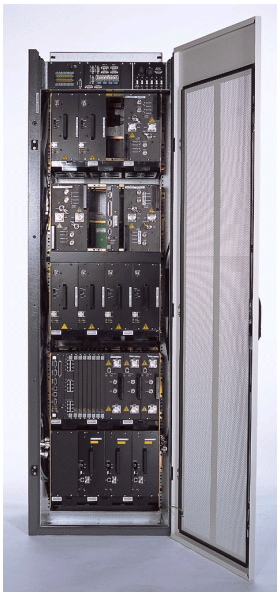
EVOLIUM™ A9100 Base Station

Product description



4.6 Extended cell configurations

To provide a continuous coverage minimizing the number of sites is the goal of all operators. Particularly difficult is to reach this goal in sparsely populated areas, because of the 35 kilometers limitation in cell size stipulated by GSM recommendations.

The Extended-cell technology, which allows reaching a coverage range of up to 70 km, is a solution in low traffic density areas as rural areas, highways, off shore, desert areas, isles in coastal vicinity...

Due to the propagation limitation constraint of GSM 1800 and GSM 1900 frequencies, the extended cell solution is used only for GSM 900.

An extended cell is composed of one EVOLIUM™ BTS including two sectors. The first sector handles inner-cell traffic up to 35 km; the second sector handles outer-cell traffic, from 33 km to a maximum of 70 km. Depending on the needed traffic, each sector can include from 1 up to 4 TRX.

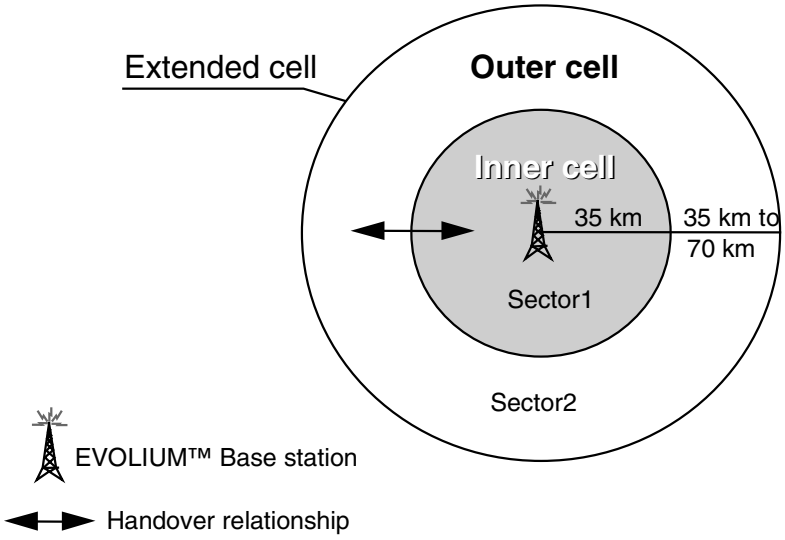


Figure 21: Extended cell principle

To compensate for the propagation delay of bursts from mobiles located in the outer cell, the receiver of the outer cell BTS is delayed. The inner cell is barred and the receiver of the Inner cell BCCH TRE is tuned to the outer cell BCCH frequency. Wherever the mobile is located (Inner, Outer or overlap zone) it always camps on the outer cell (for initial access). If the mobile is located within the Inner cell, the channel for the Inner cell will be allocated by the Outer cell. Because the Inner cell is barred, the Inner cell must be completely covered by the Outer cell area.

Active call mobiles moving from the inner cell to the outer cell, or vice versa, will be handed over to the complementary cell respectively. Mobiles leaving the extended cell coverage will be handed over to an appropriate neighbor cell which can be either a normal or an extended cell. This clever use of hand-over procedures is in full accordance with standard GSM parameters.

To achieve the coverage range up to 70 km for the Outer cell, the use of high gains and high height antennas or the use of either a range extension kit (REK) or a TMA is advised.

