UMTS900 / GSM900 co-locating

We have solutions for your UMTS900 deployment

To deploy UMTS on the 900 MHz band, operators want to re-use their existing GSM900 sites for obvious easiness and economical reasons.

This paper provides a general survey of the possible solutions usable for such deployment.

The first idea is to add an antenna per sector that will operates UMTS besides the antenna that already operates GSM. But this solution is very often not so easy because an additional antenna (so in practice three new ones per site) may oblige to face degraded visual impact, new building permit, increased loans, increased pylon wind load, local authority concern …

This is why another way is also implemented, based on sharing the existing GSM antenna for the UMTS. This can be done by using "same band combiners" that couple the GSM and UMTS signals before feeding them to the antenna.

It is important to note that UMTS900 usually requires the use of a TMA (Tower Mounted Amplifiers) to amplify the received signals (uplink limited system). So even if the existing GSM900 network is not using TMAs, going to UMTS900 will need to install such units. This will imply the need to climb up the tower.

At Jaybeam Wireless, we offer products that cover almost any installation scenario. Consult us to analyse what fits the best your deployment strategy.

Separate Antennas for GSM and UMTS

UMTS on 900 MHz can use the same type of antennas as GSM900 so it can benefit from the wide range of existing antennas which is still being improved. Fig.1 below is a photo of one of Jaybeams' newest "SLIM LINE" antennas that covers the 900 MHz band.

Fig. 1

Adding antenna on an existing GSM site will provide the typical configurations depicted by Fig.2 where for each sector the two antennas are installed beside each others. One antenna is dedicated to UMTS900 and the other to GSM900.

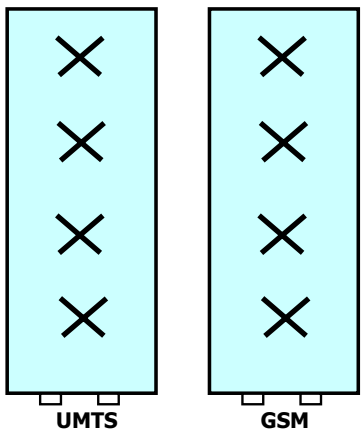


Fig. 2

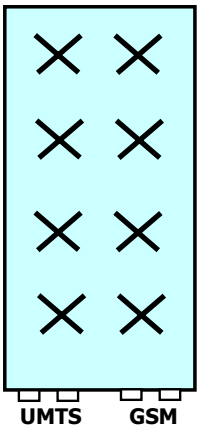


Fig. 3

Although simple to envisage, this configuration has obviously a negative impact regarding the visual aspect. An improvement is possible by swapping the existing GSM antenna to a "double 900 MHz" one. In such antenna, the two radiating arrays are fitted in a unique enclosure, as in Fig.3. It provides a less wide installation and lower wind load on the mast.

Separate antennas for UMTS900 and GSM900	
Advantages	*Disadvantages*
- No impact on existing GSM900 network - Electrical downtilt on GSM and UMTS can be different	- Need new antennas - Need new feeders - Degrade visual aspect - Increase structural constraints

Antenna sharing between GSM and UMTS

There are two possible ways to connect a UMTS900 Node-B and a GSM900 BTS to one unique antenna:

- hybrid combining
- same band combining

Using the same physical antenna for UMTS900 and GSM900 imposes to accept that both networks will be using identical electrical downtilt in a sector.

Antenna sharing with Hybrid combiner

Hybrid combiners are components frequently used to couple two carriers in multiple frequencies GSM900 BTS. They can be used similarly to couple UMTS and GSM signals and provide a shared feeding to a common antenna. Installed close to the BTS and the Node-B, they allow re-using the existing two feeders.

Hybrid combiners use wideband 3dB/90° couplers with the penalty of very high losses (3.2 dB).

Hybrid combiners	
Advantages	*Disadvantages*
- No additional antenna - No new feeders required - No tower climb if no TMA is added (serious constraint in uplink sensitivity)	- High loss in downlink (UMTS900 capacity loss !) - Existing GSM900 network too much impacted - Same electrical downtilt for UMTS and GSM

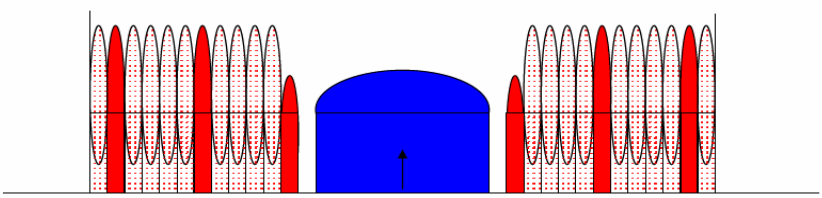
Because of so high loss and the impact on the GSM network performances, hybrid combiners are not a practicable solution for UMTS900 deployment.

