TSG-RAN meeting #19 RP-030147
Birmingham, Great Britain, 11th -14th March, 2003

Agenda Item: **9.10**

Source: **Telefonica, Tekmar**

Title: **Proposal for a study item on an optional low level interface (LLI) for FDD base stations**

Document for: **Approval**

Introduction

The purpose of this document is to introduce the description sheet for a new study item, called “Optional RF Low Level Interface in FDD base stations”. In this document, we try to justify the creation of this new study item.

Discussion

The need for this type of interface has arisen as UMTS repeaters have started to be developed. Usually, repeaters are connected to a base station by means of an attenuator, which attenuates the high power signal at the antenna connector. All FDD node B manufacturers have come to split their node B RF part in two sides. At one side we have the low level transceiver, which generates an RF signal with a power of about 0 dBm. At the other side we have the power amplifier, which amplifies the low level RF signal, and delivers it to the antenna connector. That is the reason why we have thought that it would be useful to be able to connect the repeater directly to the low level transceiver. The main problem in order to do that is that the signal at the output of the low level transceiver is not standard. Manufacturers use predistortion and feedback techniques in order to increase the efficiency and the linearity of their power amplifiers. Another important problem is that the power amplifier in the node B cannot be disconnected, because the node B software detects it as a problem, and stops RF transmission. This is the reason why a new open interface at the output of the low level transceiver should be standardised. In this case eventual linearization and clipping of the amplification unit shall not be performed in the low power Node B, but after the low power interface, in the remote power units.

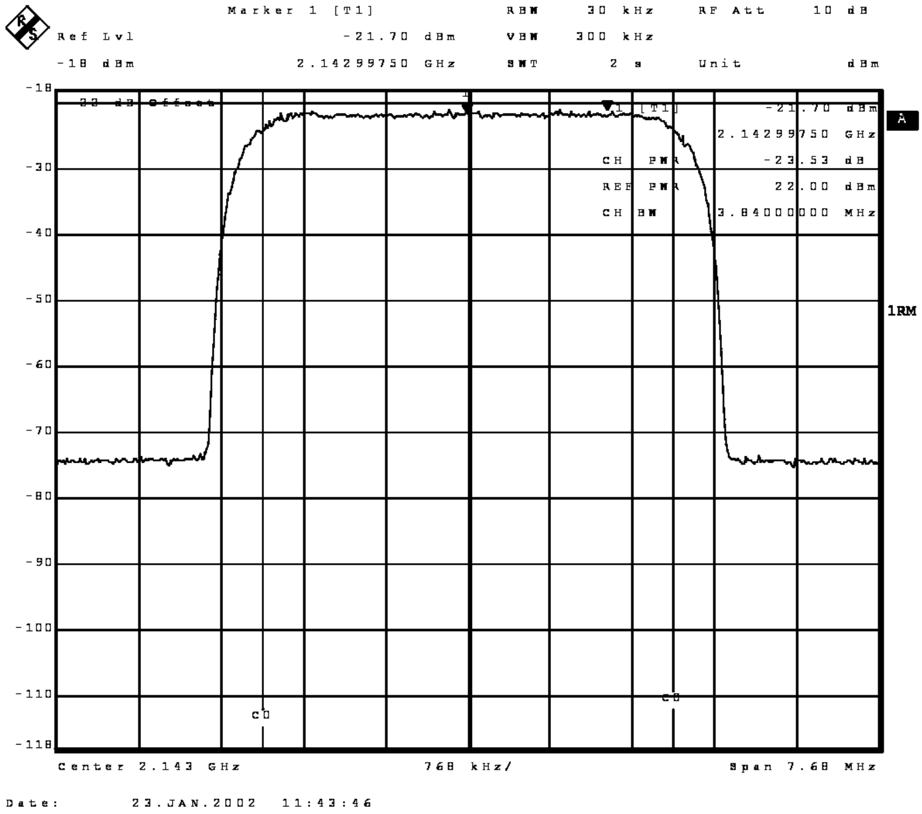
Some node B suppliers have planned to build a node B splitted into two parts: a base band part, and a remote RF part. The base band module and the RF remote module are connected by means of an optical fibre link. This could be a good solution for the problem, but it is not a standard solution. And this is an important point, because if the low level interface is opened, it facilitates infrastructure sharing between operators. It is becoming increasingly difficult to find new sites for base stations, and in some locations (underground train, shopping malls, hotels, …) the site owners or the regulators force the operators to share the infrastructures. If the operators want to use a common repeater system, it is advantageous to have an open LLI interface. Another advantage of opening the LLI interface is that it can be standardised within 3GPP, because if any operator uses the LLI interface of its supplier’s node B, and this interface is not standardised, it can lead to disturbances to other network operators. By standardising this interface, it can be ensured that no undesirable emissions come from the LLI interface, and the signal quality at the interface is the right one.

