◆ **Cabinet extendible on site (1-door to 2-doors.)**

◆ **Front access to BTS equipment only**

◆ **Number of antennas: ≤ 6 (3 sect.) in MBO1, ≤ 12 (6 sectors) in MBO2**

◆ **Full variety of options (BBU, MW, REK, TMA, CrossConn, etc.)**

◆ **3-phase or 1-phase AC mains**

◆ **Temp. maintained by air/air heat exchanger and heaters**

◆ **Types of Cabinet and Configurations**

- ◆ **Height: total 1485mm,**

- ◆ **Width :   total MBO1 903mm, total MBO2 1520mm,**

- ◆ **Depth: total 747mm**

- ◆ **MBO1 - Multi Standard BTS Outdoor 1-door**

  - up to 8 TRE GSM (1x8, 2x4, 3x 2) in 4 subracks

- ◆ **MBO2 - Multi Standard BTS Outdoor 2-doors**

  - up to 12 TRE GSM (2x6, 3x4) in 7 subracks
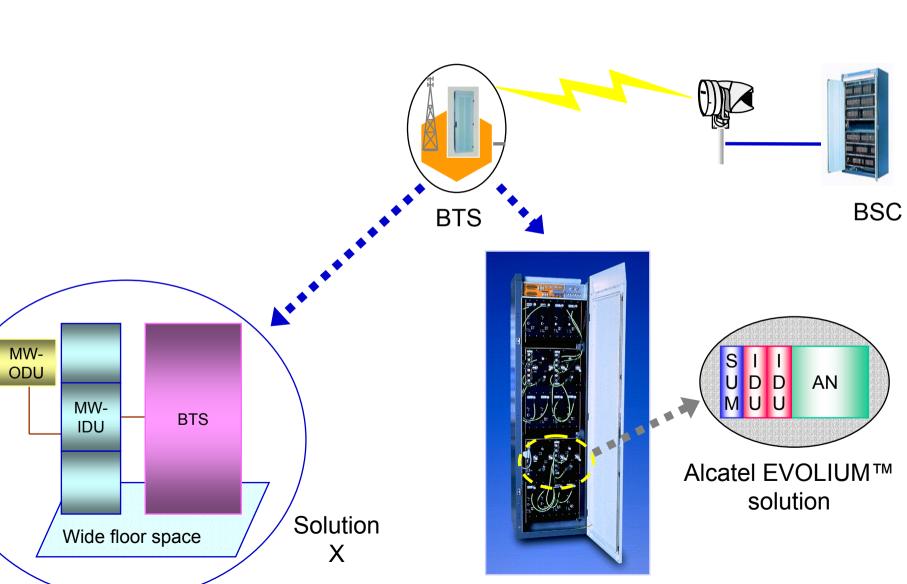
BATTERY saving features

- **One TRX "full power" + others "60% power"**

- **Automatic Shutdown**

  - Keeps BCCH TRX alive

  - Configurable timer to start operating

Example of battery times:

- MBO2 - S4,4,4 - one BU90 (multiply the time up to 3xBU)
  - "Auto shutdown" not enable $\Rightarrow$ **120** min (2h)
  - "Auto shutdown" enable (timer set to 0 min) $\Rightarrow$ **340** min (5.6h)
  - "Auto shutdown" enable (timer set to 150 min) $\Rightarrow$ **240** min (4h)

EVOLIUM™ integrated microwave

BTS

BSC

MW-ODU

MW-IDU

BTS

Wide floor space

Solution X

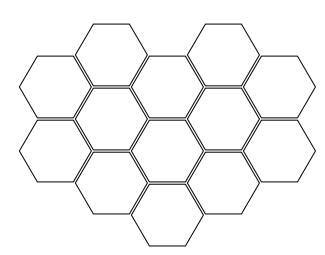| S U M | I D U M | I D U | AN |

Alcatel EVOLIUM™ solution

TRX

The dimensioning of the TRX is done according to the profile of the subscriber that will use the voice and data (GPRS) channels. The amount of each group of subscribers and the type of adopted signaling (normal, high or very high) is also considered.
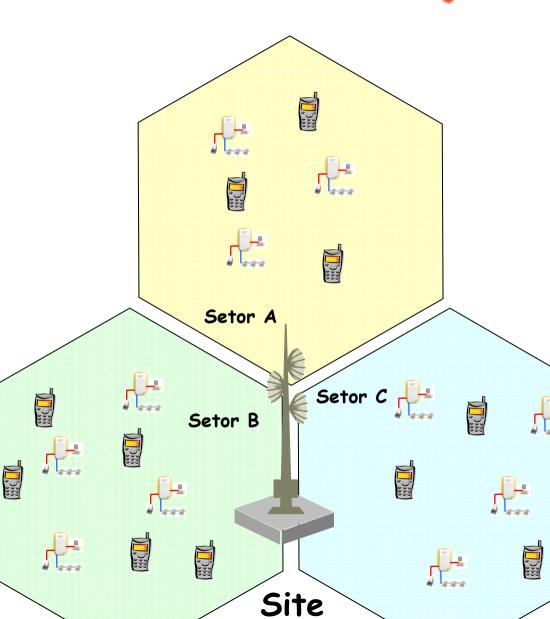
TRX	BCCH Combined	Normal TCH	Normal Traffic	High TCH	High Traffic	Very High TCH	Very High Traffic
1	Yes	7	2,93			6	2,28
1	No			6	2,28	6	2,28
2	Yes			14	8,2	14	8,2
2	No	14	8,2				
3	No	22	14,9	21	14,04	21	14,04
4	No	29	21,04	28	20,15	28	20,15
5	No	37	28,25	36	27,34	35	26,44
6	No	44	34,68	43	33,76	42	32,83
7	No	52	42,13	51	41,19	50	40,26

Site

The site dimensioning is done according to the quantity of sectors and the amount of BTS's. The configuration of the BTS's depends on the quantity of TRX. The BTS has a limitation regarding the quantity of the TRX not only because of the hardware limitation but also because of the bandwidth available

Setor A

Setor B

Setor C

Site

Advanced and compact platform

- Scalable and flexible to meet all network requirements

- Efficient resource usage on Air, Abis and Ater interfaces

Allowing optimized investment strategy

- Low start-up cost

- High growth potential to meet traffic requirements

- Support of more than 144,000 BHCA (busy hour call attempts)

- No hardware upgrade for GPRS

32-128TRX 192-288TRX 352

Intelligent and flexible call handling

- Enhanced Full Rate - Adaptive Multi Rate

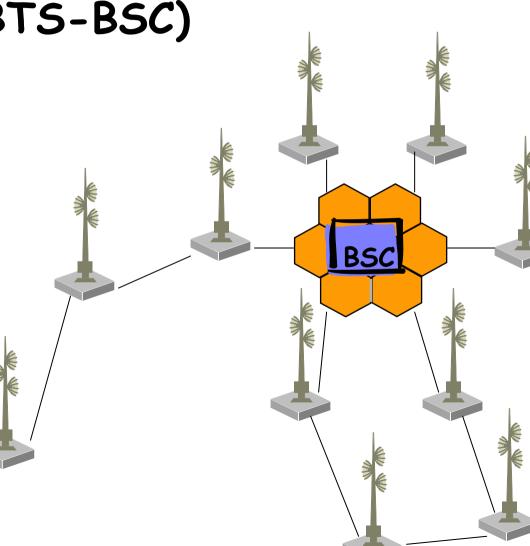- Advanced algorithms for hierarchical and multiband networks