Extended cell EVOLIUM™ BTS using Range Extension Kit (REK):

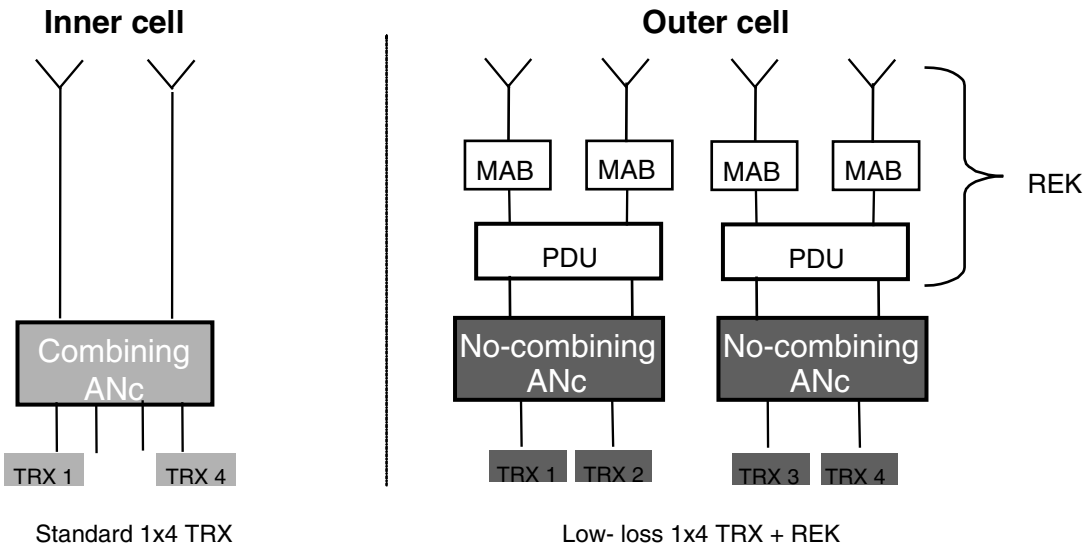


Figure 22: Extended cell EVOLIUM™ BTS using Range Extension Kit (REK)

Extended cell EVOLIUM™ BTS using Tower Mounted Amplifier (TMA):

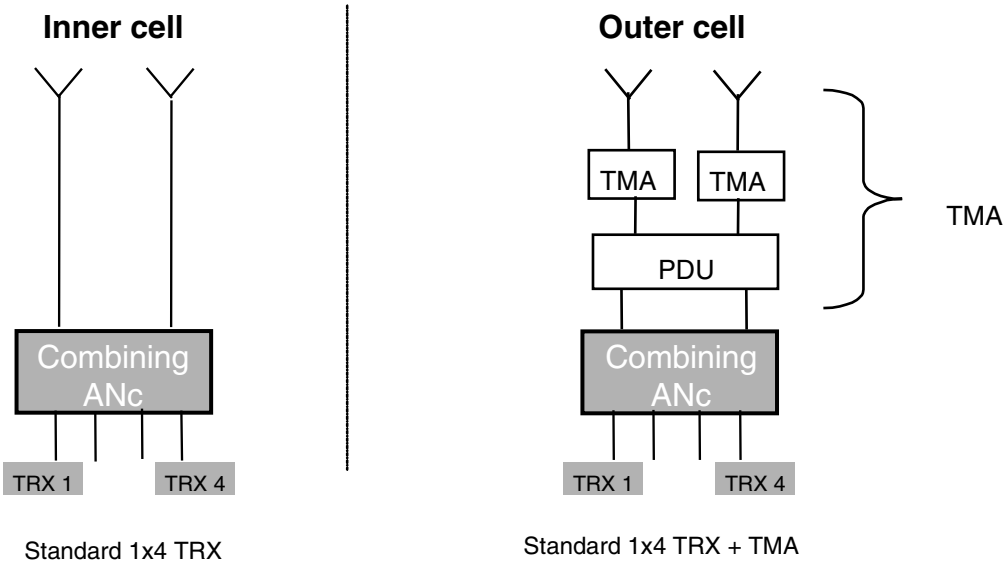


Figure 23: Extended cell EVOLIUM™ BTS using Tower Mounted Amplifier (TMA)

