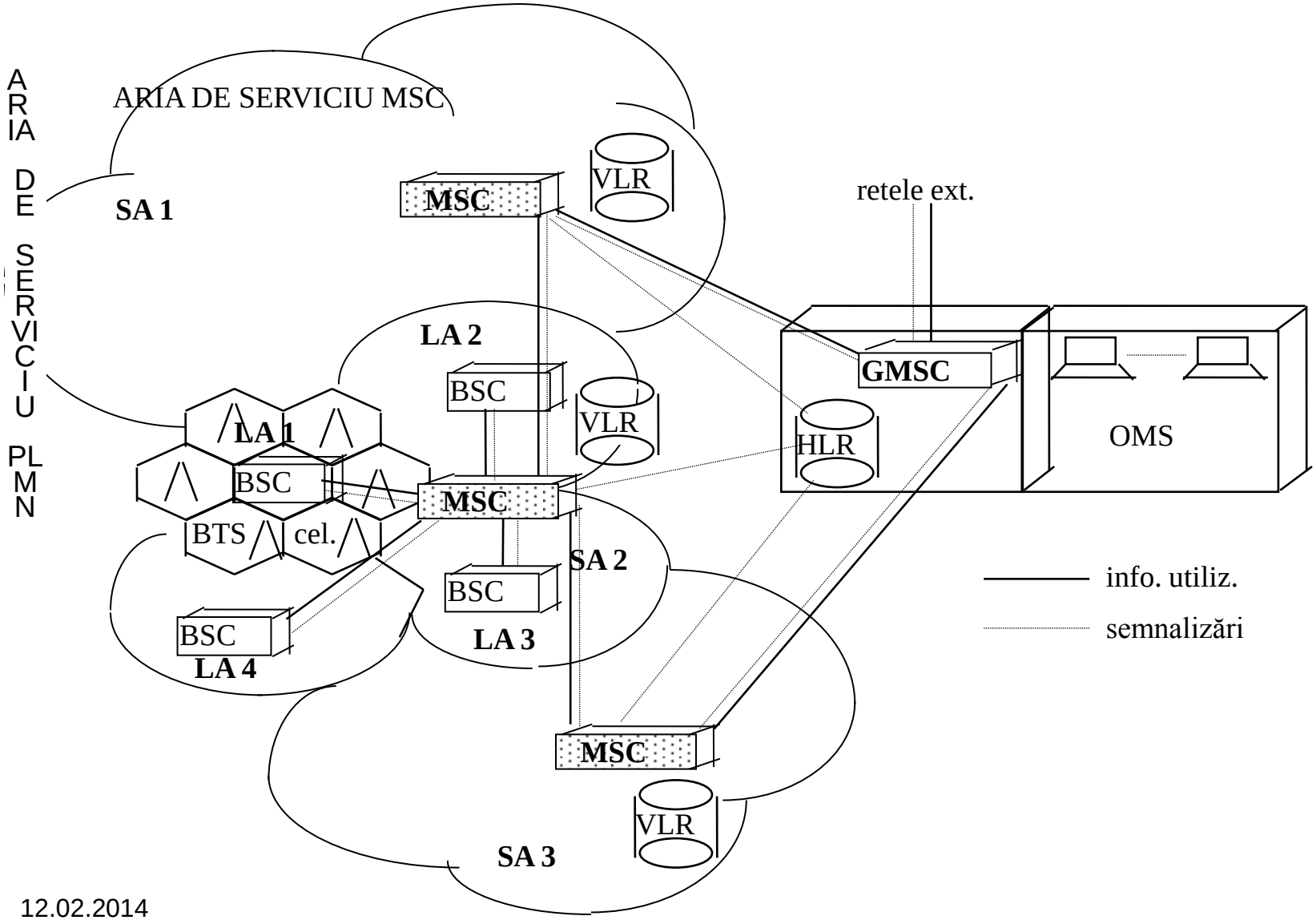


Ce parti lipsesc pentru a avea un sistem complet ?
Ce probleme nu au fost inca discutate ?

Arhitectura GSM (2)



Arhitectura GSM (3)



Arhitectura GSM (4)

1.MS - telefonul mobil *Mobile Station*

2.BSS - staţia de bază
Base Station Subsystem
- echip. specifice aspectelor radio
- BTS
  - ***Base Transceiver Station***
  (staţie transceiver de bază)
  - echip. radio şi interf. cu reţeaua fixă
- BSC - ***Base Station Controller*** **(controler al staţiei de bază): gestiunea interf. radio, comutare. Controlează mai multe BTS.**

3.NSS - subsistemul reţea şi comutaţie (*Network and Switching Subsystem*)
- include principalele funcţii de comutare, bazele de date de gestiune a mobilităţii şi echipamentelor, autentificare
- MSC - ***Mobile services Switching Centre*** **(centru de comutaţie a serviciilor mobile)**
  - comutator. Deserveşte mai multe BSC.
- GMSC **- *Gateway MSC* (MSC de tip gateway). MSC+interfata cu alte reţele**
- VLR - ***Visitor Location Register*** **(registru cu localizările vizitatorilor) - în zona MSC**

Arhitectura GSM (5)

- HLR - ***Home Location Register*** **(registru cu localizările abonaţilor proprii)**
  - informaţii statice (numerotare, categorie abonat, etc.)
  - informaţii dinamice (localizare la nivel MSC, servicii suplimentare activate, etc.)
- AUC - ***Authentication Centre*** **(centru de autentificare)**
  - autentif. abonat şi cifrare
- EIR **-** ***Equipment Identity Register*** **(registru cu identitatea echipamentelor)**

4.OMS - subsistemul operare şi întreţinere (*Operation and Maintenance Subsystem*)

- echip. de calcul şi periferice. Funcţii de OAM. Conţine centre de OAM (OMC)

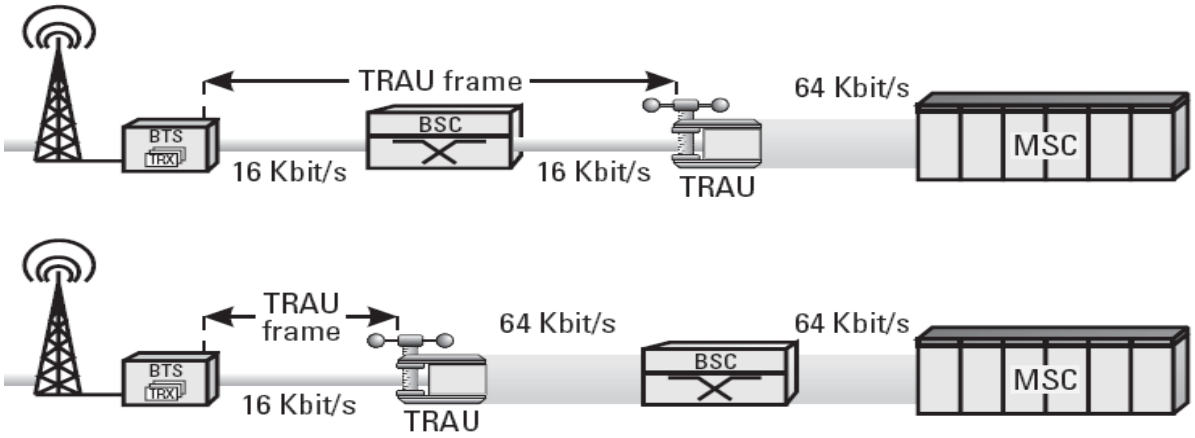
- OMC -*Operation and Maintenance Centre* (centru de operare şi întreţinere)

Arhitectura GSM (6)

Reteaua *fixa* GSM

- transporta informatia BTS <-> BSC <-> MSC pe legaturi fixe PDH, SDH, ATM
- realizeaza maparea cailor de 13Kbps la cai de 64 kbps: 4 x (13 kbps+ 3 kbps)
- include TRAU (*Transcoder/Rate Adaptation Unit*) - amplasat uzual la intrarea in MSC (teroretic poate fi amplasat si la BSC sau BTS)
- la interfata cu PSTN (IWF) se realizeaza conversia intre codarea hibrida la 13Kbps specifica GSM si codarea PCM 64Kbps, compandare legea A, si rezolva problema compensarii ecoului telefonic