Access Network (BTS-BSC)

- topology
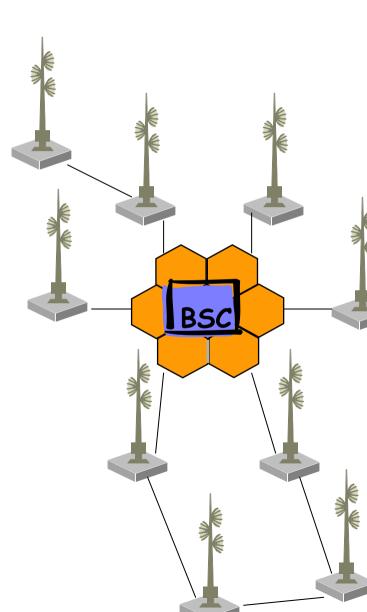   - multidrop
        - chain
        - loop
    - star
    - meshed

BSC configuration

- Number of BTS

- Number of Cells

- Number of TRXs

- CODEC to be used

- Traffic

- A / Ater mux interface PCM

- Abis Interface PCM

- Number 7 signaling channels

- Topology
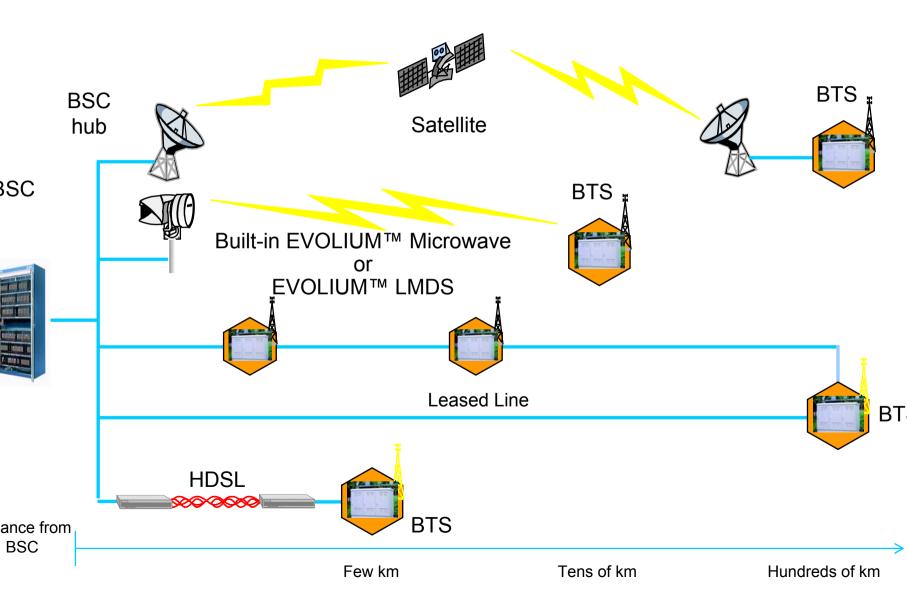
BSC capacity

Configuration	Traffic capacity in Erlang[1]	No. of TRXs (FR/DR)	No. of BTSs (FR/DR)	No. of cabinets	No. of A-bis/A-ter TSUs
1	160	32/16	23/16	1	1/2
2	650	128/64	95/64	1	4/3
3	1100	192/96	142/96	2	6/5
4	1300	288/144	214/144	2	9/6
5	1600	352/176	255/176	3	11/8
6	1900	448/224	255/224	3	14/9

Capacity

 • Sized to your current need with support for more capacity as your network growth

 • 192 A itf (48 Ater mux) capacity, ie up to 5600 Erl per TC rack

Compactness

 • Compact equipment practice : 19" standard rack - only 2m height

 • Unrival compactness with only 3.75 liters per A interface

Flexibility

 • Rack sharing feature

 • Multiple BSCs connection simplifies your network design

A new generation TC
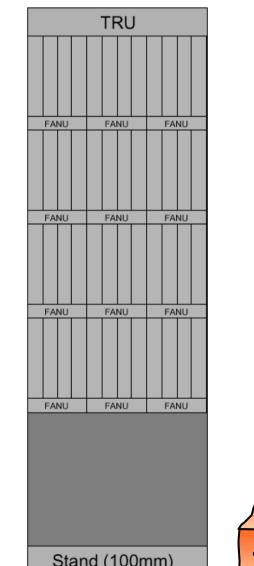*With built-in high-performance for maximum capacity*
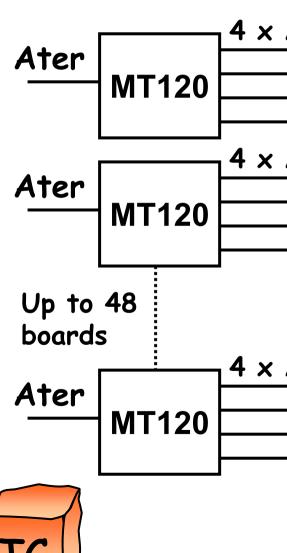
925 Transcoder

25 TC has capacity for 4
racks of up to 12
120 boards each, in a
al of up to 48 MT120
ards for each rack.
25 TC can transport
a of up to 24 BCS's
ing into account the
imum of two connected
120 boards to each
C.

```
┌─────────────────────┐
│         TRU         │
├─────────────────────┤
│ ││││││││││││││││││││ │
│ FANU    FANU    FANU │
│ ││││││││││││││││││││ │
│ FANU    FANU    FANU │
│ ││││││││││││││││││││ │
│ FANU    FANU    FANU │
│ ││││││││││││││││││││ │
│ FANU    FANU    FANU │
│                     │
├─────────────────────┤
│    Stand (100mm)    │
```

Ater — **MT120** — 4 x

Ater — **MT120** — 4 x

Up to 48 boards

Ater — **MT120** — 4 x
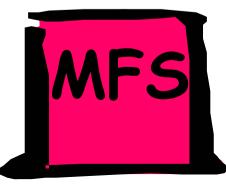
A935 MFS

- **GPRS** (General Packet Radio Service
- Data transmission based on packet Swithching instead of Circuit Swithcing
- Mail, Internet Browsing (Web Surfers) etc
- No end-to-end connection requirement no channel individual allocation, share resources between users

Up to 3500 Cells

OMC-R
(A 1353)

