TSG-RAN Meeting #11 *RP-010198*
Palm Springs, CA, USA, 13 - 16 March 2001

(BRAN22d115, to TSG-RAN) LS on HIPERACCESS

Chairman of ETSI Project Broadband Radio Access Networks
Jamshid Khun-Jush, Dr.-Ing.
Ericsson Eurolab Deutschland GmbH
Ericsson Research, Corporate Unit
Nordostpark 12
D-90411 Nürnberg, Germany
Tel: +49 911 5217260 / Fax +49 911 5217961
Email: jamshid.khun-jush@eed.ericsson.se

Date: February 2, 2001

TO: 3GPP and UMTS forum

Dear Ms Kooistra and Dr Eylert,

ETSI Project BRAN is standardising a point to multipoint access system, HIPERACCESS, which in our assumptions might be used as a backhaul for UMTS, as explained by Annex 2 (extract from HIPERACCESS System Overview). In our understanding a PMP microwave system might be useful to connect several B nodes to the RNC.
HIPERACCESS will provide both dynamic bandwidth allocation and provisioned capacity; the real exploitation of the potential advantages of HIPERACCESS in this field
requires a deep analysis and consideration of the characteristics of the traffic within UMTS cells and specific requirements to be fulfilled.

We already recognized the following areas of investigation about which we would appreciate your comments and suggestions. Of course general comments about the suitability of a point to multipoint microwave system as UMTS backhaul and any other suggestions will be welcome.

- **Interfaces and signaling protocols:**

  As far as we understand, node B interfaces are ATM based: E1/T1 ATM, E1/T1 IMA, E3/T3 ATM, STM-1 ATM. For small & medium B Nodes the most widely used interface will probably be E1/T1 IMA. Therefore, HIPERACCESS shall support one or more of these interfaces and the bandwidth allocation protocols will have to guarantee the QoS requirements of ATM connections that UMTS will generate. It would be very helpful if you could provide us enough information about this and eventual signaling protocols that should be supported.

- **Capacity Partitioning:**

  In case of using the same carrier for UMTS Backhaul and other applications then an appropriate capacity partitioning mechanism is required to support the required capacity of

UMTS Backhaul applications. About this item you could warn us of potential problems if an operator would try this kind of optimization.

- **Spectrum**:

  The amount of required spectrum to support this application has been studied by HIPERACCESS Spectrum group. We attach the result of this work in Annex 1 for comments.

ANNEX 1

1. Main HIPERACCESS characteristics for the 32 GHz band

The main characteristics of HA include:

- Provision of up to 132 Mbit/sec in the downlink directions and up to 88 Mbit/sec in the uplink direction ;
- Channelisation and modulation scheme as follows:
- Down-link 28 MHz using 4/16/64 QAM adaptive;
- Up-link 28 MHz using 4/16 QAM adaptive;
- The system architecture is P-MP;
- The access scheme is TDM/TDMA;
- Symmetrical band capability, although at any point in time the traffic to and from a specific end user need not necessarily be symmetrical;
- Intended to operate in paired spectrum allocations employing FDD in either full or half-duplex operation (TDD is also optionally possible); with full compatibility with the 31.8-33.4 GHz channel plan as expressed in the current draft ERC recommendation (see [3])
- Intended to provide full compatibility with the Draft ETSI DEN/TM04116 (see [4]) radio co-existence standard for the 31.8-33.4 GHz band

3. Cellular deployment and evaluation of the net capacity per channel

The Reference cellular pattern assumed for the deployment of the HIPERACCES system, with 2 frequencies and 2 polarisation (frequency reuse factor of 2), is depicted in figure 1