Therefore the possible configurations with associated Outer cell coverage (as examples) are:

MBI5 Indoor	Low-tree / Outdoor* Outer cell range	Open area/ Outdoor* Outer cell range	Agriculture/ Outdoor* Outer cell range
Inner cell: Standard 1x..4 Outer cell Low-loss 1x..4 with REK	52 km	70 km	70 km
Inner cell: Standard 1x..4 Outer cell Standard 1x..4 with TMA	38 km	70 km	65 km

*: 19 dBi antenna gain

4.7 Options

4.7.1 Range extension kit

4.7.1.1 Functional description

The Range Extension Kit (REK) is intended to provide operators with enhanced coverage solutions (in uplink and in downlink) applicable to a variety of practical situations (in terms of mobile environment). The range extension kit has been designed as an add-on to the complete family of EVOLIUM™ A9100 Base Stations; it shall be applicable whenever a maximum coverage range is sought, provided that there is no coupling of TRX in the cell (in fact, the REK is not broadband).

The REK has been designed so as to compensate the feeder losses encountered in most of the practical situations (up to 10 dB, allowing to use 1/2" thin cables) and to provide 62 dBm maximum EIRP with a balanced link budget. It is available in the GSM 900 band, and can be used with indoor or outdoor BTS.

The overall design of the range extension kit is consistent with the architectural options selected for EVOLIUM™ A9100 Base Stations: Use of duplexed outputs and of the air-combining scheme. Further-more, it is intended for use with antenna systems featuring one separate transmit antenna per radio channel.

The range extension kit is composed of two functional blocks:

- A two-way amplification module (called the *Mast-head Amplification Box* or *MAB*) to be installed close to the antenna, featuring Power Amplification (PA) downlink and Low-Noise Amplification (LNA) uplink, along with proper supervision means.

- A Power Distribution Unit (PDU) provides power supply and alarm interface for two MABs. It is located at the BTS site, either wall-mounted close to the BTS in the case of an indoor site or integrated inside the BTS cabinet in the case of an outdoor BTS.