Antenna sharing with Same Band Combiner

As UMTS900 and GSM900 have different carrier frequencies, combiners based on filtering can be used to couple signals. By carefully design of the filters, low insertion loss is possible including for downlink paths.

Recommendations about the frequency arrangement for UMTS and GSM signals within the allocated GSM channels are given in *EEC Report 82 – "Compatibility study for UMTS operating within the GSM 900 and GSM 1800 frequency bands"* which suggests also frequency spacing of 2.6 MHz between UMTS carrier and nearest GSM carrier. The figure below is copied from this report.

In order to avoid or minimise the interference between two operators, it is suggested for the operator who plans to deploy UMTS and GSM in the same band that it is better to use the so called "Sandwich" frequency arrangement as shown below.



Suggested frequency arrangement for an operator deploying one UMTS carrier

The design of the Same Band Combiner takes the benefit of this frequency arrangement and the corresponding spacing, or variations of it, for the tuning of its filters.

A TMA can be included inside such Same Band Combiner and will share its own filtering (for Tx/Rx duplexers) with the Combiner filters.

A passive same band combiner does not have an internal TMA functionality. It will be installed close to the BTS and the Node-B, in connection with a TMA installed close to the antenna. Fig.4 is a typical block diagram of such installation.

An active same band combiner has an internal TMA on uplink paths. It will be more likely installed close to the antenna to get the benefit of the internal low noise amplifiers (LNA). Fig.5 is a typical block diagram of such installation.