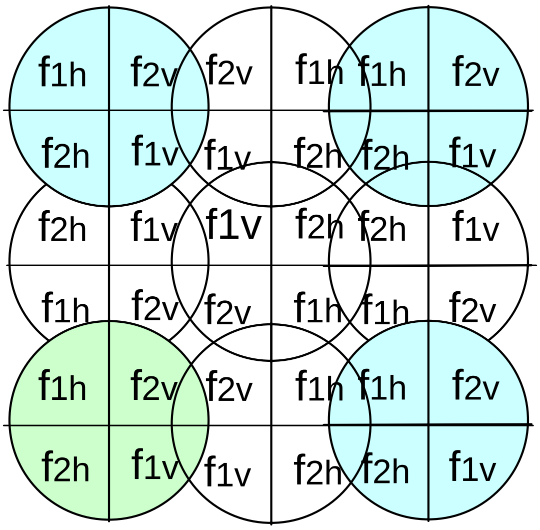

Figure 1 - Reference cellular pattern

The estimation of the net down/uplink capacity, provided by the HIPERACCESS system, is derived from the evaluation of the percentage of the sector area or of the time, in which a particular physical layer mode (i.e. the combination of a particular modulation with a particular coding scheme) is applied.
Figure 2 shows a typical downlink C/I cumulative distribution function, derived by the reference cell pattern shown in figure 1, when the interference LOS ranges from 20 to 100.

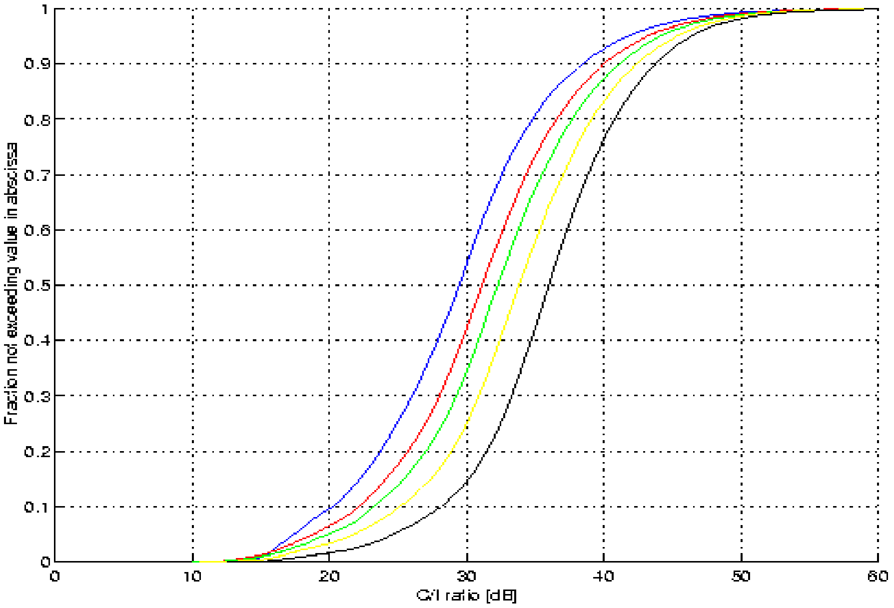

Figure 2

On the basis of the C/I behaviour shown in figure 2, the total allowed net capacity is evaluated in table 1 on the basis of the physical layer modes decided for HIPERACCESS.

Phy Modes	Mod scheme	code rate	Net Mb/s @22Mbaud	C/I@10-11 (dB)	Usable Area				Usable Mb/s	
					100% LOS		20%LOS		100% LOS	20%LOS
					potential	real	potential	real		
1	4QAM	0,58	25,52	8,4	100,0%	0,0%	100,0%	0,0%	0	0
2	4QAM	0,87	38,28	12,9	99,0%	7,0%	100,0%	1,0%	2,7	0,4
3	16QAM	0,72	63,36	17,3	92,0%	9,0%	99,0%	2,0%	5,7	1,3
4	64QAM	0,65	85,80	22	83,0%	13,0%	97,0%	4,0%	11,2	3,4
5	64QAM	0,87	114,84	25,9	70,0%	70,0%	93,0%	92,0%	80,4	105,7
								Total=	**100**	**111**

Table 1 – Total net capacity allowed by the downlink phy modes

We assume that the average net downlink capacity is **100 Mb/s** per 28 MHz channel bandwidth (net spectral efficiency: 3,6 bit/Hz).
The interference on the uplink direction is time variant, as the victim APT (Access Point Transceiver) can be simultaneously interfered by multiple ATs (Access Terminations), and the expected distribution over time of the carrier to interference ratio (C/I) is depicted in figure 3.