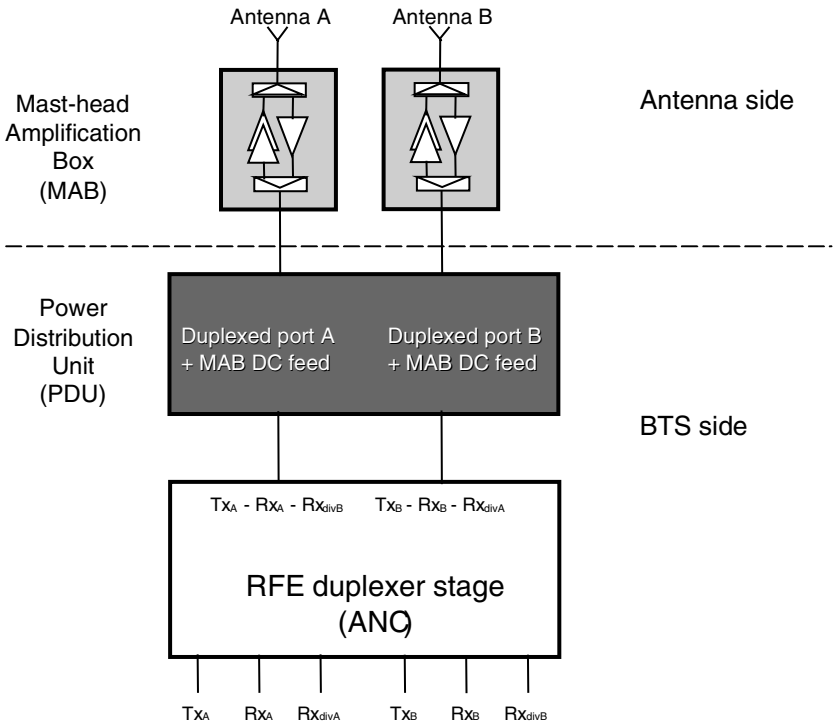


Figure 24: REK - Functional block diagram

4.7.1.2 RF performance

- Downlink, the output power of the mast-head equipment (including output filter) is 44.5 dBm (28 W) +/- 1.5 dB. To adapt the amplifier to the different BTS types and antenna cable losses, the REK is equipped with a fixed attenuator (8 dB) and a variable attenuator (from 0 to 15.5 dB) in front of the amplifier. The power amplifier of the MAB is 24.4 dB and the max nominal MAB gain, for variable attenuator set to 0 dB, is 14.1 dB (this corresponds to MAB gain minus the different losses (fixed attenuator (8 dB), loss ar MAB input (0.85 dB) and loss after amplification (1.45 dB)).
- Uplink, the receiver amplifier is made of a single balanced stage of high-performance LNAs. The maximum overall gain measured from the antenna input to the output of the MAB is 16 dB for GSM 900. The receive amplifier includes a manually settable attenuator at its output, allowing to decrease the gain by 10 dB in 1-dB steps in order to adapt for the different cable lengths.

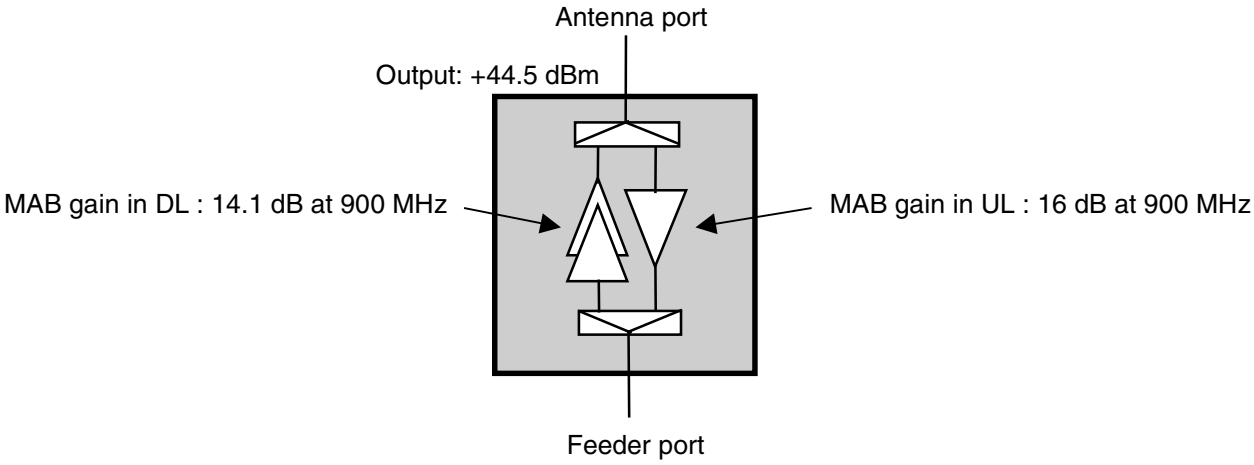


Figure 25: REK - RF characteristics of mast-head amplification box

4.7.1.3 Configurations

The REK is applicable to a wide variety of A9100 indoor and outdoor configurations in GSM 900. The main constraint is that there must be no TX coupling in the BTS, i.e. only one TRX can transmit on each antenna (one MAB per TRX); therefore there must be (at least) as many antennas as TRXs.

One PDU is required per two TRXs and these two TRXs do not need to belong to the same sector, e.g. the 3x1-TRX configuration requires only two PDUs (and three MABs).

The PDU can be housed in an outdoor cabinet in the optional sub-rack with up to three PDUs capacity.

