**Algumas das publicações geradas pelos projectos MBS e SAMBA**

## 60 GHz GaAs MMIC technology for a high data rate mobile broadband demonstrator

- U. Guttich, A. Plattner, +8 authors M. Chelouche
  1996 IEEE MTT-S International Microwave Symposium Digest

A millimeter-wave front end demonstrator for broadband pico-cell networks has been developed using 60 GHz GaAs MMIC technology. The following sub-assemblies are integrated in the demonstrator: a 56.8 GHz phase locked LO, an upconverter from 5.2-6.2 GHz IF to a 62-63 GHz band, a double-channel low noise downconverter from the 62-63 GHz band to an IF of 5.2-6.2 GHz, and a power amplifier for the 62 GHz to 66 GHz band. For a duplex operation a second upconverter module operating at 65-66 GHz (IF 8.2-9.2 GHz) is used. All monolithic HFET and PHFET circuits are realised using subquarter micron technologies. For the fully assembled receivers overall noise figures of less than 10 dB have been measured. Field tests have proven the ability to transmit data nearly error free over a distance of 200 m.

## Mobile Broadband System. A report on the work of RACE Project 2067

- John Zubrzycki
- BBC Report 1996-12, Jan 1996

Mobile Broadband System (MBS) is a wireless cellular radio network capable of carrying digital signals at bit rates sufficient for digital video, including compressed HDTV. The technological feasibility has been studied in RACE Project 2067 MBS, which had the aim to extend the Broadband Integrated Services Digital Network (B-ISDN) to mobile users, providing much higher capacity to users than current digital mobile cellular systems. MBS potentially offers broadcasters a public system to obtain dial-up high bit-rate connections for electronic news gathering. Also broadcasters could set up their own cellular systems at outside broadcasts and in studios in order to make greater use of radio-cameras and radio-microphones. The benefits of using MBS-compatible hardware is the economics of scale expected from its introduction as a public network. The results of trials of an MBS technology demonstrator are reported, which confirm the feasibility of millimetric-waveband transmission of digital video at 60 GHz. The success of the RACE MBS project has given rise to a new ACTS project called SAMBA (System for Advanced Mobile Broadband Applications) to continue the development of MBS into an operational system.

## Mobile broadband system (MBS): trends and impact on 60 GHz band MMIC development

- M. Chelouche, A. Plattner

- Electronics and Communications Engineering Journal, Volume 5, Issue 3, June 1993, p. 187 – 197, DOI: 10.1049/ecej:19930035

The RACE mobile broadband system (MBS) project aims to extend the broadband integrated services digital network (B-ISDN) to mobile users. To meet the future demand for broadband wireless picocell networks, frequencies have been allocated in the 62-63 and 65-66 GHz bands. However, for the use of a mobile broadband system to become widespread it is necessary to develop relatively low cost transceivers based on millimetre wave GaAs P-HEMT MMICs. A transceiver architecture and elementary building blocks have been defined. 60 GHz transistor models have been refined and circuit design, layout and simulation achieved. Future cost decrease is a function of the MMIC manufacturing yield, since a high yield allows a higher layout density and consequently fewer MMICs per transceiver, and of the improvement in packaging techniques above 60 GHz.

## Technology and demonstrator of the RACE project "Mobile Broadband System"

- A. Plattner
- 1994 IEEE MTT-S International Microwave Symposium Digest, DOI: 10.1109/MWSYM.1994.335504

At present, data rates of mobile communication systems are restricted to a few hundred kbit/s whereas the potential for fixed data links reaches the Gbit/s range due to the use of optical fibres. The European research project "Mobile Broadband System" which is partly sponsored by the European Commission within the RACE programme has the ambitious goal to define the system, develop the technology and build a Demonstrator which shall be able to transmit more than 34 Mbit/s in a mobile environment. This paper describes the development of the required MMIC-technology and the envisaged MBS-Demonstrator which shall be able to transmit a 16 Mbit/s digital video signal from a mobile station to a base station. In addition to the MM-wave head which uses MMIC's for most of the functions a great challenge is also the development of an equaliser which shall adapt the filter coefficient to the channel characteristics at up to 50 km/h vehicle speed.