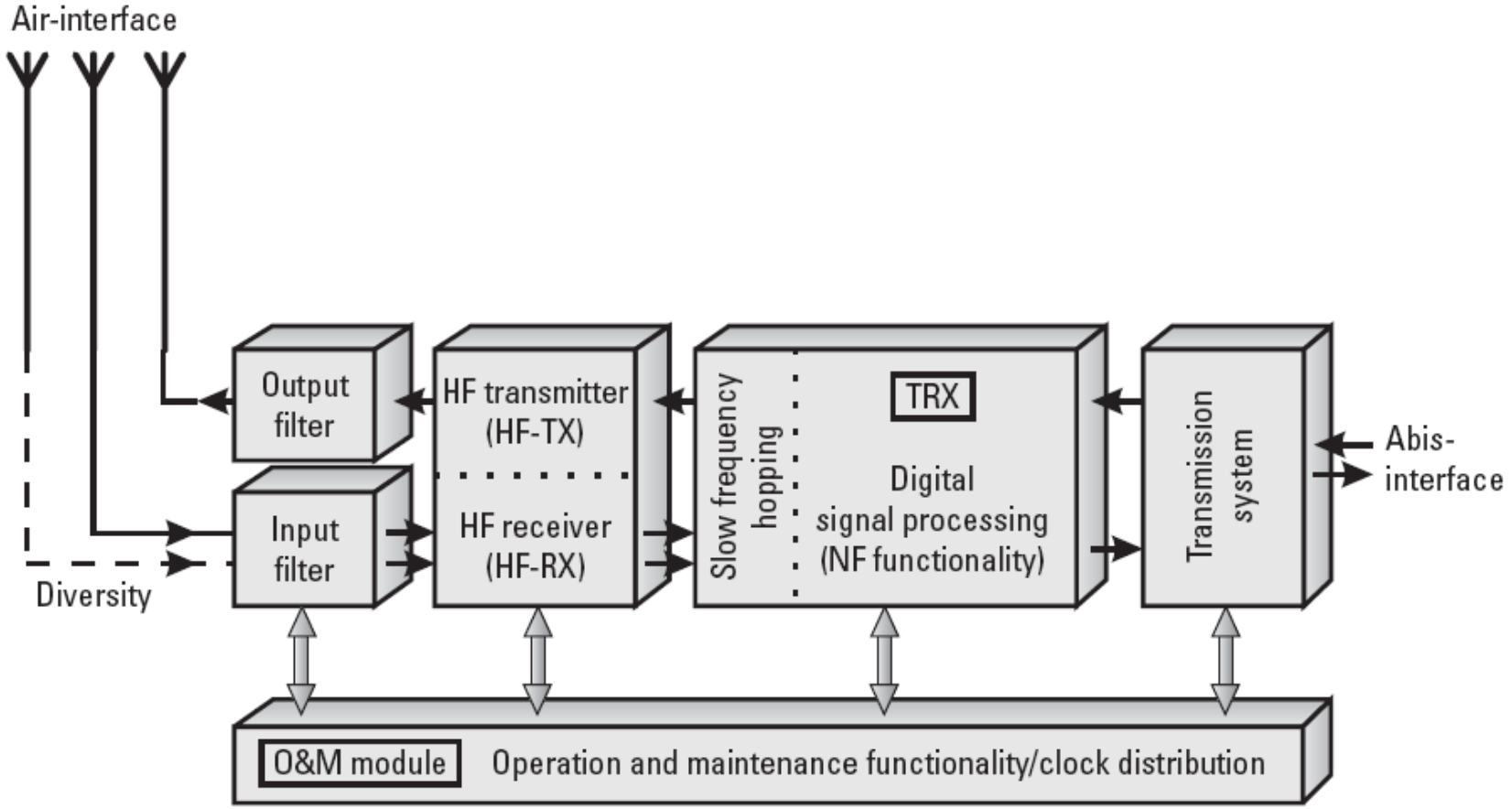
TRAU (Transcoder/Rate Adapt Unit)



- Funcții: adaptare rata voce 13/16 <–> 64, adaptare rata date

- Utilizarea diferenței de 16k – 13k = 3Kbps :
  - sincronizare segmente vorbire, 35 biti sincronizare la fiecare 260 biti vorbire
  - aliniere temporala, 6 biti
  - sincronizare temporala semnal retea fixa cu cel de pe interfata radio, 4 biti
  - etichetare semnal (rata 1 sau 1/2), 5 biti
  - marcare segmente de vorbire cu erori (pe sensul MS->BTS)
  - marcare mod DTX (Discontinous Transmission of Speech) – indicare segmente liniste/vorbire, 3 biti amonte si 1 aval
  - 5 biti rezerva amonte si 9 biti rezerva aval

Subsistemul BSS (BTS, TRX)

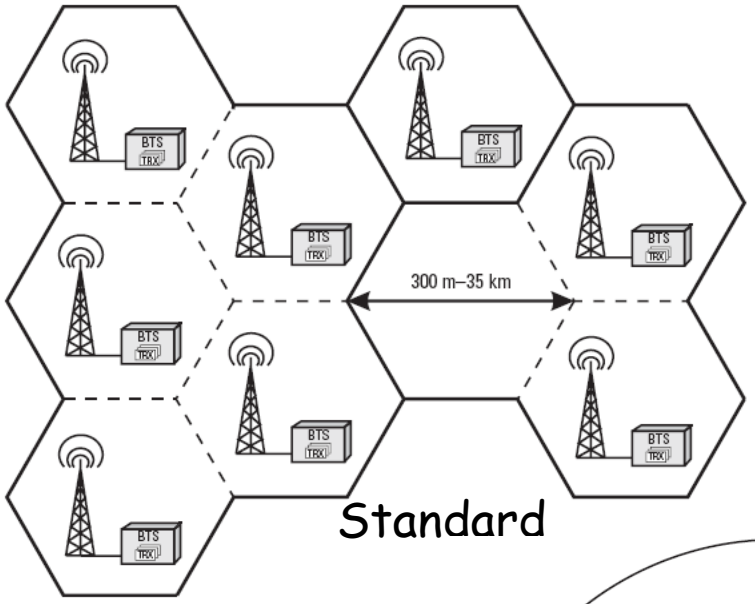


Functiile unui TRX (DRX)

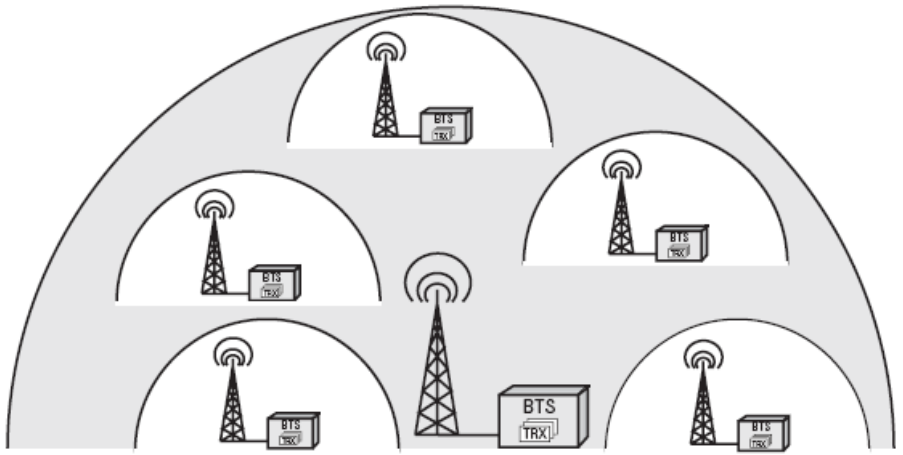
Function	LF	HF
Channel coding and decoding	●	
Interleaving and ordering again	●	
Encryption and decryption (ciphering)	●	
Slow frequency hopping	●	
Burst formatting	●	
TRAU frame formatting and conversion in direction to/from the BSC, setup of the LAPD connection to the BSC	●	
GMSK modulation of all downlink data	●	●
GMSK demodulation of all received MS signals	●	●
Creation and transmission of the broadcast common control channel (BCCH) on channel 0 of the BCCH-TRX	●	●
Measurement of signal strength and quality for active connections	●	●
Provision of the results to the BSC (MEAS_RES message)		
Interference measurements (idle channel measurements) on free channels and forwarding of the results to the BSC in a RF_RES_IND message	●	●

LF = low frequency part of the TRX; HF = high frequency part of the TRX.