During last RAN plenary meeting it was suggested to use the actual RF interface, but with an output power of 0 dBm (NBAP protocol signalling range allows this output power). The problem with this solution is that the output power needed to feed the repeater system could be even less than 0 dBm, and the base station classification is made according to Minimum Coupling Loss, not according to output power. It is not possible to define a new base station class with an output power of 0 dBm or less.

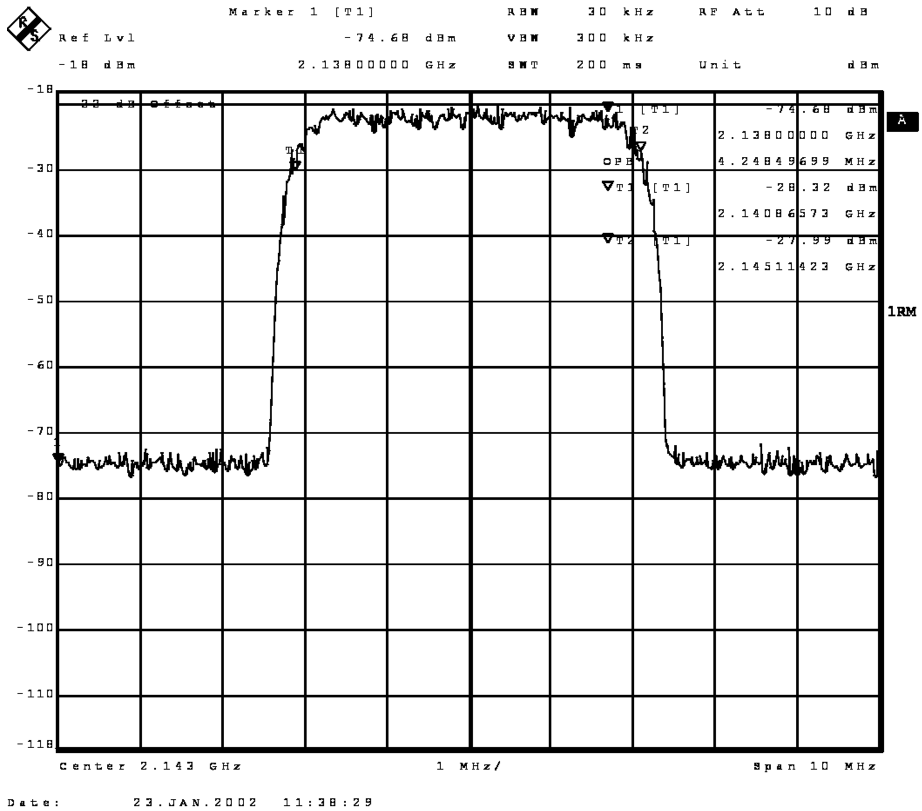
Some measurements have been performed on the “LLI” interface of three well-known node B manufacturers, in order to assess the feasibility of this interface. The measurements on the “LLI” interface of two of the manufacturers have been done only to check the nature of the RF signal in this interface. The results of these measurements are the next.