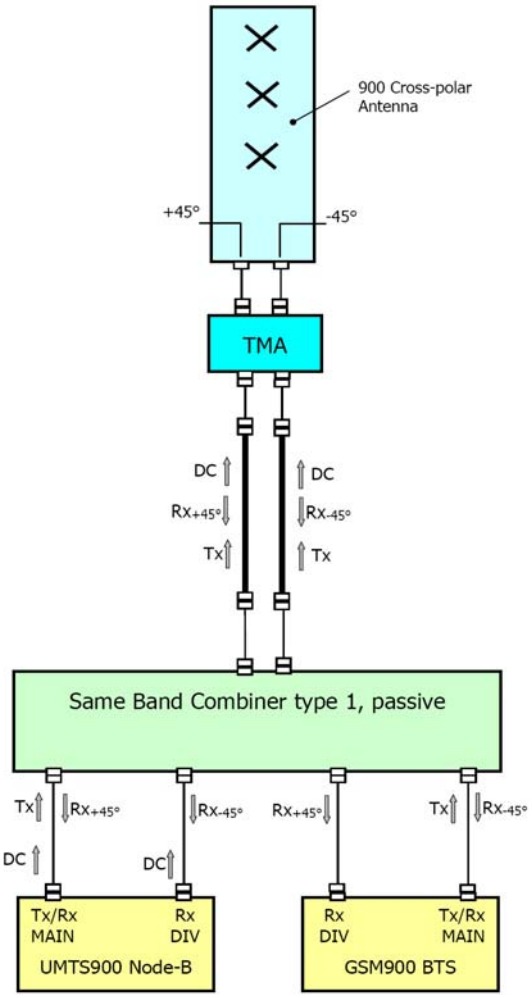


Fig. 4

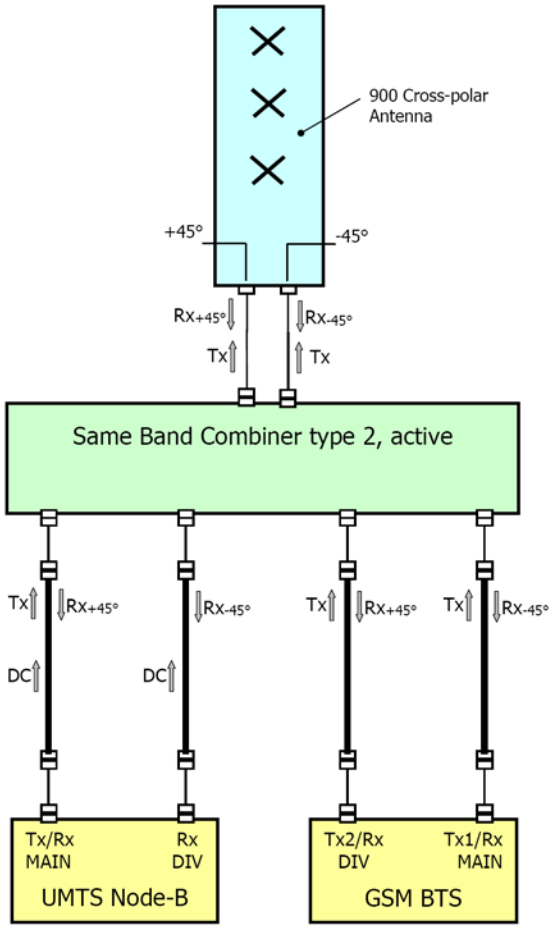


Fig. 5

In the above figures, one combiner is called 'type 1' and the other is said 'type 2'. This is not linked to the fact that it is active or passive.

A type 1 combiner (passive or active) can combine one GSM carrier and one UMTS carrier. Note that the GSM BTS is shown with Tx on its main port only in Fig.4.

A type 2 combiner (passive or active) can combine two GSM carriers and one UMTS carrier. Note that the GSM BTS is shown with Tx on its main port and on its diversity port in Fig.5. Of course this capability is obtained with added complexity in the combiner itself. But it avoids the use of a hybrid coupler to combine the two GSM carriers (mostly inside the BTS) and preserves losses (3dB extra downlink power per carrier).

Fig.6 shows a typical active combiner. Usually, its internal TMA is monitored through the AISG protocol. It can have an additional AISG connector for the remote control of the antenna electrical downtilt.

A passive combiner is smaller as it has no TMA and no electronic control board inside. It has DC through to both antenna ports for the TMA power supply. This DC through can also pass AISG signals on the RF cables for the TMA monitoring and the antenna electrical downtilt control.

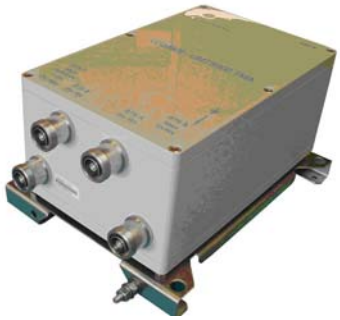
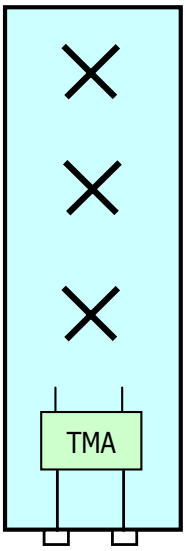


Fig. 6

'Passive' same band combiners	
Advantages	*Disadvantages*
- No additional antenna - No new feeders required - Low insertion loss in downlink (0.8 dB) - No tower climb if no TMA is added - Can be designed as type 2 for two GSM carriers capability	- 4 dB insertion loss in uplink - Tuned to operator allocated GSM sub-band - Same electrical downtilt for UMTS and GSM

'Active' same band combiner combiners	
Advantages	*Disadvantages*
- No additional antenna - No new feeders required - Low insertion loss in downlink (0.8 dB) - Internal TMA avoid installation of a separated one - Can be designed as type 2 for two GSM carriers capability	- Needs additional feeders for UMTS900 - Tuned to operator allocated GSM sub-band - Same electrical downtilt for UMTS and GSM

Combiner and TMA embedded inside Antennas

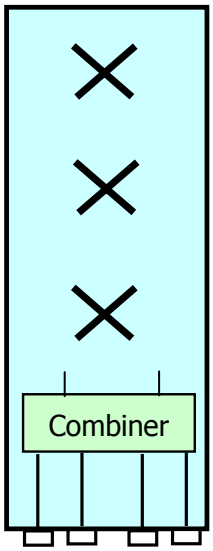


The installation of a TMA or an 'active' combiner always slightly impacts the visual aspect of the site (additional 'boxes', flying jumper cables).

Jaybeam have designed unique range of flat TMAs and combiners that can be installed inside the antenna, at the back of the radiating array. Antenna length is not impacted, only its depth is slightly increased.

The visual aspect, once installed on site, is very close to a standard antenna. This family of embedded antennas can help the operator massively to deploy UMTS900 without concern of local authorities or site owners because the physical site aspects are not being changed.

Identical/unchanged visual site layout is not the only benefit! RF performances are also improved because the jumper cable losses are avoided and the RF link between TMA or combiner and the antenna array is extremely minimized. Thanks to the reduced losses in front of the low noise amplifiers, the total RF system sensitivity is considerably improved, which improves directly the cell range and capacity!



The benefits of such solutions are detailed in *"Embedded Antennae White Paper" by Geoffrey Woodcok*. Ask us to send you this white paper if you have not read it already.