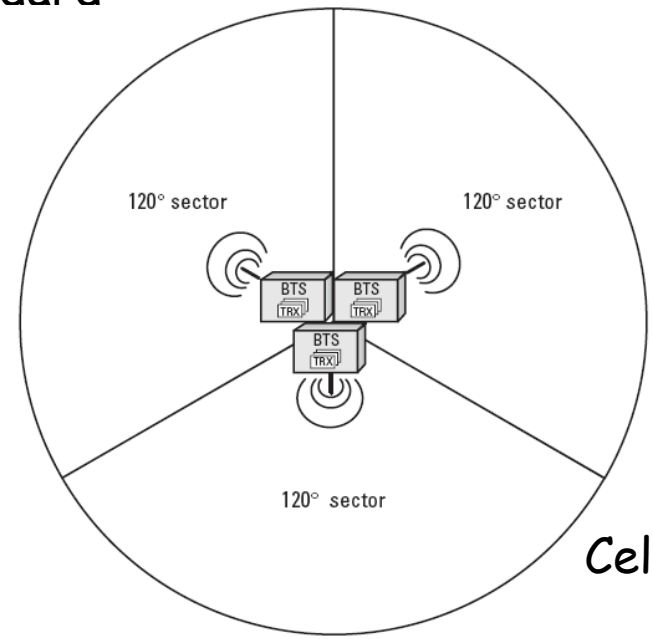
Configuratii BTS



Standard

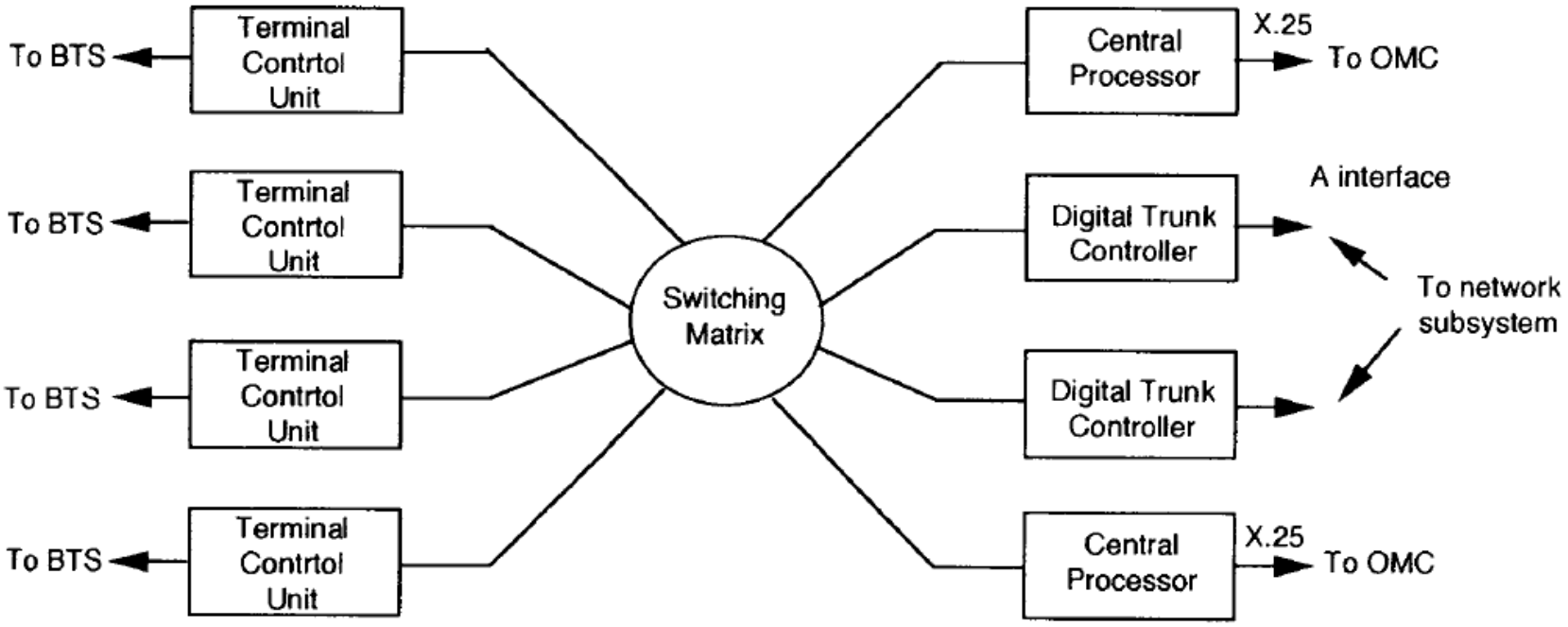


Umbrela

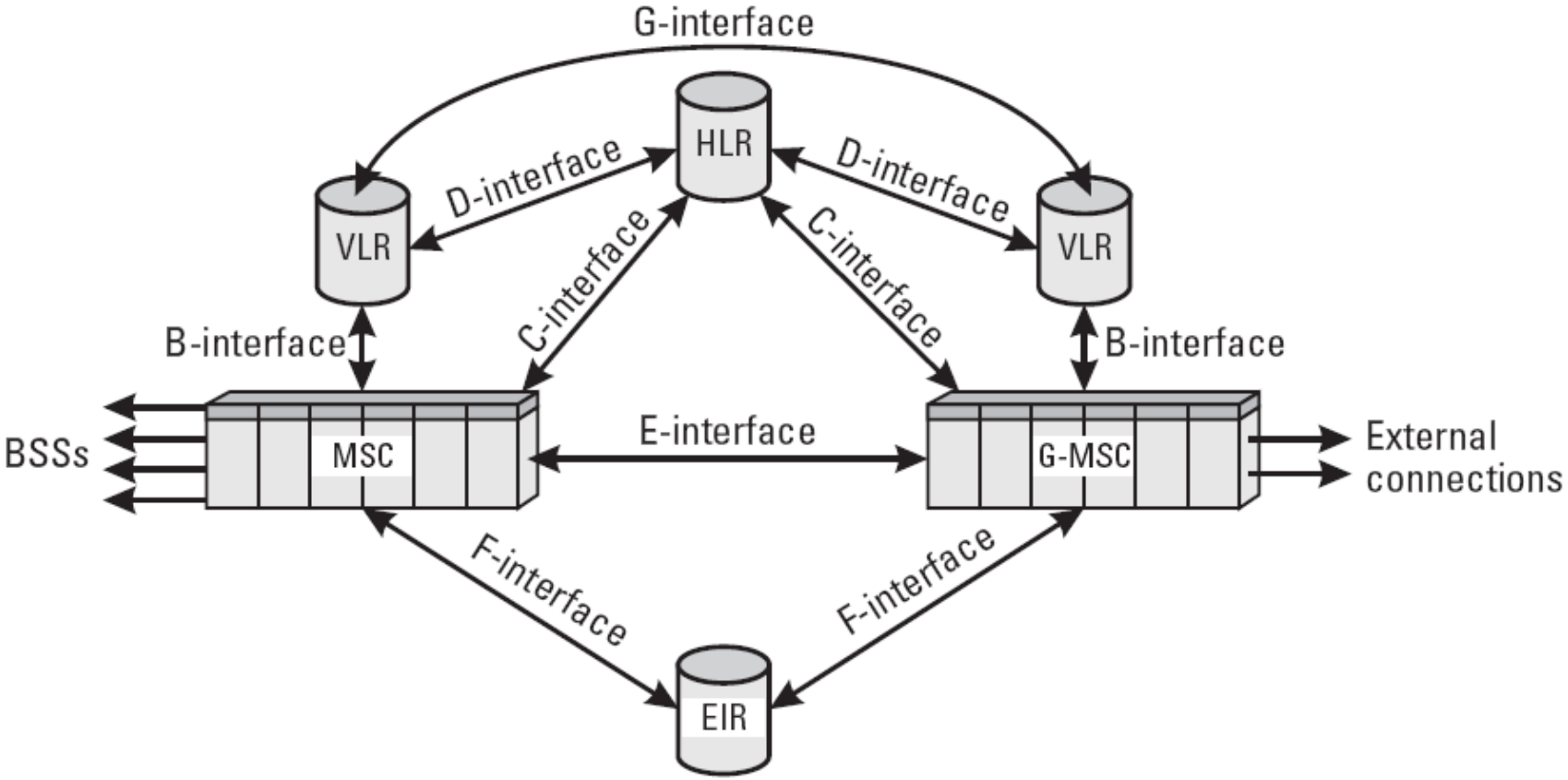


Celula sectorizata

BSC-ul

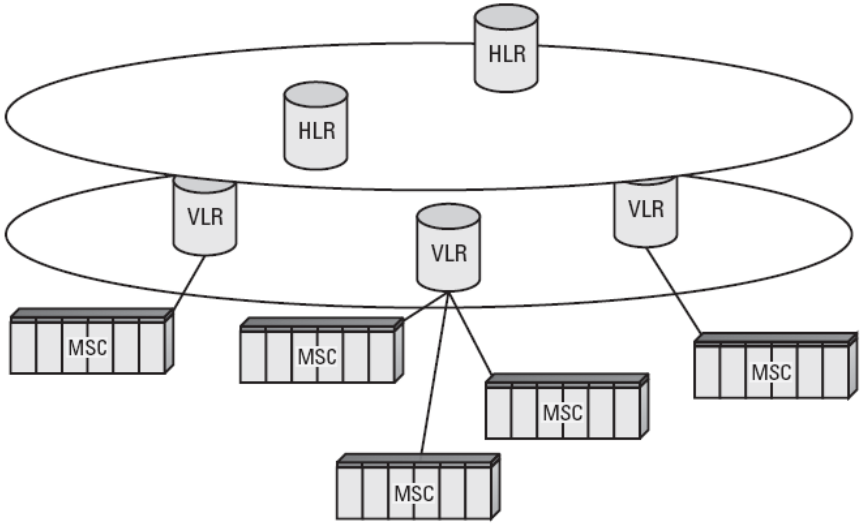

To BTS
Terminal Contrtol Unit
To BTS
Terminal Contrtol Unit
To BTS
Terminal Contrtol Unit
To BTS
Terminal Contrtol Unit
Switching Matrix
Central Processor
X.25
To OMC
Digital Trunk Controller
A interface
To network subsystem
Digital Trunk Controller
Central Processor
X.25
To OMC