BTS

BTS

BSC

BTS

PCU
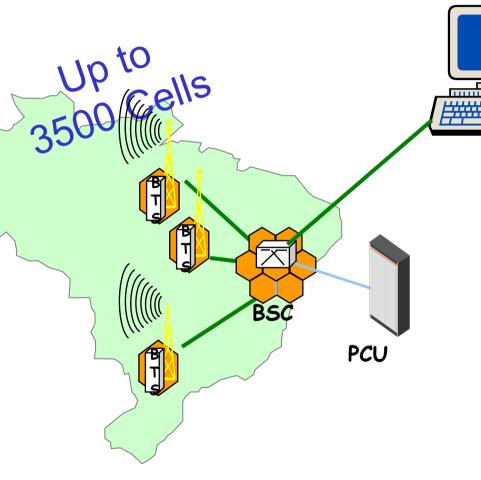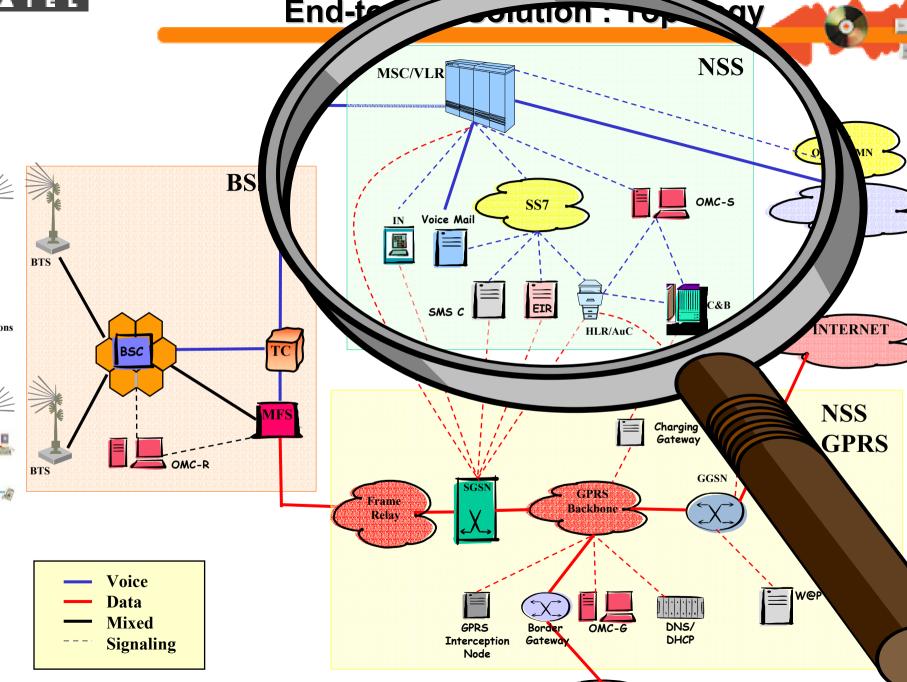
◆ Alcatel OMC-R is GPRS read

◆ One Platform Manages up to:

   ◆ 100 BSC, 3500 Cells

◆ Auto-Detection of BTS equipm

   (BSC Sync)

Only one OMC-R to control a whole region

NSS

MSC/VLR

IN

Voice Mail

SS7

OMC-S

SMS C

EIR

HLR/AuC

C&B

BS...

BTS

BSC

TC

MFS

OMC-R

BTS

ons

...MN

INTERNET

NSS
GPRS

Charging Gateway

GGSN

Frame Relay

SGSN

GPRS Backbone

GPRS Interception Node

Border Gateway

OMC-G

DNS/ DHCP

W@P

Voice
Data
Mixed
Signaling

Best-in-class capacity and performance

- From 2.5K to **1,000K** subs (2M*)
- From 36 up to **800K** BHCA (8M*)
- From 16 up to **2,048** PCM (16K*)

A vast array of features

- High revenue generation

- Lowest OPEX on the market
  - Low foot print: Up to **17** racks (400K subs)
  - Low consumption: Max **24K** Watts

Smooth evolution towards 3G solutions

Alcatel Evolium™ MSC

MSC today

No loss of air time with high peaks
Top quality service, non stop

HLR/AuC
A8360

Alcatel Evolium®

MSC/VLR

RCP/VLR

A1421   **IWF**

4 x E1 (MAP)

4 x E1
INAP   **k x E1**

PSTN/
ISDN

n x E1 (ISUP)

With Echo Canceller

m x E1
(A Interface)

A1000 E10 MM
SSP

BTS
BTS

BSC

BTS

BSC

BTS

BTS

BTS

ther Devices:

ile Collector

egister)

vice Center)

➢ **Up to 2 Million Subscribers**
➢ **STM-1 Interfaces**
➢ **Up to 4 RCP**
➢ **Low consuption 1,3kW per Rack**
➢ **Less than 22 Racks total**
  (SSP+RCP+IWF)
➢ **RCX/RCH Technologies**

BSS
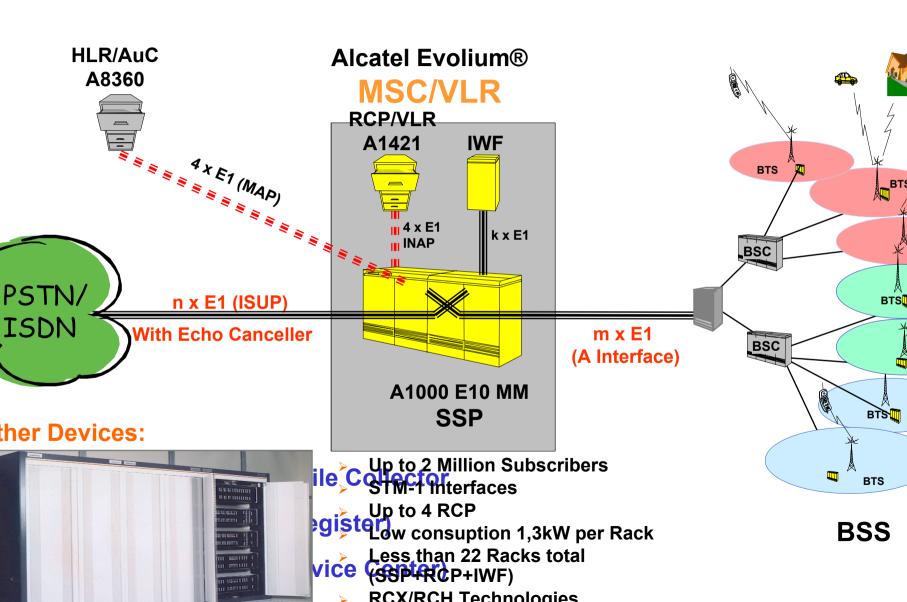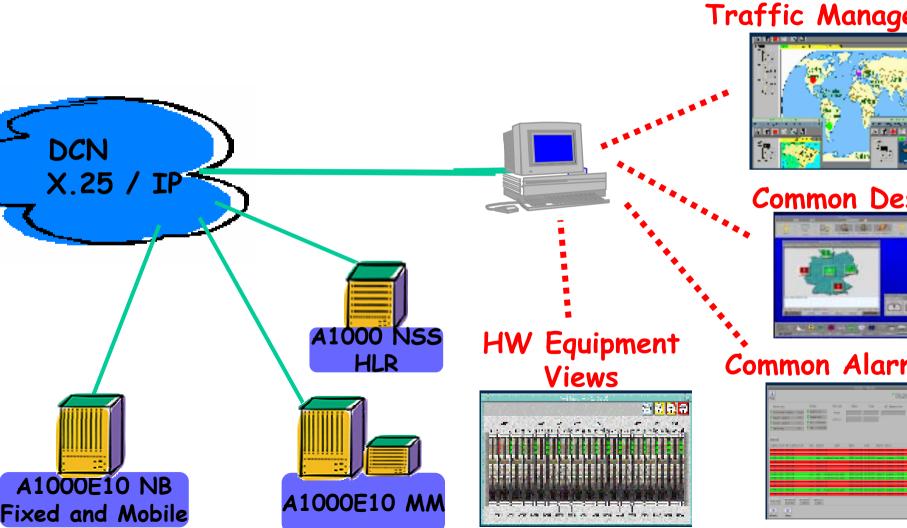
pervision of Alarms, Elimination of malfunctions, Performance Management,
ecurity Management
eating Subscriptions, Delating Subscriptions, Collecting Charging Tickets.

