

THE MARKET FOR SHORT-HAUL LINE-OF-SIGHT MILLIMETERWAVE TRANSMISSION LINKS

Cellular-Telephone-Distribution and Video-on-Demand in Europe

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Abstract - GSM type telephone systems have become a global standard today. In such a digital network, mobile CELLULAR-TELEPHONEs communicate at 0.9 or 1.8 GHz within cell sizes of 1 to 20 km in diameter; groups of five to 20 of these cells have to be linked to a controller-station. This is the first *valuable niche market*, where millimeter radio fits in. Wireless CATV with projects like CellularVision, utilizing defined spectrum allocations at 28 and 42 GHz, respectively, are the basis for another upcoming market: VIDEO-ON-DEMAND, i.e. interactive television transmission and teleconferencing. This is the second *valuable niche market*, where millimeter radio fits in. The actual market situation - upcoming trends and development directions - with emphasis on Europe, will be reviewed in this paper.

INTRODUCTION

Today the field of mobile communication is moving rapidly, GSM (Global System for Mobile communications) type telephone systems have become a worldwide standard. In such a digital network, mobile CELLULAR-TELEPHONEs communicate at 0.9 or 1.8 GHz within cell sizes of 1 to 20 km in diameter; groups of five to 20 of these cells, i.e. transceiver base-stations, have to be linked to a controller-station. This is the first *valuable niche market*, where millimeter radio fits in, as digital mobile communication is the 'rising star', not only in Europe [1], but worldwide. Table 1 shows today's mobile communication distribution in some areas of this world [2].

Wireless CATV with projects like CellularVision - currently tested in Brooklyn, NY, USA and Hongkong - , utilizing defined spectrum allocations at 28 and 42 GHz, respectively, are the basis for another upcoming market: VIDEO-ON-DEMAND,

i.e. interactive television transmission and teleconferencing. This is the second *valuable niche market*, where millimeter radio fits in.

SHORT-HAUL line-of-sight TRANSMISSION LINKS for PCN's

In Germany, for example, there are 2 million subscribers today within the three already existing digital mobile communication networks: D1, D2, and *eplus*. For the year 2,000 10 to 15 million users are previewed [2]. Taking into account the maximum capacity of the existing networks - D1 and D2 at 900 MHz having a capacity of 2 million user each, while *eplus* at 1,800 MHz provides space for 8 million users - a fourth digital network will be necessary to be licensed in the near future; preparations have started already [3].

Due to flexibility reasons and based on the important demand of a quick installation time *short-haul line-of-sight transmission links* are very advantageous for connecting the base stations of such PCN's with their corresponding switching centers [4], fig. 1. Depending on the hop length being necessary topologywise, the use of 23, 38, 55 or 58 GHz links is appropriate. Table 2 shows the corresponding Channel Plan and Equipment Regulatory Specifications, being proposed in 1990 by the Radiocommunication Agency of London, UK [5], which today is commonly used as a general standard for industry in countries where no official frequency assignment is available yet.

As an example, a total requirement of 16, 000 38 GHz-T/R-units can be estimated to be necessary for the German DCS 1800 mobile telephone

network, *eplus*, before completion of the installation in 1998; more than 2,500 units are installed already. Starting with an estimated number of 8,000 to 10,000 base stations to cover all of Germany, 85 % of which will be wirelessly connected and 80 % of these wireless connections will be at 38 GHz (German topology), with a redundancy factor of 30 % and two frontends per transmission link, the above number can be calculated. Spare units for maintenance and redundancy for 'hot spots' are not taken into account yet, as special re-routing capabilities might enlarge this number even further.

This is just one provider network. While the network provider of the German D2 network -Mannesmann - has just joined with Skoda (Cz) to apply for the license of the first czech GSM network [6], one of the major stakeholders of *eplus* - Thyssen Steel - is part of the consortium to build the french DCS 1,800 network, starting in 1996. As of October 1994, at least 92 GSM systems were operational or in 'statu nascendi' worldwide [7].

WIRELESS CABLE and VIDEO-ON-DEMAND

Unlike conventional cable, "*wireless cable*" systems do not require hardwired infrastructure or signal amplification. The system uses an addressable, multichannel, high-frequency signals, operating along a line-of-sight path to a customer's antenna. Using, e.g. the 27.5 to 29.5 GHz band, a virtually unused segment of the spectrum previously reserved for point-to-point commercial networks, CellularVision of New York (Freehold, NJ) is currently providing a point-to-multipoint distribution system with 49 video channels in the Brighton Beach section of Brooklyn. The system uses a 12.7 cm flat plate antenna at the user's premises. Service prices are significantly lower than that of cable [8]. For services in Europe a frequency of 42 GHz has been provided.