## Shaped coverage of elongated cells at millimetrewaves using a dielectric lens antennas

- Carlos A. Fernandes, Paulo O. Francês, Afonso M. Barbosa
- 1995 25th European Microwave Conference, DOI: 10.1109/EUMA.1995.336918

A reasonably uniform coverage with significant ground reflection discrimination can be obtained at 60 GHz over an elongated cell like a section of a street a few hundred meters long, or like a long indoor corridor by using a conveniently designed dielectric lens antenna. The lens is fed directly by the waveguide open-end, and its 3D surface is shaped so that the antenna gain ideally compensates the free space attenuation at each direction wihin the cell limits, and falls-off outside this region. This lens antenna was developed in the framework of the European RACE II R2067-MBS project, to

equip its Demonstrator. In this communication, the actual yielded coverage in a long indoor corridor and the fading of the received signal are compared with the performances of conventional rectangular horns when used in the same type of cells, showing a significant improvement.

### Shaped Dielectric Lenses for Wireless Millimeter-Wave Communications,

- C. A. Fernandes,
- IEEE Antennas and Propagation Magazine, Vol. 41, No. 5, pp. 141 - 150, October, 1999,

Dielectric lens antennas are effective to produce highly shaped beams that can enhance the performance of wireless broadband communication systems. Beam shaping is used to reduce multi-path interference that causes fading and delay spread, and to enhance gain so that the received power level is compatible with the requirements of high data rate transmission. This paper presents an overview of the design, and measured performance of some examples of dielectric lenses that can be used in typical scenarios of wireless broadband communication systems. The paper also addresses the radiocoverage produced by these antennas. The lenses are based on a single basic configuration where the feed is embedded in the lens body. This antenna configuration is flexible enough to accommodate different target beam shaping specifications.

### Performance of Lens Antennas in Wireless Indoor Millimeter-Wave Applications

- C. A. Fernandes, J. Fernandes,
- IEEE Transactions on Microwave Theory and Techniques, Vol. 47, No. 6, Part 1, pp. 732 - 737, June, 1999,

Dielectric lens antennas can be designed to produce highly shaped beams that significantly improve the system performance in emerging wireless indoor millimeter wave systems. A lens configuration is analyzed in this paper that produces a circularly symmetric cell with uniform spatial power distribution, with fairly sharp boundaries and scaleable cell radius. The last characteristic is used to control the reflections at side walls. A hemispherical coverage lens antenna is designed for the mobile terminal to ensure relatively free movement. The impact of these antennas is analyzed in terms of cell coverage and channel time dispersion, considering the effect of cell radius scaling, and mobile terminal antenna tilting. Measurements and simulations show that the proposed lens antennas outperform common solutions based on pyramidal horns or biconics.

### Impact of Antenna Choices on the Reliability of Mobile Broadband Transmission at Millimetre-Wave Frequencies

- António Gusmão, Rui Dinis & Paulo Silva
- Chapter In: Goodman, D.J., Raychaudhuri, D. (eds) Mobile Multimedia Communications. Springer, Boston, MA. https://doi.org/10.1007/978-1-4899-0151-4_31

Abstract
This paper deals with the impact of several antenna choices on the radio transmission performance within a cellular Mobile Broadband System (MBS) currently under research in Europe. Several antenna types are considered, namely switchable-beam antennas and adaptive antennas employing a phased array approach. Several simulation results are presented and discussed: they show that some directivity in the MS antenna is recommendable for an acceptable performance, and that the proposed adaptive MS antennas can be of interest for MBS, namely for advanced system implementation stages.