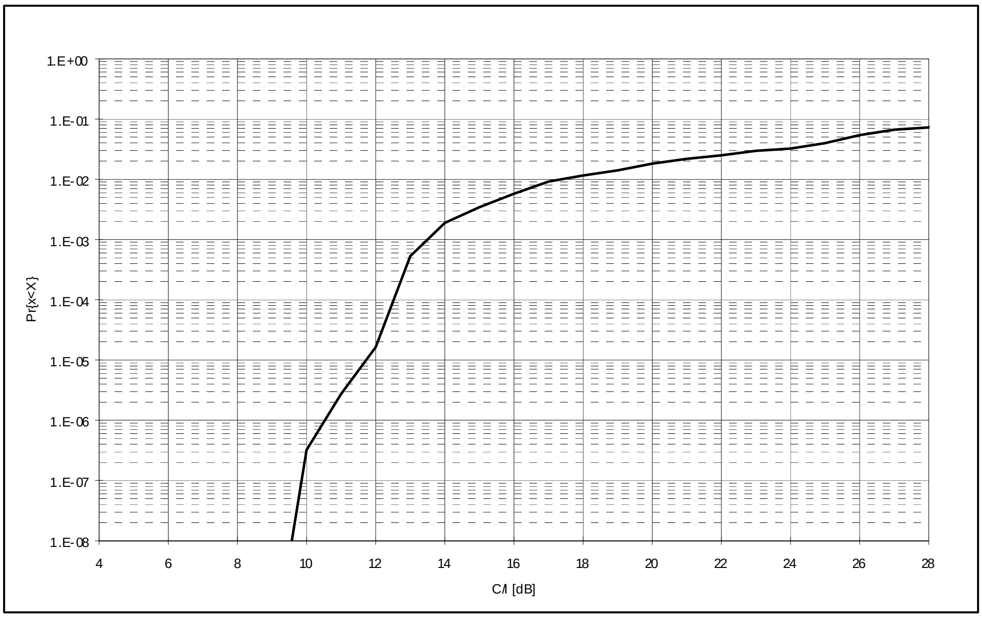

Figure 3 - C/I distribution in uplink

On the basis of the C/I cdf of figure 3, table 2 shows the percentage of unavailable time for each uplink phy mode (agreed for the HIPERACCES system).

Phy Modes	Mod scheme	code rate	Net Mb/s @22Mbaud	C/I@10-11 (dB)
1	4QAM	0,51	22,44	8,1
2	4QAM	0,77	33,88	12,5
3	16QAM	0,64	56,32	17

Table 2 – Uplink unavailable time for each phy mode

We hereby assume that the average net uplink capacity is **50 Mb/s** per 28 MHz-channel bandwidth (net spectral efficiency: 2,1 bit/Hz).

4. System coverage range

In accordance with the reference diagram in figure 4, the current HIPERACCES system parameters, defined as typical, are as follows:

AP antenna gain:	18 dBi +/-1 dB (90 degrees sector antenna)
AT antenna gain:	35 dBi +/-1 dB (30 cm diameter antenna)
AP/AT output power (V’):	15 dBm +/-2 dB
AP/AT receiver sensitivity (V):	-84dBm +1 dB (@10E-6 BER threshold)

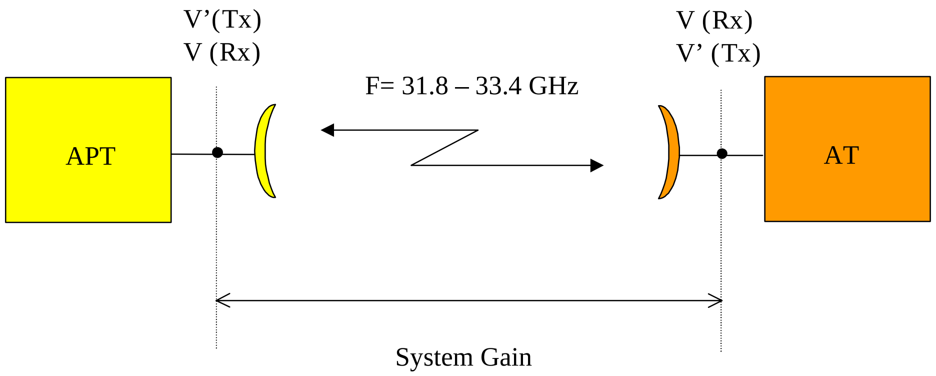

Figure 4 - Reference system diagram

From the above parameters, table 3 shows the allowed maximum coverage ranges as a function of the rain zone and of the availability requirement:

ITU rain zones	99,99%	99,999%
E	4,3	2,5
K	2,8	1,5

Table 3 – coverage range (km)

5. Spectrum requirements

On the basis of what presented in the above section, table 4 evaluates the spectrum required by the UMTS infrastructure on the basis of the traffic model, presented in [1] and [2], relevant to the central business district, for the years 2005 and 2010. A market penetration of 30% is assumed.