Traffic Manage

DCN
X.25 / IP

Common Des

A1000 NSS
HLR

HW Equipment
Views

Common Alarm

A1000E10 NB
Fixed and Mobile

A1000E10 MM

Agenda:

♦ **GSM Key Features**

♦ **GSM System Architecture**

BSS Subsystem

NSS Subsystem

♦ **Design Considerations**

Dimmensioning (Cells, Traffic, Users)

Spectrum and Coverage

♦ **Conclusions**
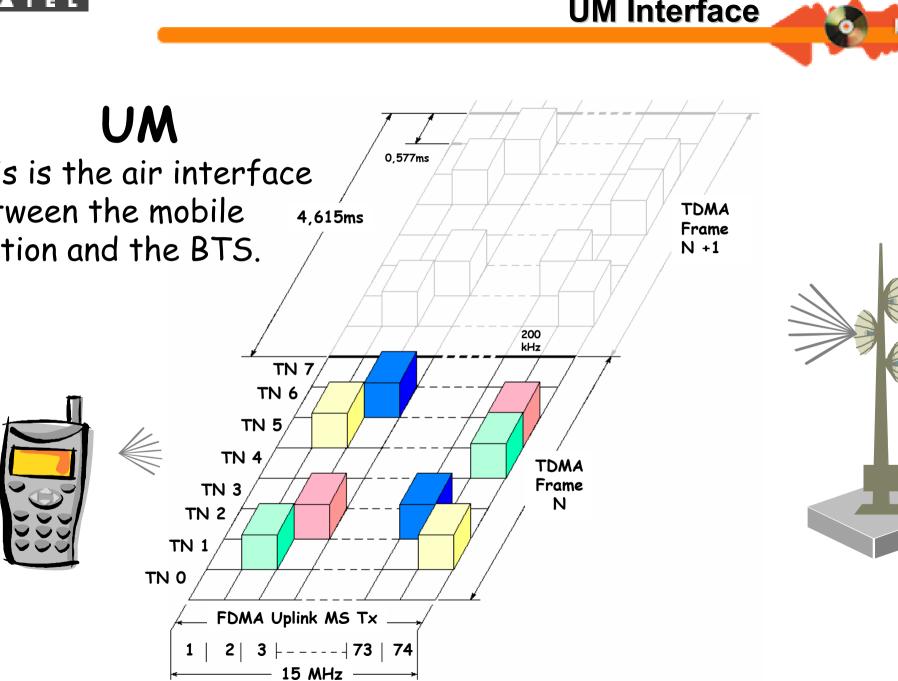
Interfaces

UM

is is the air interface
tween the mobile
tion and the BTS.

0,577ms

4,615ms

TDMA
Frame
N +1

200
kHz

TN 7
TN 6
TN 5
TN 4
TN 3
TN 2
TN 1
TN 0

TDMA
Frame
N

FDMA Uplink MS Tx

| 1 | 2 | 3 |------------| 73 | 74 |

15 MHz

UM Dimensioning

♦ Dual Rate total mobile penetration

♦ TRAFFIC VOLUME per subscriber (in mErl)

♦ Number of subscriber per cell

♦ TRAFFIC BLOCKING probability

GPRS Parameters

♦ Type of Services (Business, Consumer, …)

♦ Number of users per type of service

♦ Data Volume per user per Busy Hour (kbits)
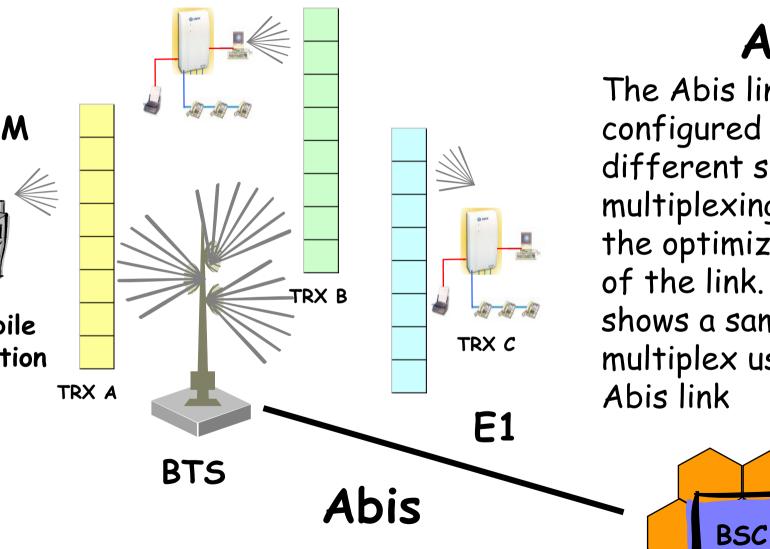
♦ Throughput per service

Optional!!!

Signaling Parameters at the Busy Hour

- CALL attempt (Mobile Originated)
- CALL attempt (Mobile Terminated)
- Short Message Services (Mobile Originated)
- Short Message Services (Mobile Terminated)
- LOCATION UPDATE
- IMSI ATTACH
- IMSI DETACH

Abis

The Abis link can be configured to use different schemes o multiplexing that fin the optimized occup of the link. The figur shows a sample of multiplex usage on th Abis link