Manufacturer 1

- Signal power: -1.52 dBm

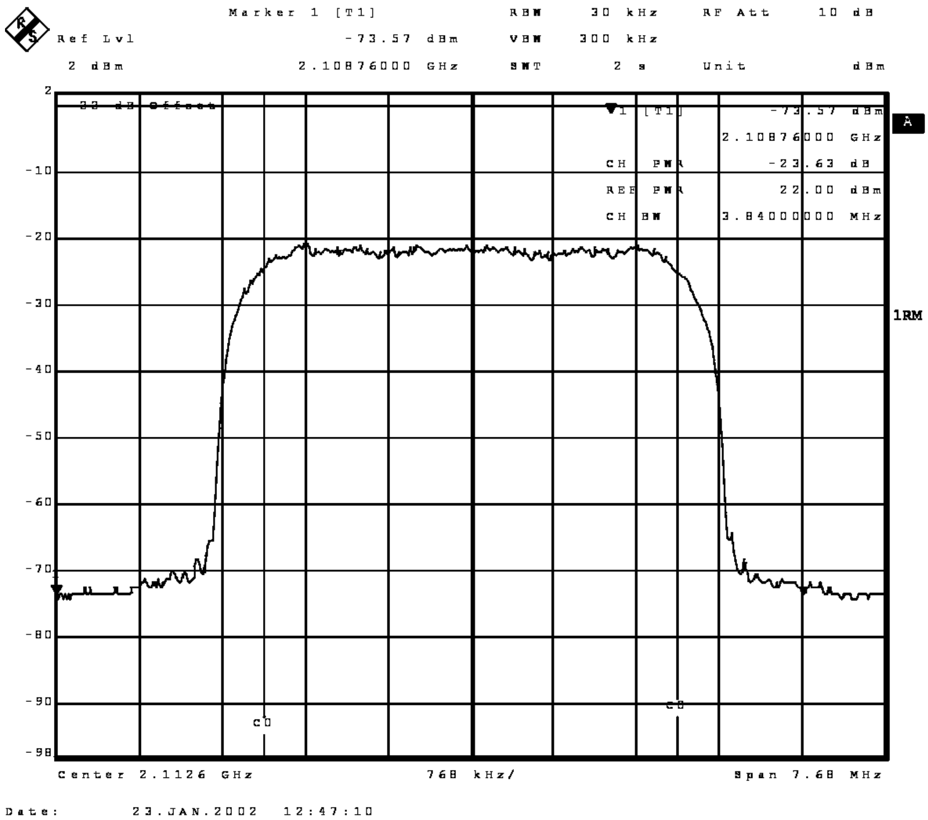


- Signal bandwidth: 4.24 MHz

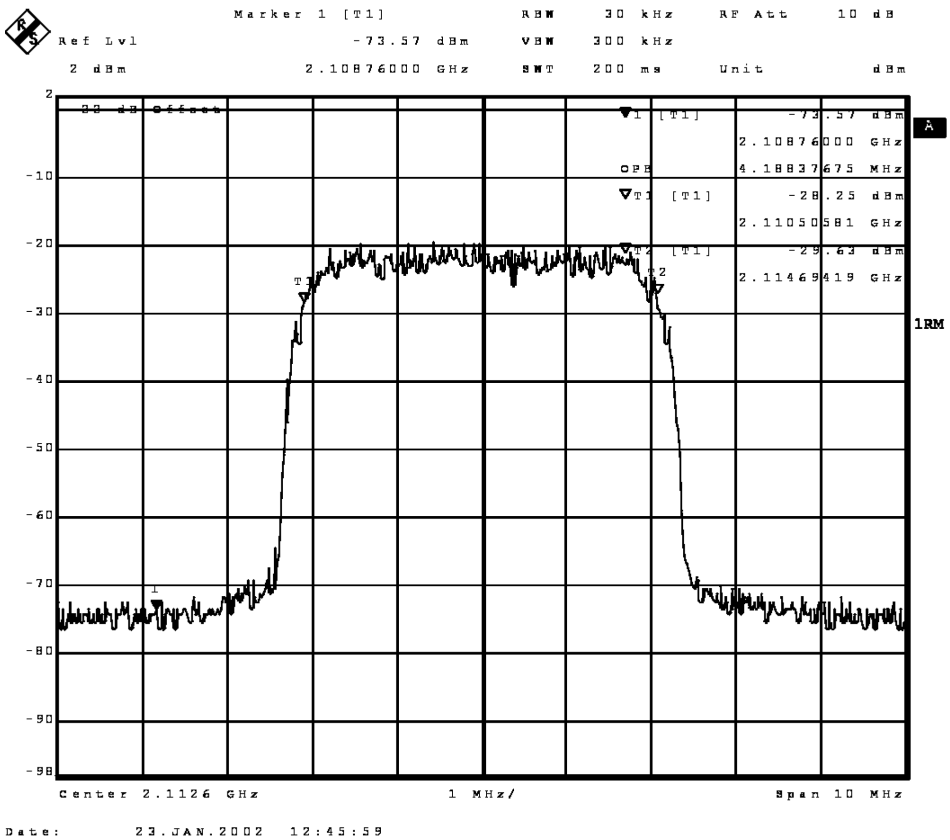


Manufacturer 2

- Signal power: -1.63 dBm



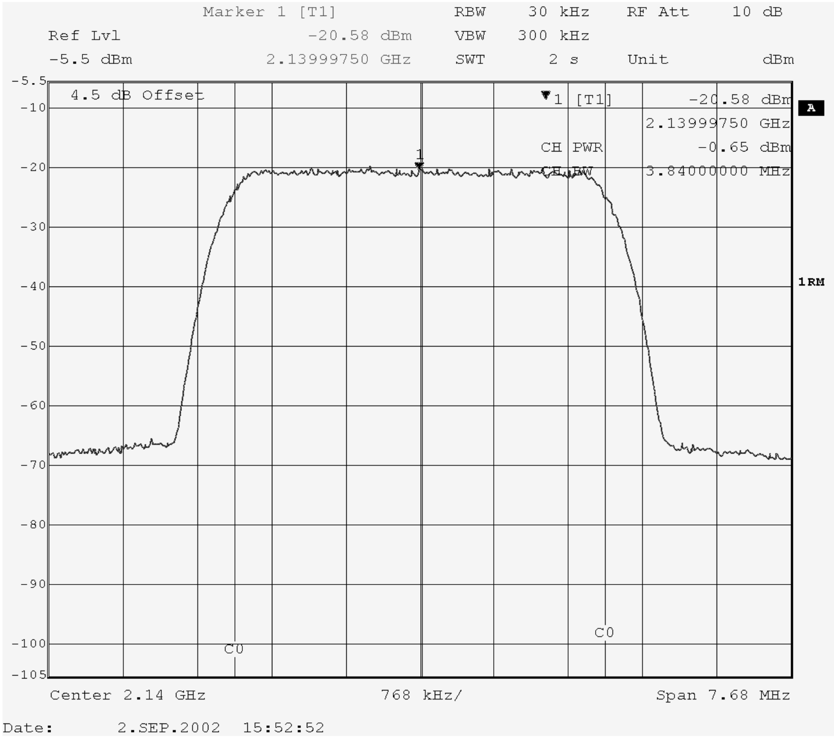
- Signal bandwidth: 4.18 MHz



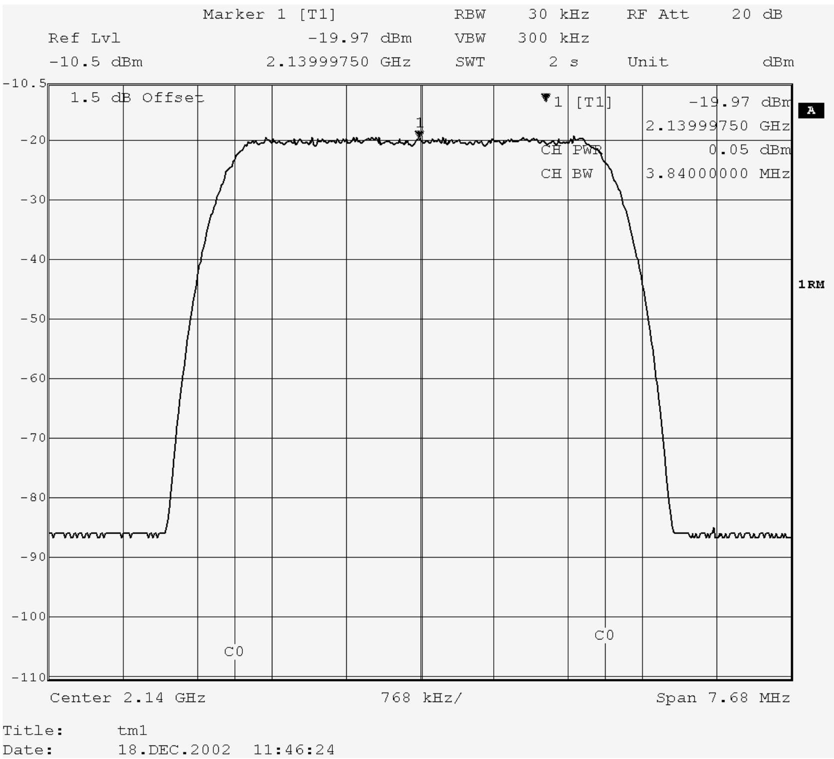
The measurements on the “LLI” interface of the third manufacturer have been more complete, because it was easier to generate channel models and it was possible to disconnect the power amplifier without stopping RF transmission. The results of the measurements for the third supplier are the next:

Manufacturer 3

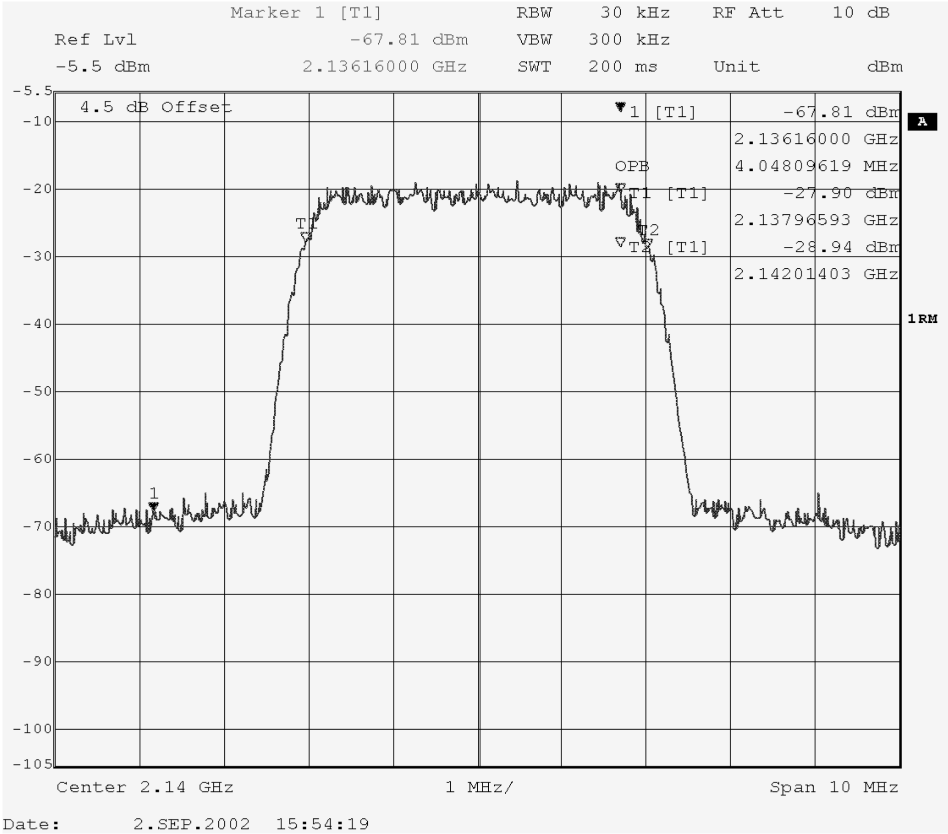
- Maximum output power (Test Model 1 with 16 DPCH): -0.65 dBm