TECHNOLOGY and REALIZATION

Until today in most cases hybrid millimeterwave technology is employed predominantly. However, MMIC technology is incorporated now, as it has become available. A good example of the earlier is

millimeterwave radio type 40 DR - delivered to **northern telecom Europe, Ltd.** of Paignton [9], England and manufactured by MRC (Microwave Radio Corporation), a subsidiary of California Microwave in the US.

A MMIC based system, like the *millimeterwave radio type MDL 38*, has been delivered by **Philips-TRT** of Paris, France [10], and is one of the first 38 GHz systems for applications requiring connection of 1 to 4 x 2.048 Mbit/s bit streams. It is homologated and in service in various countries worldwide (e.g. Europe, Oceania and Latin America).

Another MMIC based system, the *millimeterwave radio type S3000 - 38*, built by **Hughes Communication** of Torrance, CA, USA, is part of a line of fully integrated millimeterwave transceiver products, designed specifically for wireless data and voice communication applications. Using 64 QAM/SONET type modulation, up to 154 Mbit/s bit streams can be transmitted over a maximum range of 10 miles [13].

Alpha Industries of Methuen, MA, USA, the major MMIC chip supplier in this field nowadays has shipped more than 2,000 *monolithic 38 GHz chip-sets worldwide in 1994, with an actual shipping rate of 700 per month in autumn 1995* [11]. Fig. 2 displays the unique situation of Alpha Industries as a key-player in this field - providing 38 GHz chip-sets for most of the major equipment manufacturers [12].

CONCLUSION

The actual market situation and the foreseeable future trends - Hughes, for example, estimates a worldwide demand of about 200,000 to 250,000 units until the end of 1998 [13], while Siemens evaluated the "component quantities required" to "about 10 K per system and frequency in Europe" [14] - clearly shows the large market of Cellular-Telephone-Distribution and Video-on-Demand for short-haul line-of-sight millimeterwave transmission links.

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Germany	2.5 %
England / USA	6 %
Skandinavia	10 %
Hongkong / Singapore	30 %

Table 1: Mobile communication distribution today from [1]

TRAFFIC CAPACITY	Frequency		
	38 GHz	55GHz	58GHz
	Channel	Spacing	(MHz)
2 Mbit/sec	14	25	100
8 Mbit/sec	28	50	100
34 Mbit/sec	56	75	100
140 /155 Mbit/sec	140	150	tbd
Narrowband TV	28	tbd	100
Colour TV / Radar Remoting	56	tbd	100
GO/RETURN Spacing (MHz)	1260	> 500	N/A
Frequency Stability (+/- MHz)	4	9	36

Table 2: Channel plan and equipment regulatory specifications from [5]

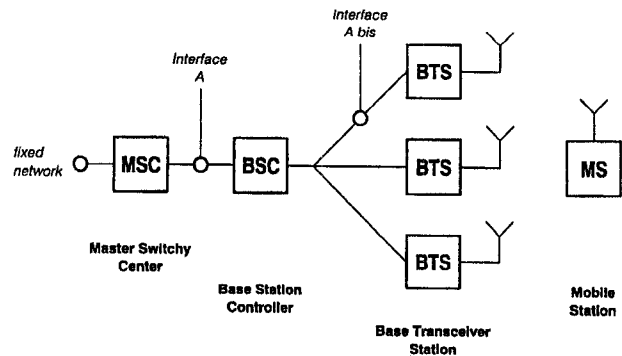


Figure 1: Network architecture for a GSM type system

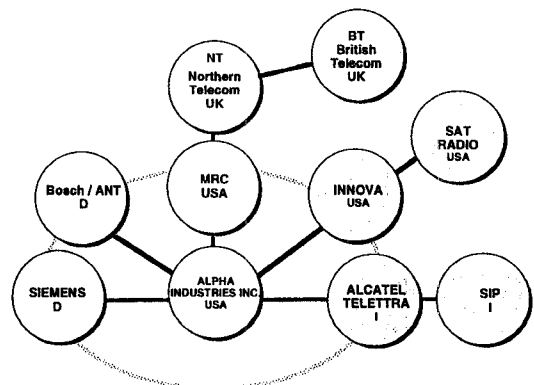


Figure 2: 38 GHz short-haul transmission-links worldwide key-players and their connection to Alpha-Industries