The possibilities are summarized in the following table:

Configuration	Number of PDU per sector	Number of MAB per sector
Standard 1TRX/sector	1	1 if diversity not required
Standard 1TRX/sector	1	2 if diversity required
Standard 2TRX/sector	1	2
Low-loss 3TRX/sector	2	3 if diversity not required
Low-loss 3TRX/sector	2	4 if diversity required
Low-loss 4TRX/sector	2	4

4.7.2 Tower-mounted amplifier

4.7.2.1 Functional description

A significant part of the benefits brought by the outstanding sensitivity of the EVOLIUM™ A9100 Base Station can be lost if the losses incurred by signals along the feeder cable between the receiving antenna and the antenna coupling module (ANc) are too high. As a matter of fact the noise factor of the system is degraded by an amount depending on the feeder loss.

The basic idea of tower-mounted amplification is to implement a low-noise amplifier as close as possible to the antenna (figure below), so as to compensate for all losses incurred by received signals. The TMA solution can be used in GSM 900 or 1800, indoor or outdoor configurations.

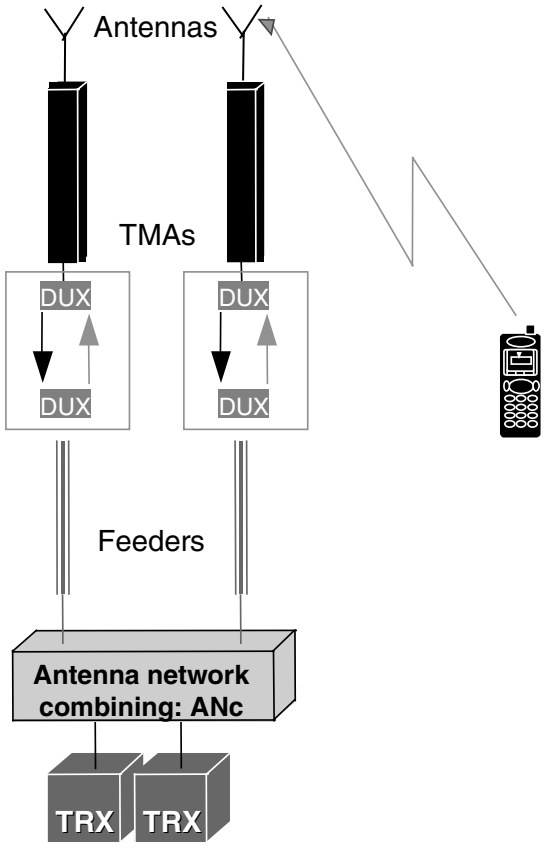


Figure 26: Principles of tower-mounted amplification

Tower-mounted amplification appears as an efficient sensitivity enhancement technique; however, both uplink and downlink power budgets must be considered for the calculation of the coverage range: The smallest available path loss determines the range. In that respect, tower-mounted amplification can be beneficial in those cases where system performance is limited by a weaker uplink budget (for example when using GSM 1800 High-Power TRX without the combiner module - *twin wide band combiner stage*-ANy).

On the other hand, in the case of a balanced uplink/downlink situation, the introduction of tower-mounted amplification can be an efficient mean to reduce the output power level of all mobile stations. The uplink power control mechanism provided at each base station will force all mobiles to reduce their emission level. Two benefits can be obtained in that case:

- A lower output power favorably impacts the standby time of every mobile station,
- A lower output power can contribute to minimize the 'electromagnetic pollution' within the service area.

In summary, the decision to exploit tower-mounted amplification may be influenced by system design considerations but also result from the application of the operator's internal policy.

The counterpart of getting a better sensitivity by means of a tower-mounted amplifier is the risk to degrade the blocking and intermodulation characteristics of the base station if the value of the amplification gain greatly exceeds the value of the feeder losses. The attention of operators is drawn to the fact that, in such a case, the site equipment might not fully comply with ETSI requirements settled in the GSM recommendation 05.05.

All EVOLIUM™ A9100 Base Stations are compatible with tower-mounted amplifiers, provided the following requirements are fulfilled:

- The TMA shall allow for one single feeder to be used for transmit and receive signals,

- The TMA shall be equipped with duplexers, allowing for the splitting of uplink and downlink signals with at least 30 dB isolation. The transmit signal shall be bypassed to the antenna and the receive signal shall be amplified by a low-noise amplifier.