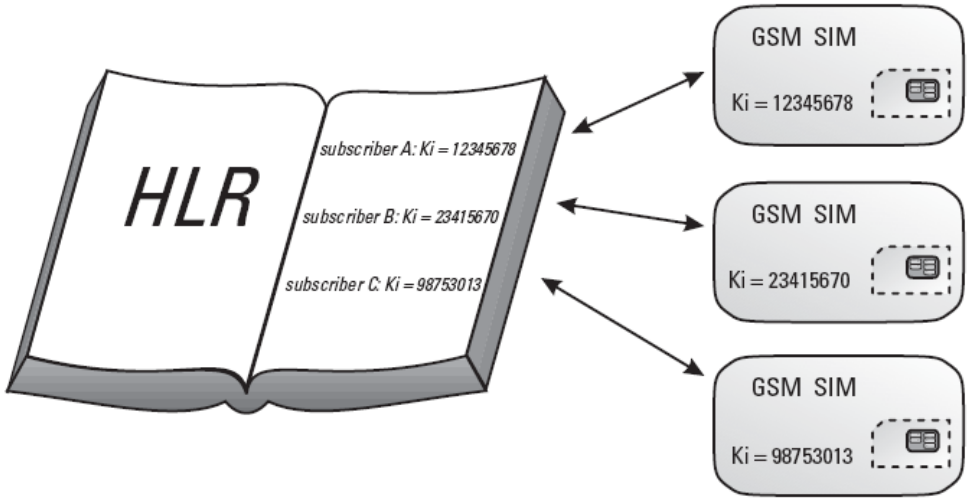
Subsistemul NSS



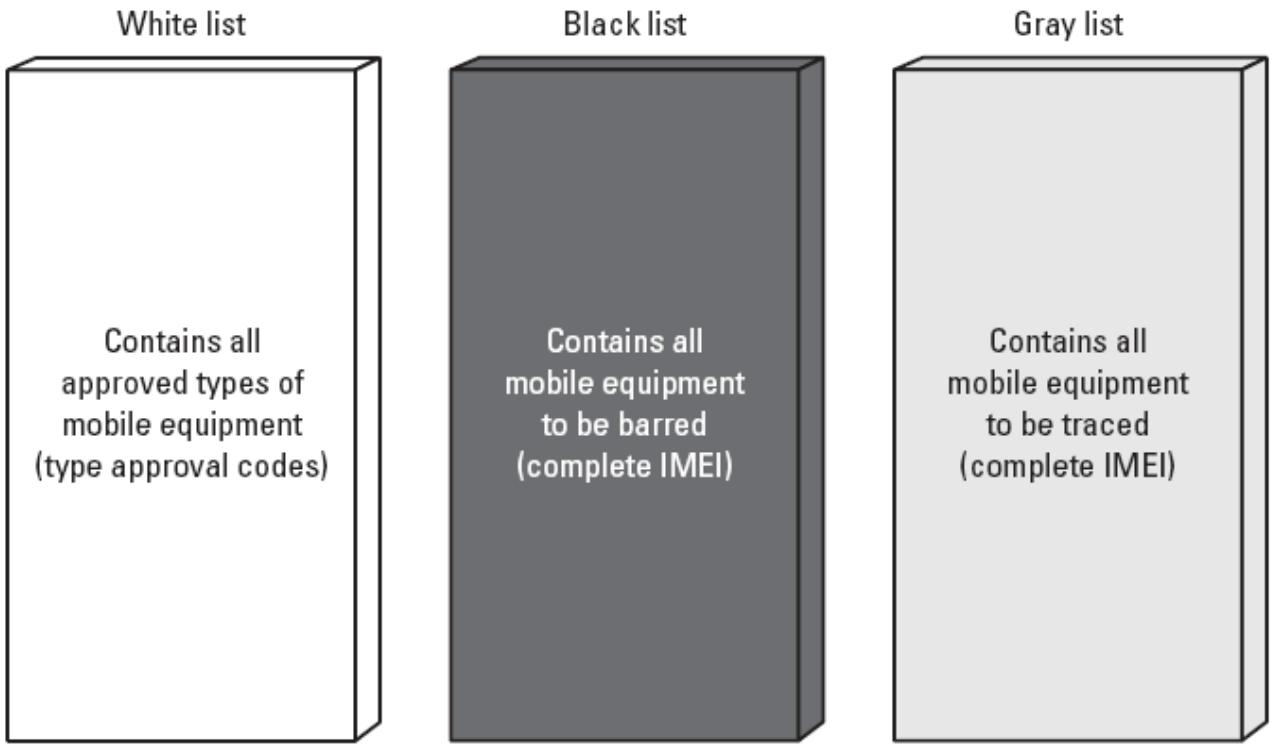
HLR, VLR

Parameter	HLR/AuC	VLR
Subscriber specific:		
IMSI	●	●
K_i	●	
TMSI		●
Service restrictions	●	
Supplementary services	●	●
MSISDN (basic)	●	●
MSISDN (other)	●	
Authentication and ciphering:		
A3	●	
A5/X (in BSS)		
A8	●	
RAND up to five triplets	●	●
SRES up to five triplets	●	●
K_c up to five triplets	●	●
CKSN		●
Subscriber location/call forwarding:		
HLR number		●
VLR number	●	
MSC number	●	●
LAI		●
IMSI detach		●
MSRN		●
LMSI	●	●
Handover number		●





EIR


White list
Contains all approved types of mobile equipment (type approval codes)
Black list
Contains all mobile equipment to be barred (complete IMEI)
Gray list
Contains all mobile equipment to be traced (complete IMEI)

Aspecte practice

- Considerente legate de alegerea frecventelor pe interfata radio
- Ilustratii ale unor echipamente ale retelei de comunicatii mobile

Banda de 900 MHz (GSM)

- Acoperire mai buna decat la f > 900 MHz (ex. 1800), raza celula < 35Km din cauza limitei avansarii temporale
- Undele patrund mai bine prin obstacole (peretii de beton, de exemplu)
- Problema: limitare la 124 de canale TDMA

Banda de 1800 MHz (DCS)

- Acoperire mai redusa decat la 900 MHz (atenuare mai mare), raza celula < 30Km
- Undele patrund mai putin prin obstacole dar se reflecta mai bine
- 374 canale TDMA
- Solutie pentru cresterea traficului in orase

Banda de 2,1GHz (UMTS)

- Frecventa mai mare -> atenuare mai puternica in spatiu
  - Raza celula < 10Km
- Traficul (conexiuni simultane) si debitul suportate sunt mai mari decat in benzile 900, 1800

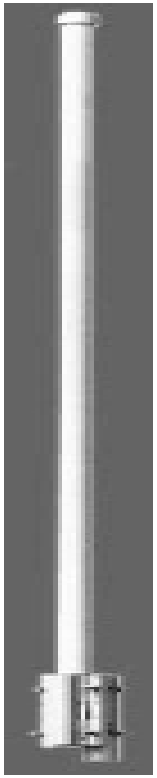
Tipuri de antene GSM

- Interfata Um (MS-BTS)
  - Anteme macro
  - Antene micro
- Interfata Abis (BTS-BSC)
  - Antene PDH
  - Antene SDH