M

bile tion

TRX A

TRX B

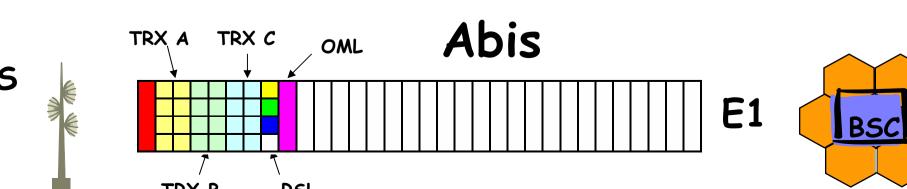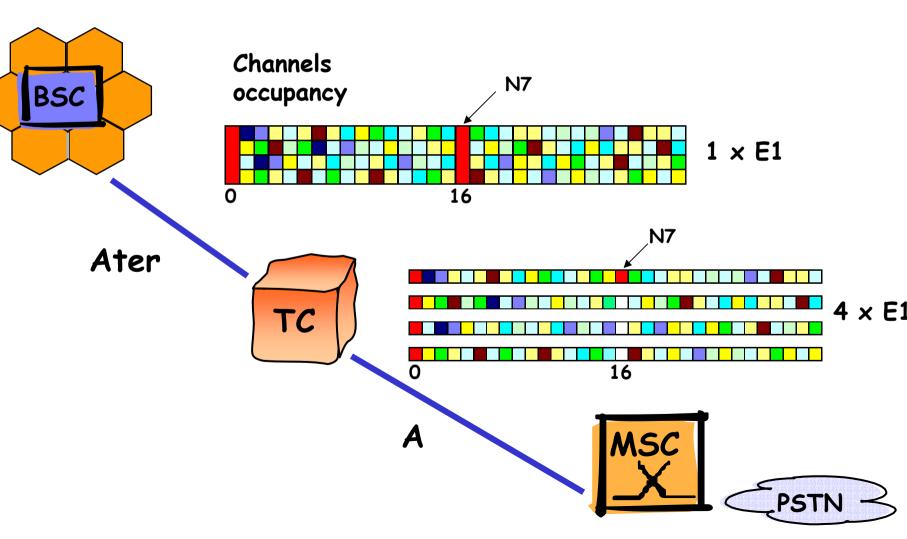TRX C

BTS

Abis

E1

BSC

Abis

The dimensioning of the Abis link is done according to the quantity of TRX, BTS's cabinets, cells and the type of multiplex used on the signaling. The usage of some features will also impact on the dimensioning of the Abis link. The following table shows just an example of occupancy on the Abis link.

Config	Abis Tim Slots (64k
O1	4
O2	6
O3	8
S11	6
S22	10
S33	15
S111	8
S222	15
S333	22

Abis

TRX A   TRX C   OML

S

E1

BSC

TRX B   DSL

Channels occupancy

N7

1 × E1

0

16

BSC

Ater

TC

A

N7

4 × E1

0

16

MSC

PSTN

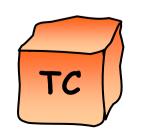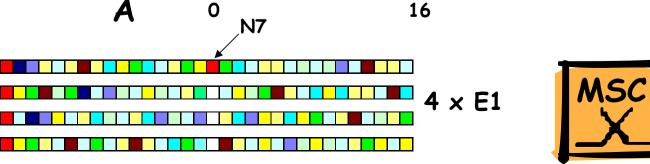| Blocking rate		0,10%
A interface	Ater interface	Traffic
1	1	15,50
2	1	39,00
3	1	63,50
4	1	89,00
5	2	115,00
6	2	141,00
7	2	168,00
8	2	195,00
9	3	222,00
10	3	249,00
11	3	276,00
12	3	303,00
13	4	331,00
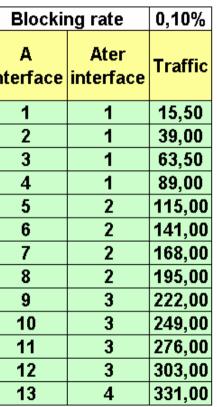
A Interface
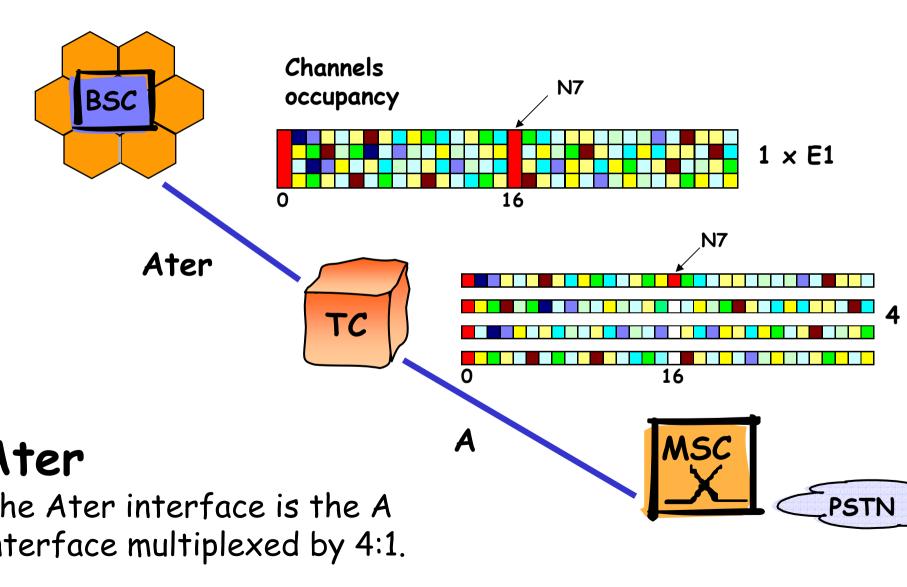
The calculation of the PCM's links used for the A interface is done according to the traffic generated by the BTS taking into account the busy channels only using the Erlang B law. The table shown presents an example of traffic capacity using Blocking Rate of 0.1%.
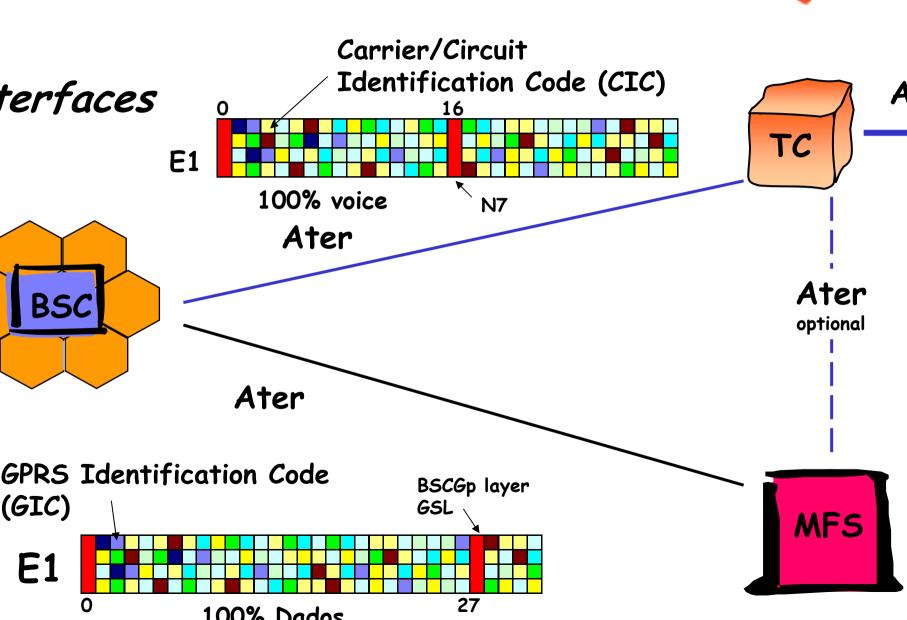
A   0   16
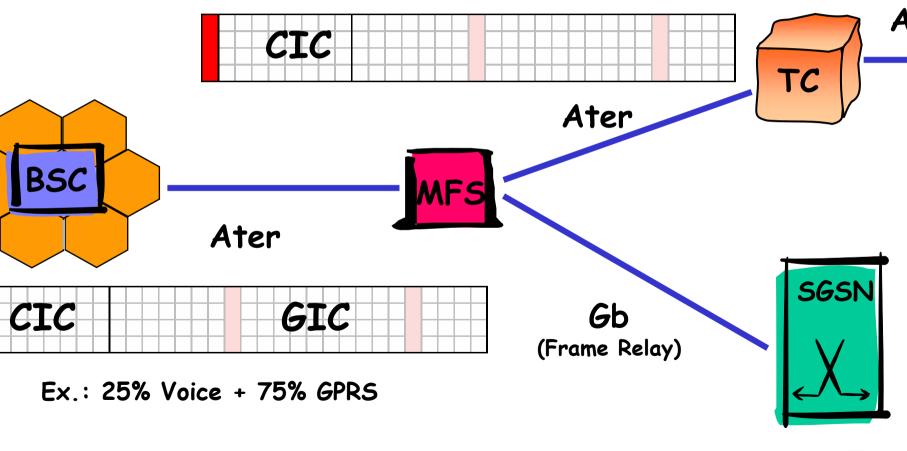
N7