## Radio Transmission and Experimental Channel Characterisation Using an MBS Platform Operating in the 40 GHz Band.

- Mota, S., Silva, A., Dinis, M. et al.
- Wireless Personal Communications 21, 245–267 (2002) https://doi.org/10.1023/A:1016092020045

his paper focuses on results obtained in the ACTS SAMBA project. The project's main objective was the implementation of a Trial Platform providing a full duplex radio link of 34 Mbit/s to prove the technical feasibility with today's technology and to evaluate the main MBS functionality for the public cellular MBS segment. Thus, extensive field trials were carried out in the city of Aveiro, Portugal, in different environments and using the 40 GHz band. The paper starts with an introductory analysis of the radio channel impairments and discusses the various appropriate mitigation techniques. A brief description of the SAMBA Trial Platform used in the measurements campaign is presented concentrating on the description of the main technical solutions related with the physical layer. Then, representative measurements results collected in an urban and in an indoor environment are analysed so as to evaluate the system performance, focusing on the cell coverage area and transmission quality. This study is made analysing parameters such as: received power level, bit error rate, fitted Rice distribution parameters to model the small-scale fading, power level cumulative distribution functions, level crossing rate and average fade duration of the signals received in the two diversity antennas and the resulted signal after combination. The achieved results constitute a significant forward step for the MBS development.

## Traffic from Mobility in Mobile Broadband Systems

- Fernando J . Velez and Luis M. Correia
- Telektronikk – Strategies in Telecommunications Vol. 94, Nº 3/4, pp. 95 - 111, December, 1998.

Models allowing the study of the influence of coverage distance and velocity on the supported traffic and on the new calls traffic linear density are examined, and results are obtained for typical scenarios in a Mobile Broadband System (MBS) with a linear coverage geometry. For systems without guard channels for handover, for a fixed bounding value for the blocking probability, the new calls traffic linear density was analyzed, increasing with the decrease of the maximum coverage distance, R, being upper limited by a value which depends on the characteristics of the mobility scenario. However, call-dropping probability requirements also need to be fulfilled, leading to a new calls traffic density that only increases with the decrease of R down to an optimum value of R, and being lower for scenarios with higher mobility. These optimum values of R are higher for scenarios with higher and higher mobility, leading to limitations in system capacity, mainly for high mobility scenarios. In order to resolve these limitations, the use of guard channels for handover is studied, particularly for high mobility scenarios. For these scenarios one concludes that there is a degradation in system capacity because, for the typical coverage distances foreseen for MBS, the new calls traffic linear density is one order of magnitude below the values obtained for the pedestrian scenario (where it is approximately 15 Erlang/km), decreasing from 2.47 Erlang/km, in the urban scenario, down to 0.84 Erlang/km, in the highway scenario, when two guard channels are used.

## Impact of mobility in mobile broadband systems multi-service traffic

- F.J. Velez; L.M. Correia
- 12th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications. PIMRC 2001

Abstract:
Multi-service traffic engineering has a strong impact in mobile broadband systems (MBS) revenues, and it will allow one to obtain merit functions for optimisation purposes, a key aspect in cellular planning. MBS applications have access to different service components, with different data rates and average durations. Fast mobility has an important impact in handover failure probability, hence, in system capacity. While in the business city centre and other urban scenarios mobility has no significant effect, it affects the supported traffic in main roads. A reduction of up to 54% may come as a consequence.

## Frequency Reuse and System Capacity in Mobile Broadband Systems: Comparison between the 40 and 60 GHz Bands,

- F. J. Velez, L. M. Correia, J. Brázio,
- Wireless Personal Communications, Vol. 19, No. 1, pp. 1 - 24, August, 2001

This paper addresses the comparison of characteristics between the bands of 40 and 60 GHz, prospectively allocated for Mobile Broadband Communication Systems. The key difference between

the two bands is the oxygen absorption, which is negligible at 40 GHz, but presents high values at 60 GHz, decreasing from 14 dB/km (at 62 GHz) down to approximately 1 dB/km (at 66 GHz). The impact of this excess absorption is two-fold: on one hand it reduces the received signal power but on the other hand it also reduces the co-channel interference. These two quantities may not suffer the same amount of reduction, and hence differences in the reuse pattern may result. The results show that for the regular coverage geometries the difference in the reuse pattern obtained in both bands is not relevant, a value of 3 being achieved. Differences however exist in the range of maximum coverage distances values at 43.5 GHz being up to 20% larger than at 66 GHz. For irregular urban geometries the results obtained from specific cellular layouts, show that the reuse pattern is the same for both bands (in the range 5–7) for the range of coverage distances where the system operation interference limited (say, for coverage distances less than 124 m). Again, larger coverage lengths can be achieved at 40 GHz, although with a higher associated reuse pattern.