Antenele macro

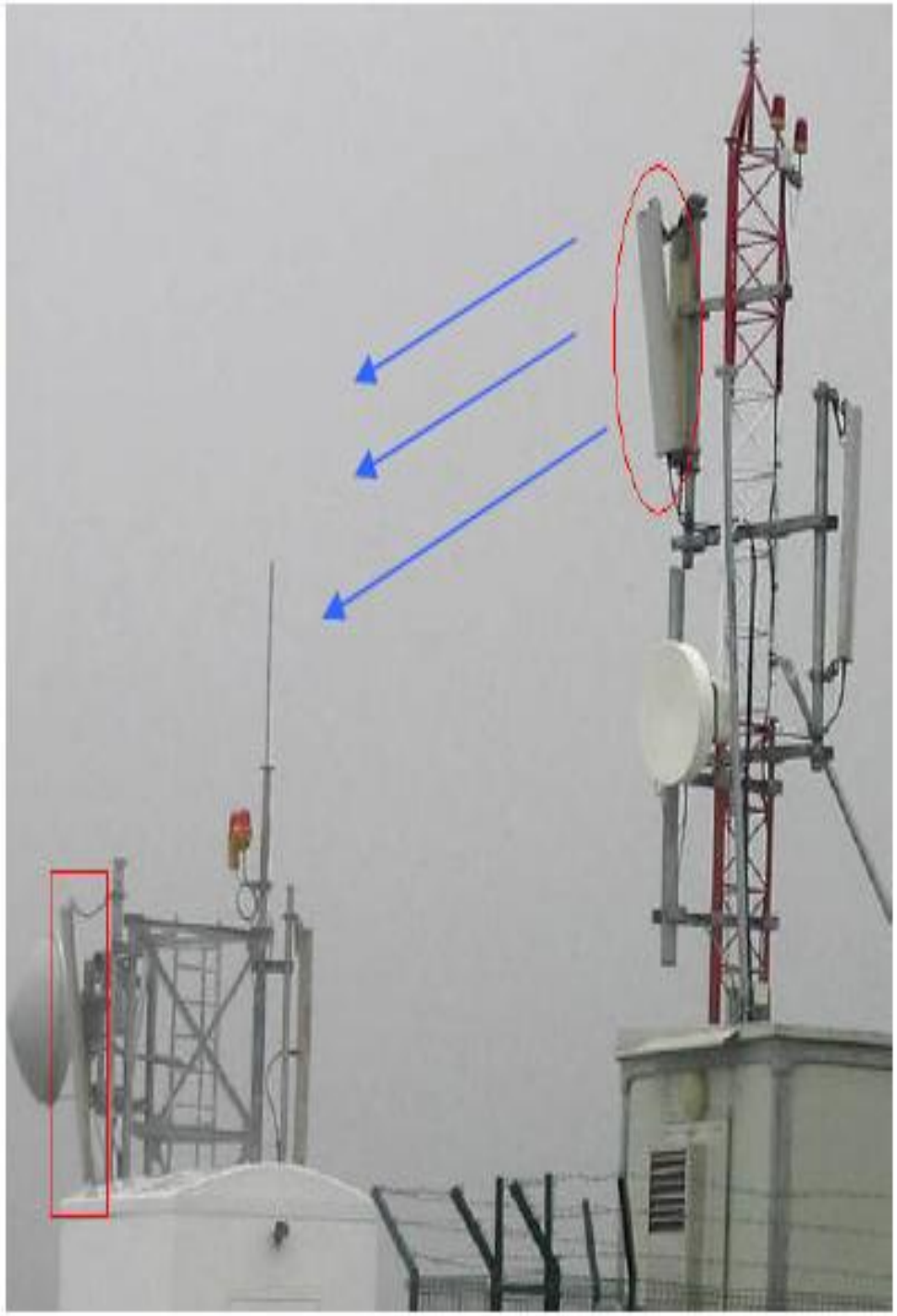
- Amplasate la înaltime pentru a permite acoperirea unei zone largi
- Puterea teoretica maxima de emisie: 200 - 500W în functie de model
- singleband (900 MHz only, 1800 MHz only, sau UMTS only),
- dualband (900/1800, 900/UMTS, 1800/UMTS),
- tri-band (900/1800/2100)
  - Numarul de coaxiale care intra în antena :
    - 2 pentru singleband (unul pentru RX = receptie, celalt pentru TX = emisie)
    - 4 pentru o dualband (câte un cuplu RX/TX pentru fiecare banda de frecvente)
    - 6 pentru triband.

Antenele macro



Omnidirectionale

Directionale



Inclinarea antenei : tilt-ul

- de obicei negativ, adica antena emite spre pamânt
- controlat mecanic sau electric

Instalare antene:

- Inaltime 50 m

- Co-localizare cu antene PDH (Abis)

- Dispunere sectoriala

Antene pe Abis

Antene rotunde sunt numite “Link-uri”, opereza la frecvente mai inalte (ex. 5GHz, 10GHz, 12,5GHz)

Antena BTS-ului si cea a BSC-ului trebuie sa fie în vizibilitate directa, fara obstacole

Legatura BTS-BSC (Abis) se mai poate face si prin fibra optica, ghid de unda sau coaxial.

Stalp de BSC

numai antene de tip “link”

Stalp de tip monotub

- inaltime 30m
- 2 antene sectoriale
- 1 antena PDH

adapost (Shelter)
pentru BTS

Antene in benzile de :

- 900MHz
- 1800MHz
- Link-uri

Antene sectoriale :

- de 1800 MHz
- de 900 MHz

LNA-uri (Low Noise Amplifier)

- utilizate pentru a ameliora legatura între BTS si mobil (în sensul uplink, MS -> BTS)

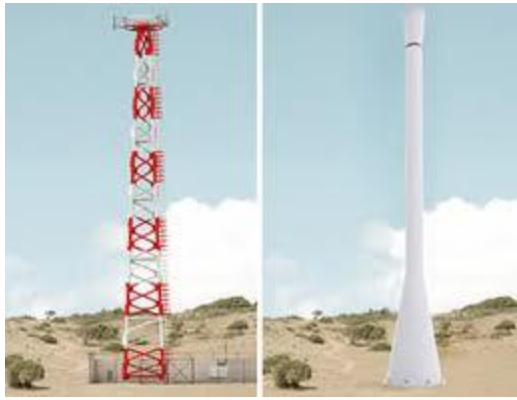
- evita situatia când MS este în limita de acoperire; MS receptioneaza semnalul de la BTS, dar nu poate emite cu putere destul de mare incat sa ajunga pâna la el (uplink).

Traim in Romania…

Intre timp, in Suedia, Ericsson propune alta solutie pentru integrarea in peisaj – the *Tower Tube*

The Ericsson Tower Tube

- an innovative construction that houses base stations and antennas, fully encapsulating them in an aesthetic, energy-efficient and low environmental impact tower.

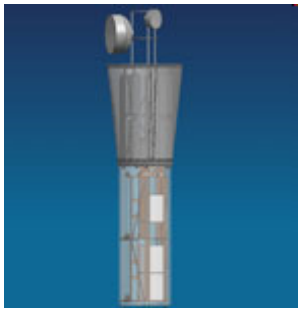


- cutting-edge design and building materials,
- can be built in a variety of sizes and colors that make it a natural fit for any landscape.

- the exterior can also be adapted to help it fit into rural or urban settings, and win public acceptance for a new site.

- modular concrete construction that allows the structure to be deployed quickly and easily

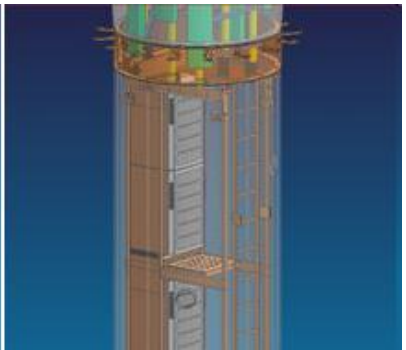
The tower from inside



- http://www.ericsson.com/campaign/towertube/whatisit.shtml
- The tower is a self-contained site. It safely houses all equipment within its slim design (about 5m in diameter).

- The tower's concrete exterior protects equipment effectively from the elements and provides a stable internal environment;
- weatherproof enclosure;
- additional protection from vandalism and lightning.

- Radio base stations (RBS) are enclosed within the tower. They are initially installed at the bottom of the tower and then raised to the top by an elevator. By positioning a RBS at height, there is very low feeder loss, which allows improved network coverage and capacity.



Antenele micro

- Utilizate în locurile aglomerate (gara, galerii comerciale, metrou…)
- Acopera zone mai mici
- Pot fi omnidirectionale sau directionale