TC

4 × E1

MSC

BSC

Channels occupancy

N7

0   16

1 x E1

Ater

TC

N7

0   16

4

A

MSC

PSTN

Ater

he Ater interface is the A
terface multiplexed by 4:1.

Interfaces

Carrier/Circuit Identification Code (CIC)

E1   0   16

100% voice

N7

Ater

TC

BSC

Ater

Ater
optional

GPRS Identification Code (GIC)

BSCGp layer GSL

E1   0   27

100% Dados

MFS

terfaces

CIC

BSC

Ater

MFS

Ater

TC

A

Gb
(Frame Relay)

SGSN

CIC GIC

Ex.: 25% Voice + 75% GPRS

INTERNET

Dimensioning examples:

onfig	Abis Time Slots (64kb/s)
O1	4
O2	6
O3	8
S11	6
S22	10
S33	15
S111	8
S222	15
S333	22

A925 TRANSCODER	
Maximum number of A interfaces	192
Maximum number of Ater interfaces	48
Maximum number of connected BSCs	24

Conf.	Number of BTS	Number of Cells	Number of TRX	Traffic (Erl)	Number of cabinets
1	23	32	32	160	1
2	95	128	128	627	1
3	142	192	192	1074	2
4	214	264	288	1300	2
5	255	264	352	1500	3
6	255	264	448	1900	3

Blocking rate		0,10%
A interface	Ater interface	Traffic
1	1	15,50
2	1	39,00
3	1	63,50
4	1	89,00
5	2	115,00
6	2	141,00
7	2	168,00
8	2	195,00
9	3	222,00
10	3	249,00
11	3	276,00
12	3	303,00
13	4	331,00

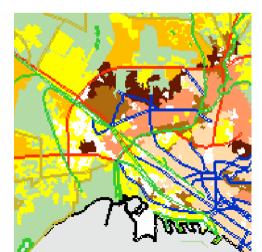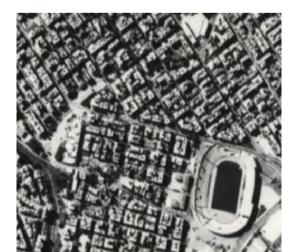# Coverage, Traffic and Design Parameters

Acquiring:

Maps (compulsory)

Aerial pictures (optional)

Digital database

(optional: used for Radio planning)

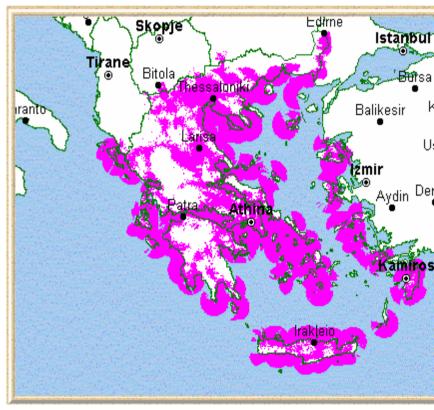# *Gathering all information about the existing sites*

- Coordinates

- Coverage area of each sector

- Antenna heights

- Infrastructure available

  - Antenna tower

  - Rooftop / Greenfield

  - Energy...
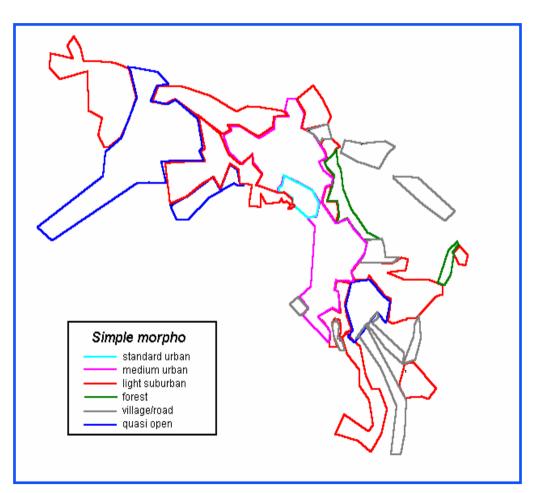
Land Usage

- Dense Urban,
- Urban,
- Suburban,
- Residential,
- Industrial,
- Forest,
- Village,
- Open area,...

Simple morpho

standard urban
medium urban
light suburban
forest
village/road
quasi open
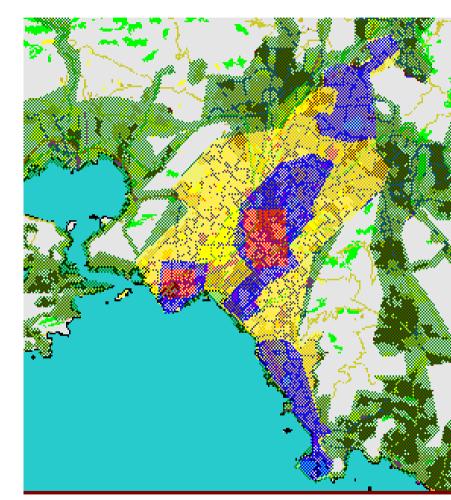
ype of services areas
nd typical margin

- Deep Indoor (20 db)
- Indoor first wall (15 db)
- In-car without car kit (10 db)
- Outdoor (0 db)

rade of service

- Coverage Probability (impacts Shadowing margin) typical:
  - ♦ 90 % (suburb and rural)
  - ♦ 95% (dense urban and urban)

ATHENS - DCS 1800 NETWORK - COVERAGE SERVICES

Indoor - 18 dB - Ph1: 90%, Ph2: 95%, Ph3: 97%

Indoor - 15 dB - Ph1: 90%, Ph2: 90%, Ph3: 95%

What kind of cell?

♦ Macro, micro,..pico

BTS System choice

♦ combining elements?