		99,99%-Kzone:		99,999%-Kzone:	
	90° sector size (sqkm)=	3,92		1,13	
		picocell	microcell	picocell	microcell
	#of Node B per HA sector=	118	8	34	3
	Penetration=	30%			
CITY - 2005	total UMTS traffic (Mb/s/km2)	UMTS traffic/ sector (Mb/s)	Spectrum (MHz)	UMTS traffic/ sector (Mb/s)	Spectrum (MHz)
downlink	365,00	429	9 x28MHz	123	2 x28MHz
uplink	259,00	305	12 x28MHz	87	3 x28MHz
CITY-2010					
downlink	737,00	867	17 x28MHz	249	5 x28MHz
uplink	361,00	425	17 x28MHz	122	5 x28MHz
		99,99%-Ezone:		99,999%-Ezone:	
	90° sector size (sqkm)=	10,13		3,13	
		picocell	microcell	picocell	microcell
	#of Node B per HA sector=	305	20	94	6
	Penetration=	30%			
CITY - 2005	total UMTS traffic (Mb/s/km2)	UMTS traffic/ sector (Mb/s)	Spectrum (MHz)	UMTS traffic/ sector (Mb/s)	Spectrum (MHz)
downlink	365,00	1109	22 x28MHz	342	7 x28MHz
uplink	259,00	787	31 x28MHz	243	10 x28MHz
CITY-2010					
downlink	737,00	2239	45 x28MHz	691	14 x28MHz
uplink	361,00	1097	44 x28MHz	338	14 x28MHz

Table 4 – Spectrum requirement Vs Rain zone and availability target

Note that:
"Spectrum (#of 28 MHz)" = "UMTS traffic/sector" * "reuse factor" / "Net 28 MHz system capacity"

Different sector sizes, relevant to the different rain zones and availability targets, are evaluated but it is worth noting that the allowed system sector size could be limited by traffic (or by the available spectrum) rather than by noise or by the availability target. For instance, the requirement driven by the E zone with 99,99% target is not realistic as it exceeds the full availability of the 32 GHz bandwidth.

Table 5 below summarises the results when assuming a reference sector size of around 3sqkm.

	2005	2010
#of 28 MHz duplex slot	**10**	**14**

Table 5 –Spectrum requirements

It has to be noted that the spectrum requirement for 2005 could be reduced down to 7x28 MHz (saving 3x28) in case that the code rate of the phy mode 3 is increased to around 0,85.

References

[1] SE19(00)91; “Fixed service requirements for UMTS/IMT-2000” – Deutsche Telekom
[2] ITU Radio Communication Study Groups- Document 8F/165-E °; “Consideration of DEPLOYMENT SCENARIOS OF IMT-2000 NETWORKS” – Deutsche Telekom
[3] SE19(00)106 rev.1; “Draft ERC-Recommendation for the band 31.8 – 33.4 GHz”
[4] Draft ETSI DEN/TM04116; “Fixed Radio Systems; Point-to-multipoint equipment; Point-to-multipoint digital radio systems in the frequency bands 31.0 GHz to 33.4 GHz”

ANNEX 2

Extract from HIPERACCESS System Overview

HIPERACCESS due to its characteristics is a good and economical candidate as one of the technologies involved in the realisation of UMTS backhaul.
The large bandwidth requirement and high base station concentration in micro and pico cells of UMTS deployment will require a large bandwidth interconnection system capable of collecting traffic from several “B nodes” very close to each other.
HIPERACCESS seem to be the natural way of doing this. … it is obvious that HIPERACCESS shall be able to support UMTS backhaul and end-user traffic with the same deployment possibly allowing statistical multiplexing of UMTS and end-user traffic sharing the same bandwidth.