Antena directionala pentru o microcelula

31 10:40

Antena omnidirectionala de microcelula

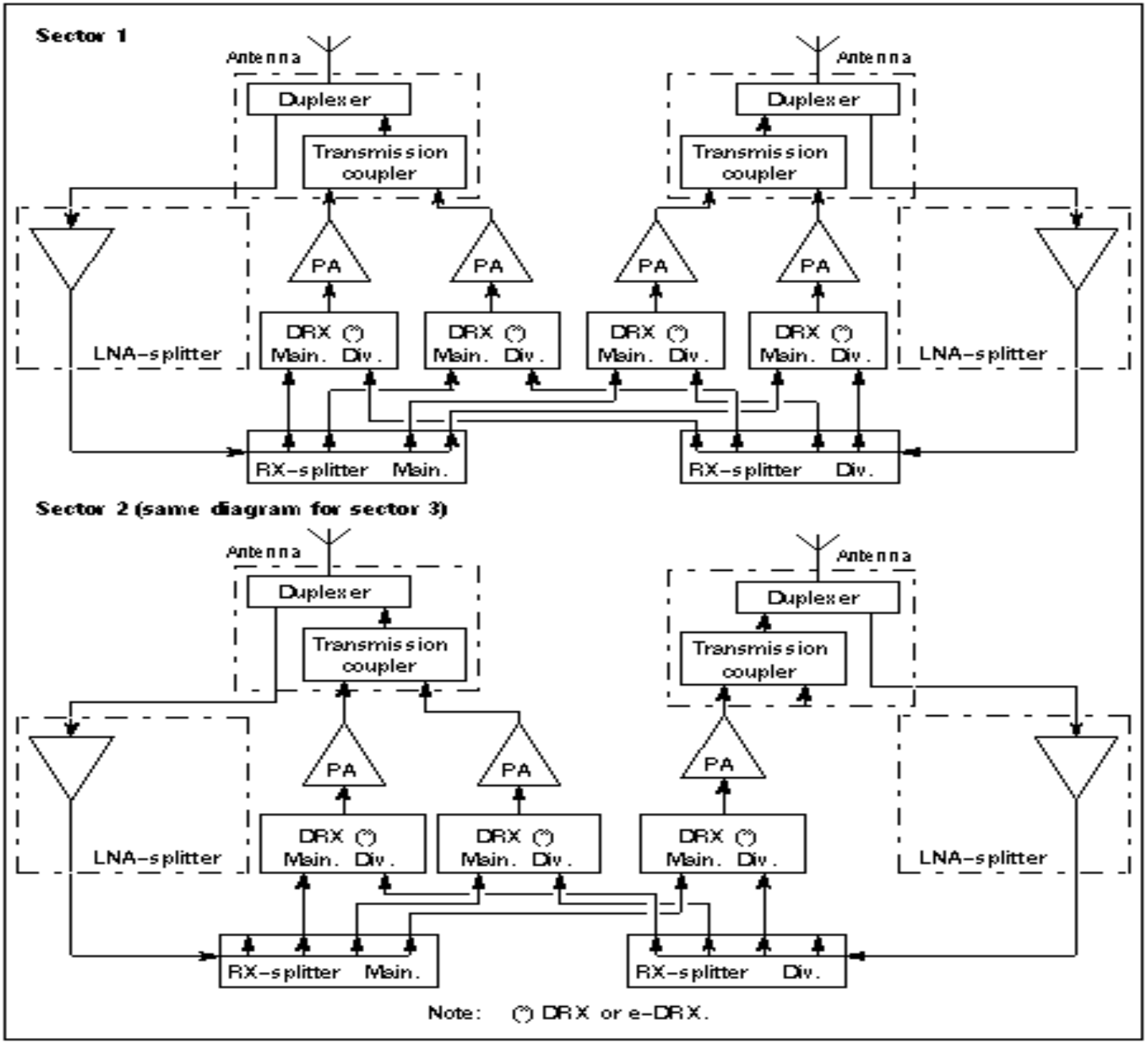


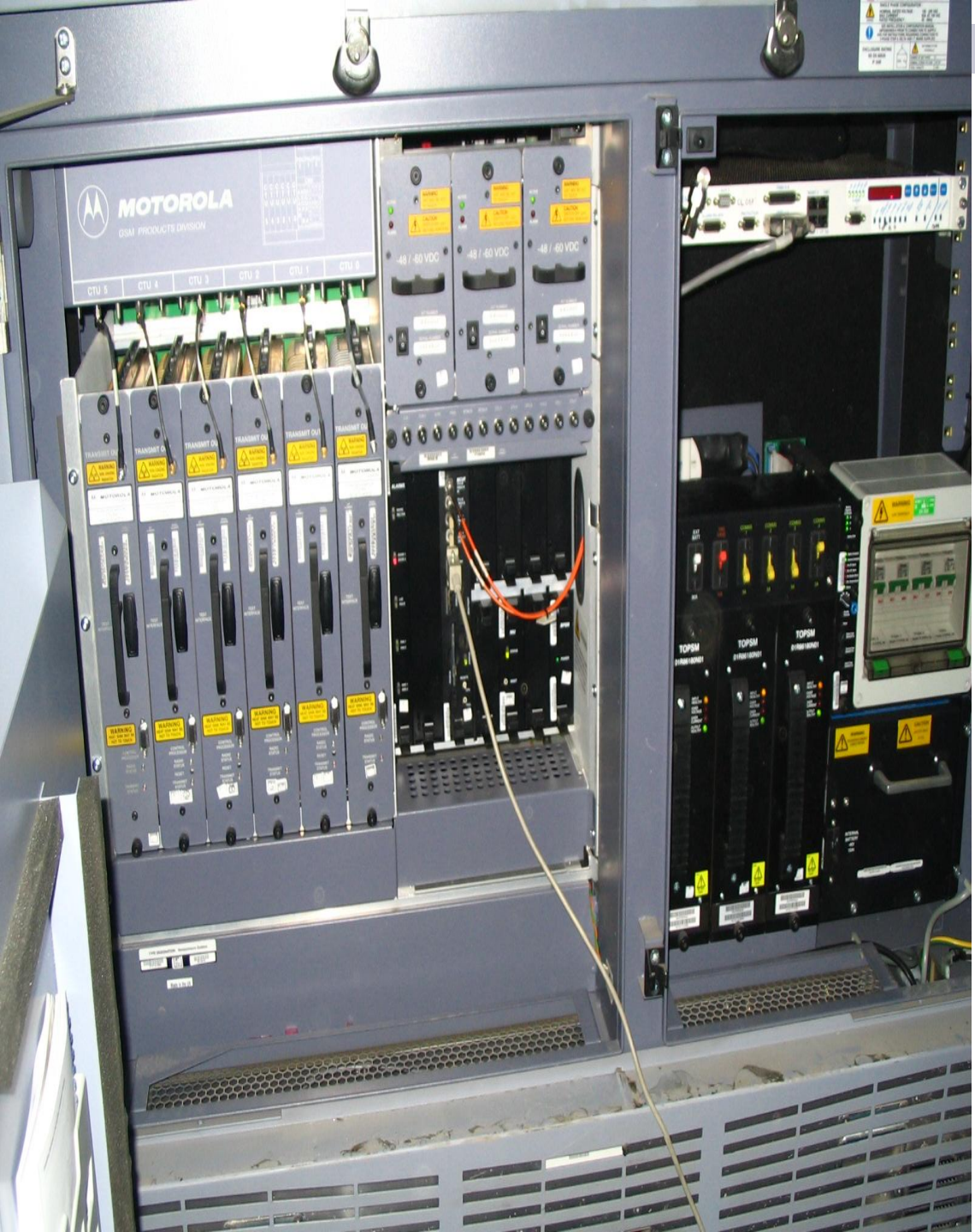
Figure 1–47 Transmission/reception for a 2S433 configuration with H2D coupling system

Echipamente de retea

- BTS
- BSC
- MSC
- Alte elemente…

BTS outdoor montat pe acoperisul unei cladiri

BTS - detalii



BTS Motorola
Outdoor

BTS Motorola Outdoor, componente:

CDU – RF Combiner Distribution Unit

TRE – Transmission Equipment

MCU – Master Control Unit

SUMA – Station Unit Module

BTS Indoor

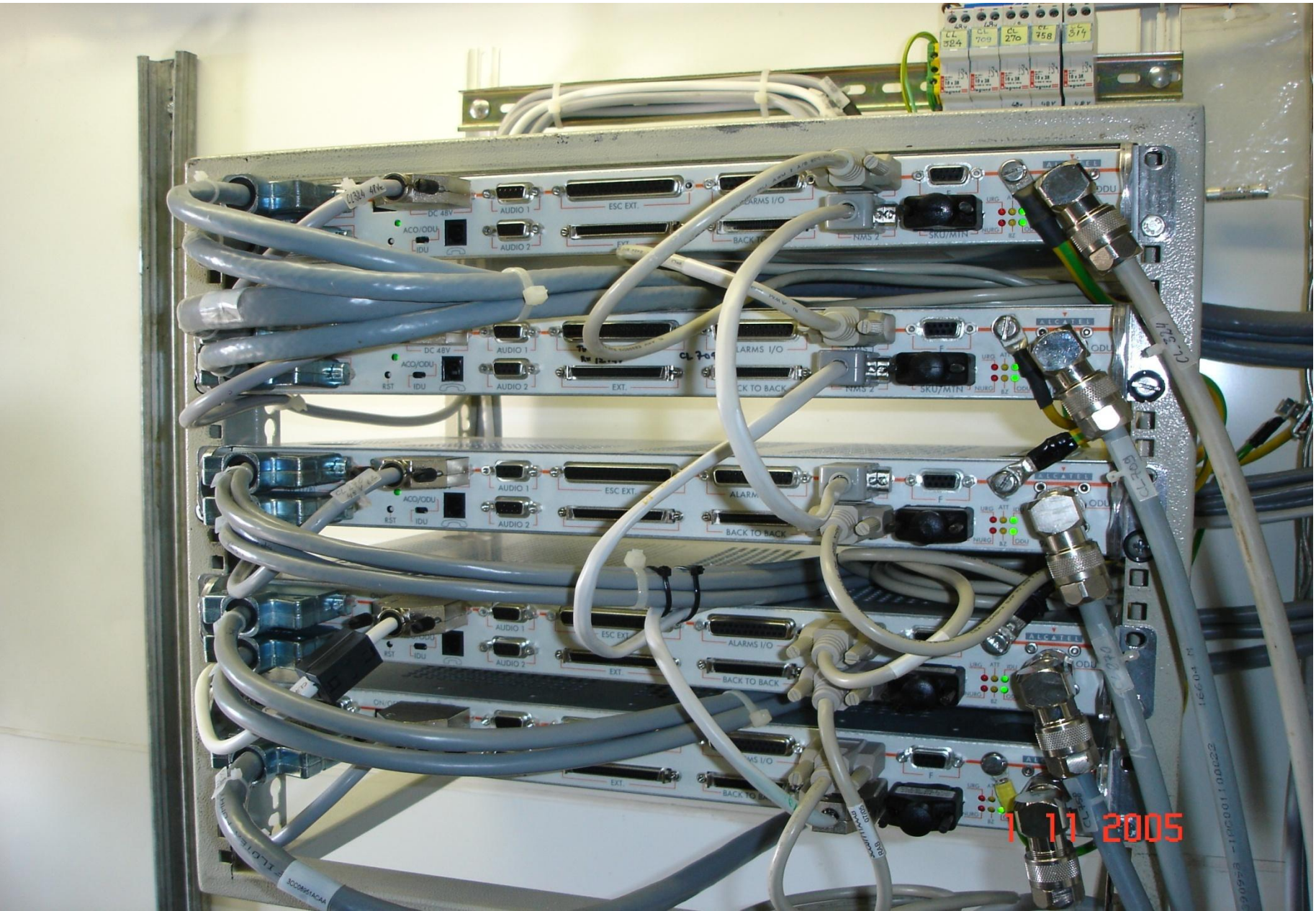
BTS Motorola Indoor

Coaxiale Rx si Tx

BTS cu 3 TRX (3 frecvente)