  ♦ ANC low loss, ANC combining mode, ANC+ANY, low los
    configuration….

♦ TMA, Range Extension Kit?

Antenna System:

♦ antenna type (gain, aperture), antenna height, feeder
  length...

Type		Combiner pre-equipment	ANc mode	Configuration	Total combiner stages	Output power in dBm at antenna connector for									
						GSM 850		GSM 900		GSM 1800		GSM 1800		GSM 1900	
						GMSK 45 W	8PSK 15 W	GMSK 45 W	8PSK 15 W	GMSK 35 W	8PSK 12 W	GMSK 60 W	8PSK 25 W	GMSK 45 W	8P 25
1	Standard	no	No Combining	ANc / Duplexer / Combiner	0	46.0	41.2	46.0	41.2	44.4	39.8	46.5	42.6	46.0	42
2	Prepared	(yes)	Combining	ANc / Duplexer / Combiner	1	42.6	37.8	42.6	37.8	41.0	36.4	42.7	39.5	42.6	39
3*)	Standard	no	Combining	ANc / Duplexer / Combiner / MP HP HP	0 & 1							42.7	39.5		
3	Standard	no	Combining	ANc / Duplexer / Combiner	1	42.6	37.8	42.6	37.8	41.0	36.4	42.7	39.5	42.6	39
	Pre-equipped	yes	Combining	ANc / Duplexer / Combiner / Combiner Combiner	2	39.1	34.3	39.1	34.3	37.5	32.9			39.1	36
4	oss	no	No	ANc Duplexer / ANc Duplexer											

	Type	Combiner pre-equipment	ANc mode	Configuration	Total combiner stages	Output power in dBm at antenna connector for									
						GSM 850		GSM 900		GSM 1800		GSM 1800		GSM 1900	
						GMSK 45 W	8PSK 15 W	GMSK 45 W	8PSK 15 W	GMSK 35 W	8PSK 12 W	GMSK 60 W	8PSK 25 W	GMSK 45 W	8P 25
5 6	Standard	no	Combining	ANc Duplexer Combiner / Combiner Combiner	2	39.1	34.3	39.1	34.3	37.5	32.9			39.1	3(
7 8	Low-loss	no	Combining	ANc Duplexer Combiner ANc Duplexer Combiner	1	42.6	37.8	42.6	37.8	41.0	36.4			42.6	3!
9 10 11 12	Low-loss	no	Combining	ANc Duplexer Combiner ANc Duplexer Combiner Combiner Combiner	1 & 2	42.6	37.8	42.6	37.8	41.0	36.4			42.6	3!

Output TX power at antenna connector

- **Macrocell model**
  - **Hata models**
    - large cells (cell range> 1 km), antenna. height (> 30 m)
    - Hata for 900 MHZ band
    - COST 231 Hata for 1800 MHZ
  - **Cost 231 Walfish-Ikegami Model**
    - small cells (cell range > 20 m)
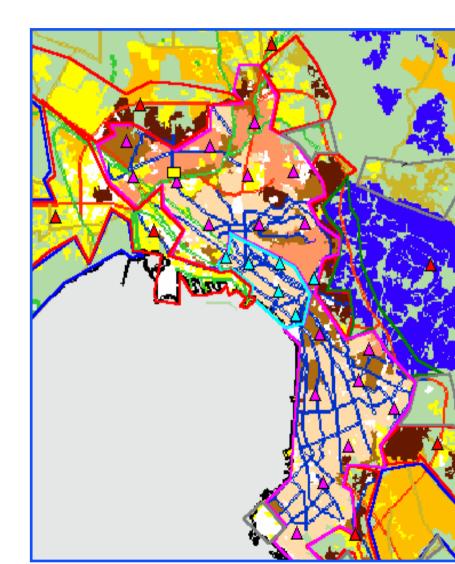- Microcells model : Ray tracing

Goal: Cells sites dimensioning to cope with ..

- coverage , traffic, and grade of service requirements

Output:

- Number of sites
- Site Configuration
  - Nb of sector
    - Three (Urban areas)
    - Two (Roads)

Coverage Approach

- Assume a max TRX per cell when choosing BTS system, nb_TRX_max

- Use a **Power budget** tool to determine a Cell radius

- Using cell_radius, calculate Site/Cell area

- Use Area size and site_area/cell_area to deduce number site/cells to cover the Area, namely nb_sites/nb_cells

Traffic Approach

- Use traffic per sub and nb sub in the area to deduce total traffic in the Area, named traffic_area

- Use traffic_area and nb_cells to calculate traffic_per_cell

- Use Erl_B_law(traffic_per_cell, blk_prob) to calculate nb_TCH

- Assume typical nb_SDCCH and use nb_TCH to calculate nb_TRX

Check

- Check that nb_TRX < nb_TRX_max (see previous slide)

- If No, assume another nb_TRX_max and perform again

Service parameters has dramatic effects on design results!

- ♦ 90% to 95% Pcov   --> 50% sites increase
- ♦ 15dB to 20dB Indoor margin   --> 100% sites increase

Cell Radius Figures

CELL RANGES FOR GSM 850 AND GSM 900		
Type Of Envioronment	**Aggressive**	**Conservative**
Dense Urban	1,2.....2,5km	0,5.....1,2km
Medium Urban	2,5.....3,8km	1,0.....1,6km
Residential	4,4.....6,3km	2,2.....3,1km
Agriculture	20,7.....29,0km	9,6.....11,5km
Open Area	33,4.....35,km	15.....18,1km

CELL RANGES FOR GSM 1800 AND GSM 1900		
Type Of Envioronment	**Aggressive**	**Conservative**
Dense Urban	1,0.....1,7km	0,3.....0,5km
Medium Urban	1,2.....2,0km	0,4.....0,7km
Residential	2,0.....3,2km	0,6.....1km
Agriculture	9,5.....14,3km	9,6.....11,5km
Open Area	33,4.....35,km	15.....18,1km

•**Full Rate:**

AMR FR			
TRX / Cell	Erl / Cell	Subs / Cell	Subs / Site 3 Sector
1	2,93491864	294	882
2	7,40182161	743	2229
3	14,0363426	1409	4227
4	20,1520691	2022	6066
5	27,3447495	2744	8232
6	32,8334236	3295	9885
7	40,2582932	4041	12123
8	46,8174515	4699	14097