- Multiband configurations are possible only if the signals used in each antenna are monoband (in fact, TMA module which is used per antenna, is monoband).

4.7.2.2 Equipment description

The TMA system is basically made of three part parts (Figure below):

- The mast-head TMA. Note that the LNA of the TMA has a gain depending on the frequency band (e.g. 14 dB for GSM 900), but the TMA solution gain, which takes into account all the UL reception chain (e.g. feeders loss) is 4 dB in GSM 900 and GSM 1800. Note that this TMA can provoke intermodulation and/or blocking in the mobile, if the antenna is installed in a height less than 20 meter.
- The bias tee, used for insertion of the DC voltage in the RF antenna cable to feed the TMA. The proposed bias tee is suited for GSM 900 and GSM 1800.

- The Power Distribution Unit (PDU) is used for the power supply for the TMA units itself and for alarm monitoring (via BTS external alarms).
  The PDU is designed to supply and to monitor up to six TMAs (typical BTS configuration 3x2 TRXs), independently from their frequency band (i.e. same PDU equipment can be used with TMA of GSM 900 or 1800. In fact PDU has no frequency notion).

  For indoor-BTS installations the PDU can be installed in a separate transmission cabinet and be powered by the BTS UPS. For outdoor-BTS configurations the DC supply should be provided by the BTS power supply and the installation is possible in the BTS cabinet. However, an AC PDU with outdoor characteristics could also be used.

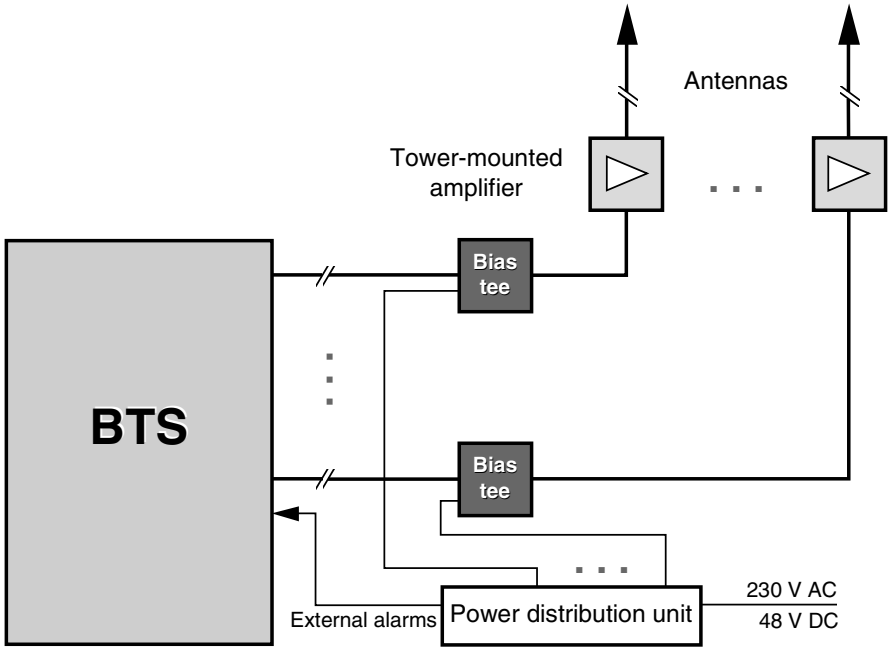


Figure 27: TMA principle of installation

4.7.3 Transmission equipment

For the outdoor BTS, transmission equipment can be integrated in the options space of the cabinet : 19” (5U) in MBO1 and 19” (5U + 7U) in MBO2. Two types of transmission equipment are possible:

- Line termination equipment for 75-ohm or 120-ohm wires (NTL). The NTL equipment is used to amplify the PCM signal received from A-bis interface.
- Baseband unit for microwave (IDU).

These equipment depend on the country and customer requirements and are defined on a case by case.

In MBI and in MBO, we can also integrate up to 3 PIDUs.