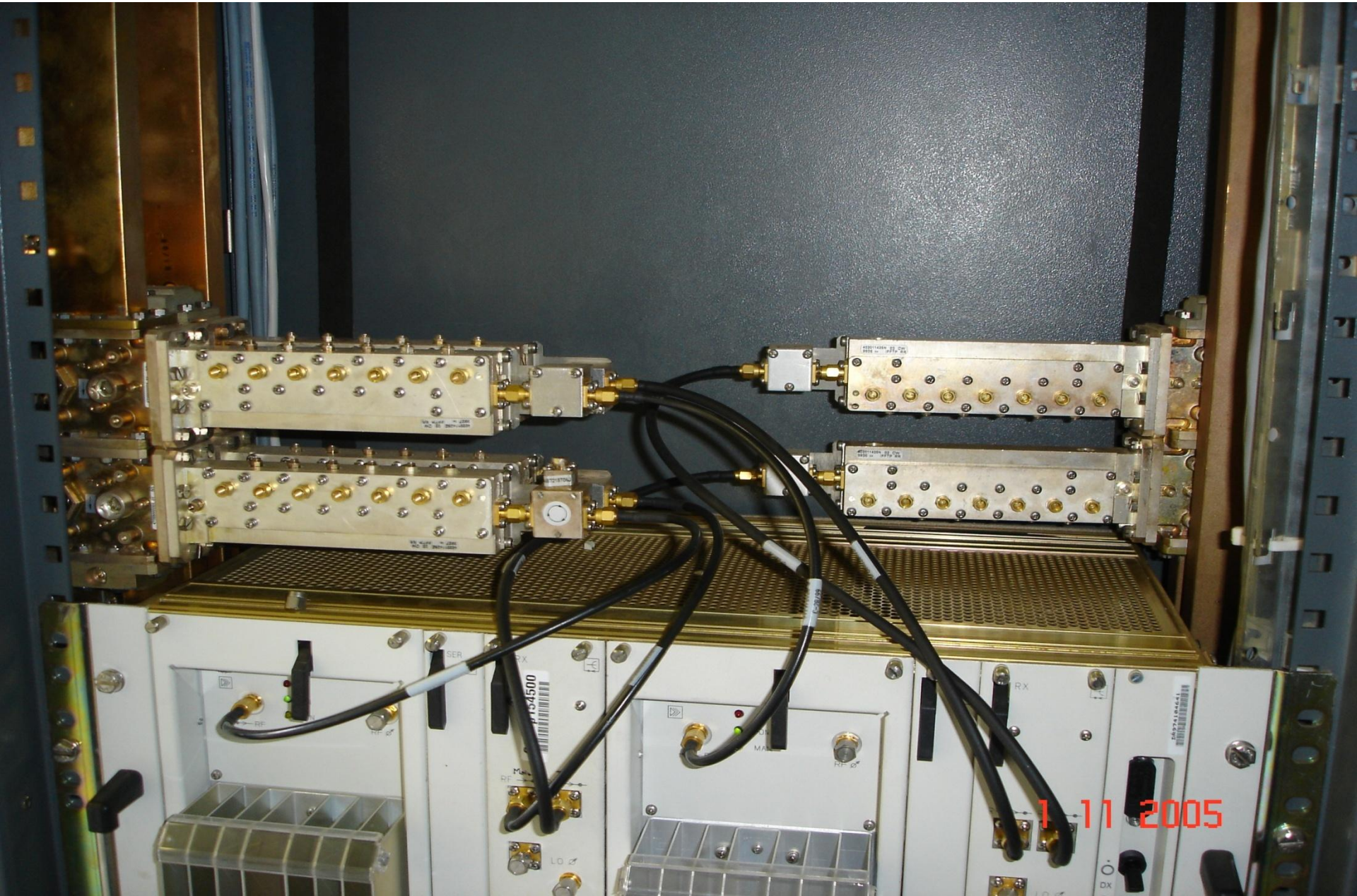
Conexiuni radiorelee

Echipamente SDH



Emitator SDH

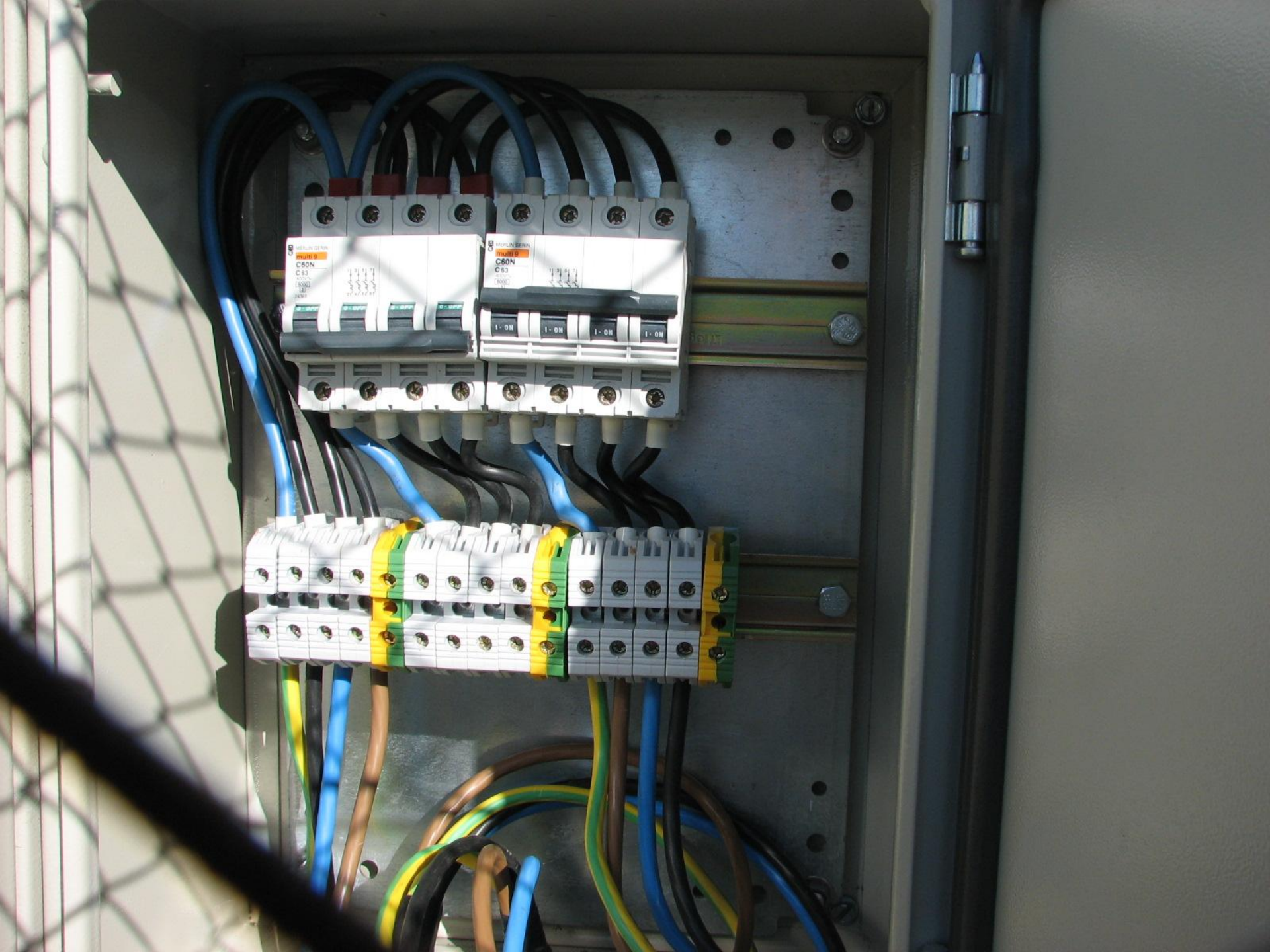
Ghidurile pentru microunde

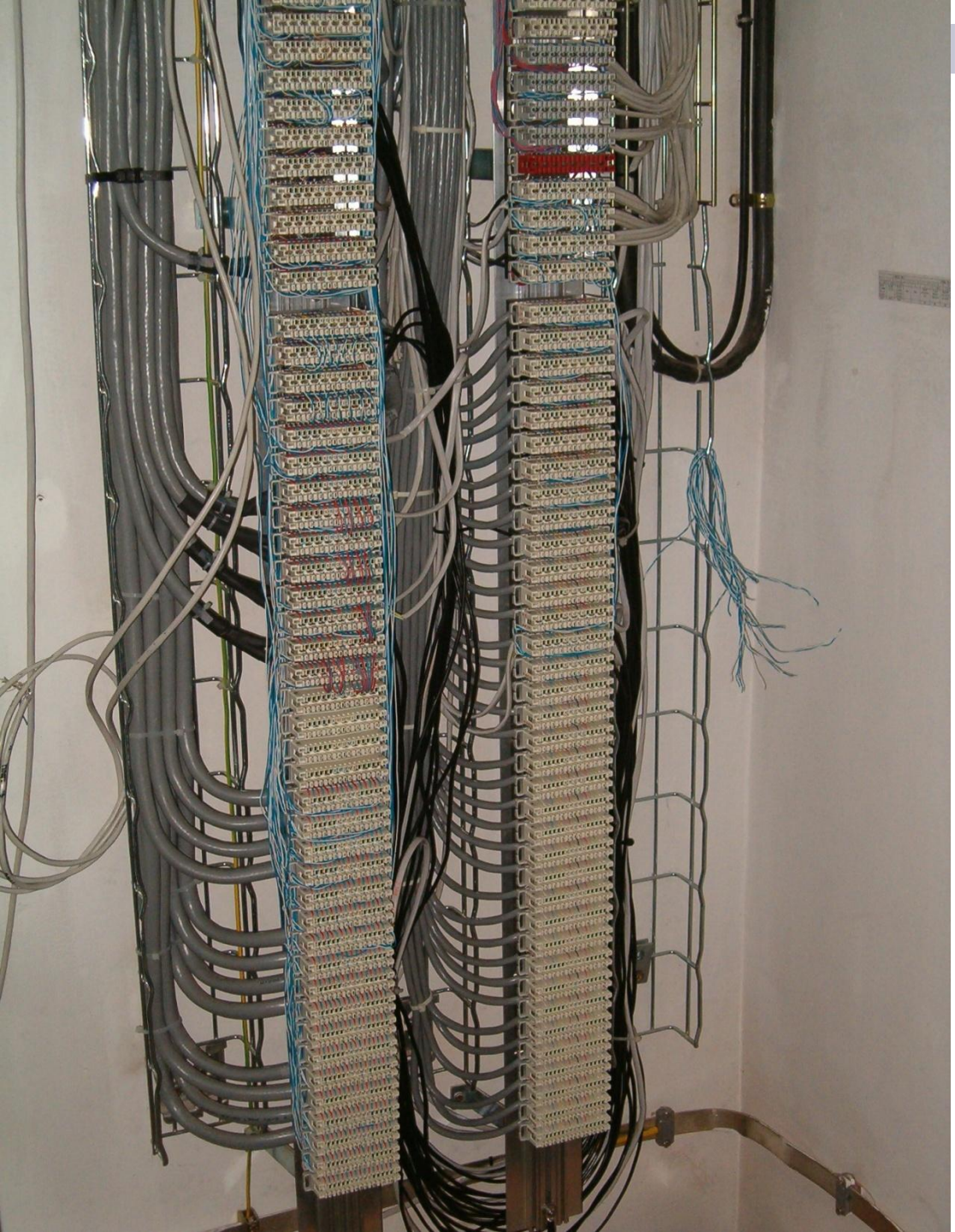


Sursa de alimentare a BTS-ului

Sursa de alimentare

Sursa de alimentare


MERLIN GERIN
multi 9
C60N
C63
I - ON
I - ON
I - ON
I - ON
MERLIN GERIN
multi 9
C60N
C63

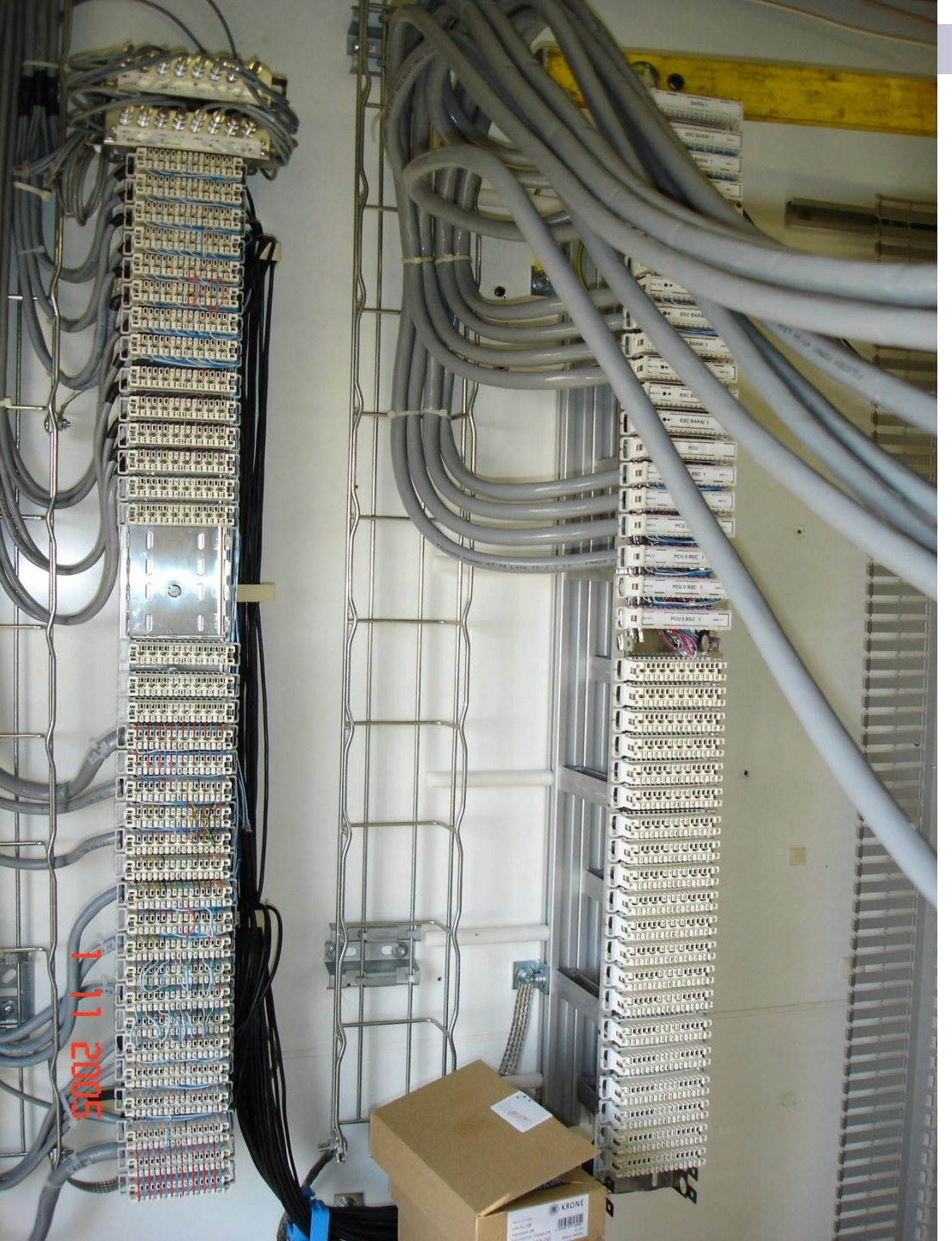


DDF – Digital Distribution Frame – permite:

- monitorizarea legaturilor Rx, Tx

- interconectarea flexibila a echipamentelor

DDF – Abis/PDH



DDF – PDH


PUNCT DE
ELIBERARE
MANUALĂ A
HFC 227 ea
(FM 200)
HFC
227 ea
FM 200
ATENȚIE!
EVACUAȚI
TOT
PERSONALUL
ÎNAINTE DE
ELIBERARE
HFC 227 ea
(FM 200)
Stingere
Efectuata
Dezactivat
HELINICK S.R.L.
SISTEME INTEGRATE DE SECURITATE

DDF alarme

Baterii

– autonomie alimentare

Senzori de fum si temperatura

Mentinerea temperaturii constante

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- http://www.hs-mittweida.de/~delport/fue/iwkm/kt/iwkmkt2.pdf