•**Half Rate:**

AMR HR			
TRX / Cell	Erl / Cell	Subs / Cell	Subs / Site 3 Sector
1	5,08460236	510	1530
2	11,9718952	1201	3603
3	21,9315529	2201	6603
4	29,6887131	2980	8940
5	40,2582932	4041	12123
6	49,6402702	4983	14949
7	59,1256256	5935	17805
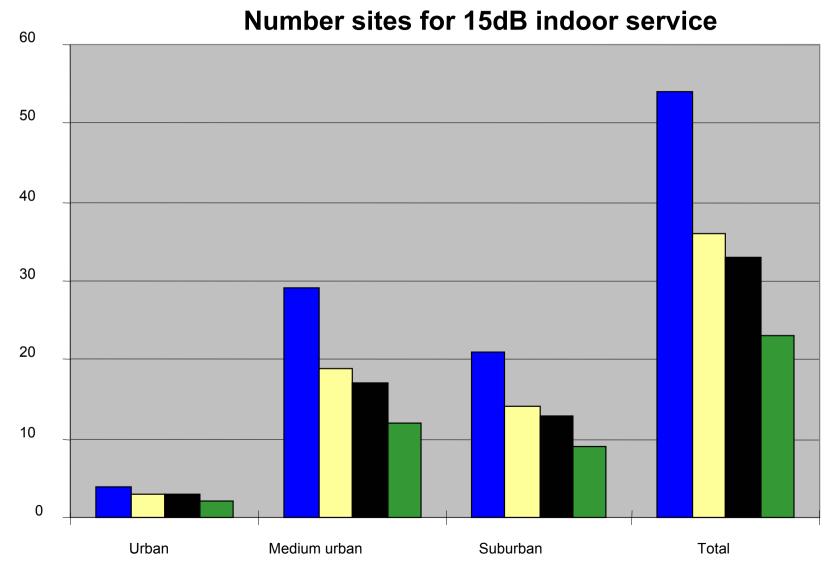
BANDWIDTH FIGURES								
Type of Fractional Reuse	1 x 3	1 x 3	1 x 3	1 x 1	1 x 3	1 x 1	1 x 1	1 x 1
# of TRX / sector	1	2	3	4	5	6	7	8
Signal Ch / Cell (Fixed)	1	2	2	3	3	4	4	5
FR (Erl)	2,93	8,20	14,90	21,04	28,25	34,68	42,13	48,70
Min. Bandwidth	3	3,4	4,8	6,3	7,8	9,2	10,8	12,5

Number sites for 15dB indoor service

Legend:
- ■ Range with Pcov = 95%
- □ Range with Pcov = 90%
- ■ Range with Pcov = 95% & Air Comb.
- ■ Range with Pcov = 90% & Air Comb

ANNEXES

- Purpose: determine the Maximum Allowable Path Loss between Transmitter and Receiver, both in Up and Downlink

- Example in GSM 1800: (reminder X dbm = 10*Log(Y mW))

  - UpLink:

    - BTS transmits with 35 W (45.44 dbm),

    - handset receives with - 102 dbm sensitivity

  - DownLink :

    - handset transmits with 1 W (30 dbm)

    - BTS receives with - 111 dbm sensitivity

Link Budget

Project

File name 1800_ANC_NC_HP   Comments..

System GSM 1800   **MS** Classe 1

		Uplink	Downlink
RX	Rx input sensitivity (dBm)	-111.0	-100.0
	Cable loss + connector (dB)	2.9	0.0
	Junction box loss (dB)	0.0	
	Ext Dux or Cpl Dev loss (dB)	0.0	
	Rx antenna gain (dBi)	18.0	0.0
	Diversity gain (dB)	4.0	
	TMA contribution (dB)	2.6	
	Isotropic pw 50%Ps (dBm)	-132.7	-100.0
TX	Tx output peak pw (dBm)	30.0	46.2
	Cable loss + connector (dB)	0.0	2.9
	Junction box loss (dB)		0.0
	Tx Cpl dev loss (dB)		0.0
	External duplexer loss (dB)		0.0
	TMA insertion loss or REK gain (dB)		0.5
	Tx antenna gain (dBi)	0.0	18.0
	EIRP (dBm)	30.0	60.8
Margins	Slow fading margin (dB)	5.8	5.8
	Interf. degrad. margin (dB)	3.0	3.0
	Penetration margin (dB)	20.0	20.0
	Body loss margin (dB)	3.0	3.0
	Cross polar. antenna margin (dB)	0.0	0.0
	User margin (dB)	0.0	0.0
	Required pw at ant. receiver (dBm)	-100.9	-68.2
	Allowable path loss (dB)	130.9	129.0

Site-Morpho-Service:

SMS name dense_urban

Morpho Class	RNP (actual)
Morpho	Medium city1
Service	Indoor, deep
Coverage probability (%)	95.0
Slow fading margin (dB)	5.8
Interference margin (dB)	3.0
Penetration margin (dB)	20.0
Body loss (dB)	3.0
Cross polar. margin (dB)	0.0
Path loss correc. (dBm)	-3.0
Cable length (m) / loss (dB)	40.0 2.4
BTS antenna height (m)	30.0
Diversity gain (dB)	4.0

Range (Km)   **0.76**

Inputs needed:

- Libraries of Equipment characteristics
  - BTS
  - Mobile handsets
  - antennas
- Subscriber's area distribution (per morphostructure)
- Services definition

Output: Computation of path loss

- various environments
- balance uplink / downlink
- Cell radius calculation

Dimensioning Inputs

- **General Information**

  - Number of GSM subscribers

    Specify per phase if necessary

  - Service : full GSM mobility / Fixed GSM subscribers

  - Minimum number of MSC

    1 by default

  - % of Prepaid subscribers

- **Services Information**

  - % of subscribers with a conditional call forwarding activated

  - Number of Supplementary Services Interrogations

Dimensioning Inputs

- Traffic

  - Average Traffic per Subscriber (OT+TT)

    Specify if Prepaid and Postpaid traffic are different or identical

  - Mean Call duration (in seconds)

  - Overload coefficient in Traffic (LoadB/LoadA)

Dimensioning Inputs

- Traffic

  - % Fax / Data calls

    by default 1%

  - Mean Call duration for Fax/Data (in seconds)

  - Number of originating SMS calls (Nb/MS/h)

  - Number of terminating SMS calls (Nb/MS/h)

  - Direct calls towards Voice Mail (% on OC and duration)

  - Forwarded calls towards Voice Mail (% on Rerouted calls and duration)

  - % of MS using conference

Dimensioning Inputs

◆ IN characteristics

- % of IN call

- Type of IN used (IN-CS1, Camel Phase1, Camel Phase2,...)

- Type and characteristics of (Prepaid, VPN,...)

- Intelligent Peripheral required (digital announcement, DTMF reception,...)

Dimensioning Inputs

- Interface Information

  - SDH/STM1 interface possible on PLMN/PSTN

    - Possible if the customer has a SDH Network and ADM connection available

  - Signalling (standard ISUP V2, R2 signaling,...)

    - By default 100% ISUP V2

  - Trunk Impedance (75ohms, 120ohms)

  - Number of Signalling links (towards SMSC, Voice Mail, SCP, others switches,...)

  - Number of PCM towards SMSC, Voice Mail, SCP,...

▽ Mobility

♦ Location Registration

- Intra VLR Location Updates

  Per MS per hour

- Inter VLR Location Updates

  Per MS per hour

Handover

➢ HO number of intra-MSC handovers Inter VLR Location Updates
  Per MS per hour
➢ HO number of subsequent inter-MSC handovers
  Per MS per hour

➢ Mobility

➢ Roaming

  ➢ RO Ratio of HLR subscribers visiting other networks (out-roamers) (%

  ➢ RO Ratio of MSC subscribers coming from other networks (in-roamer (%)