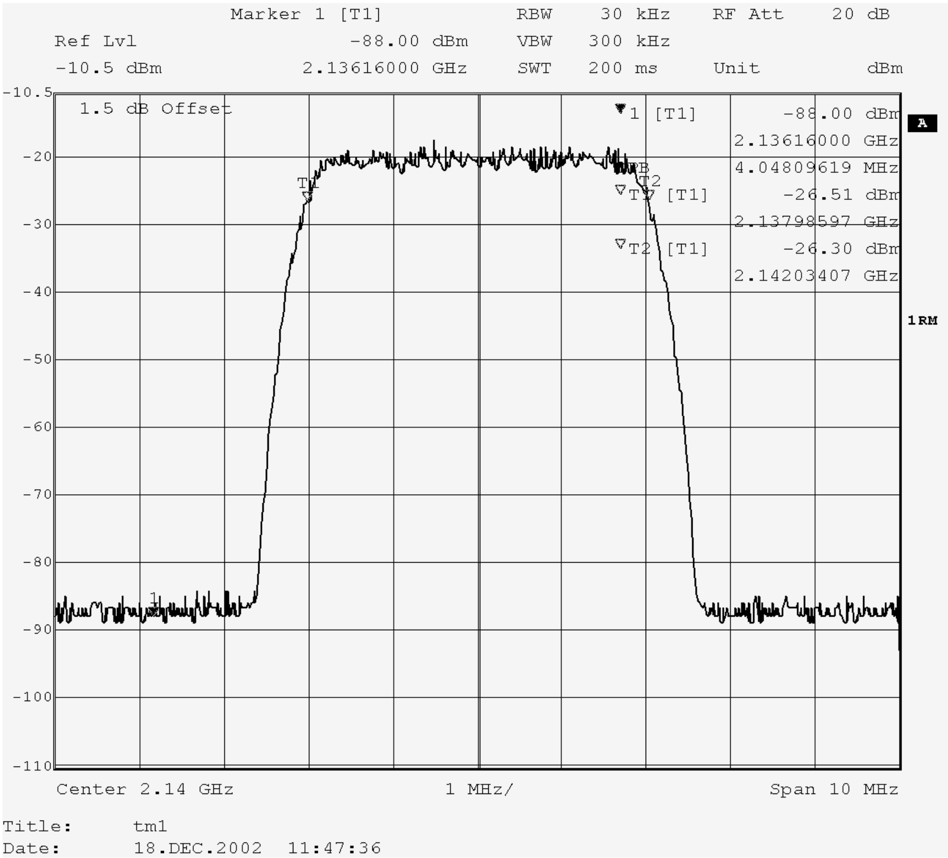
- Maximum output power (Test Model 1 with 32 DPCH): -0.05 dBm



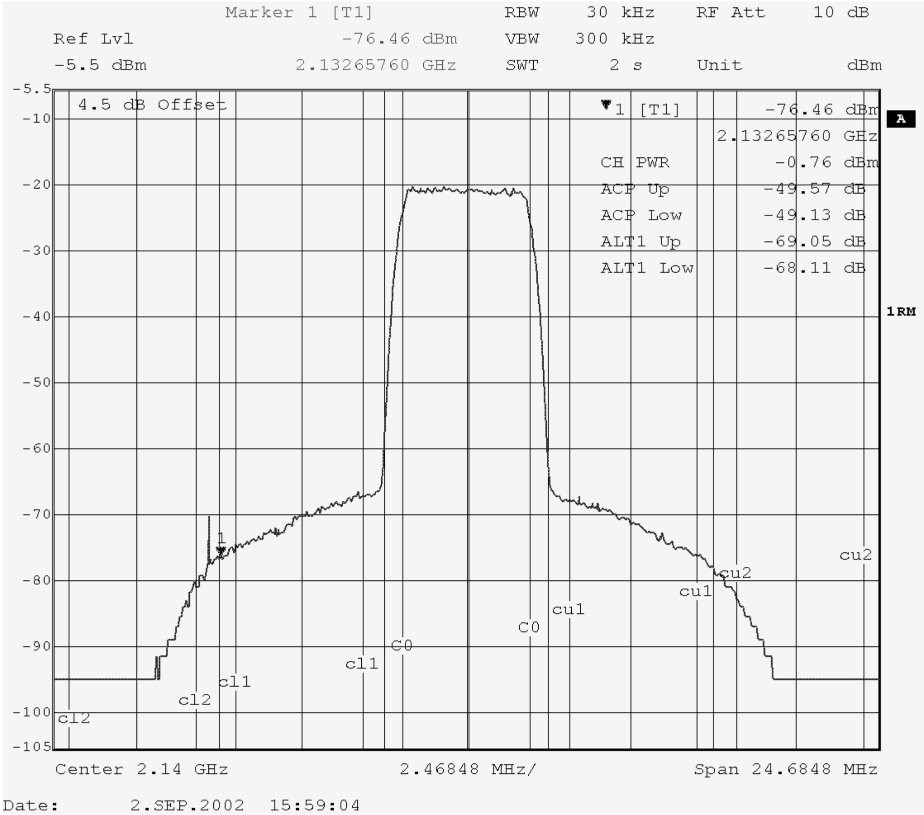
- Occupied bandwidth (Test Model 1 with 16 DPCH): 4.048 MHz



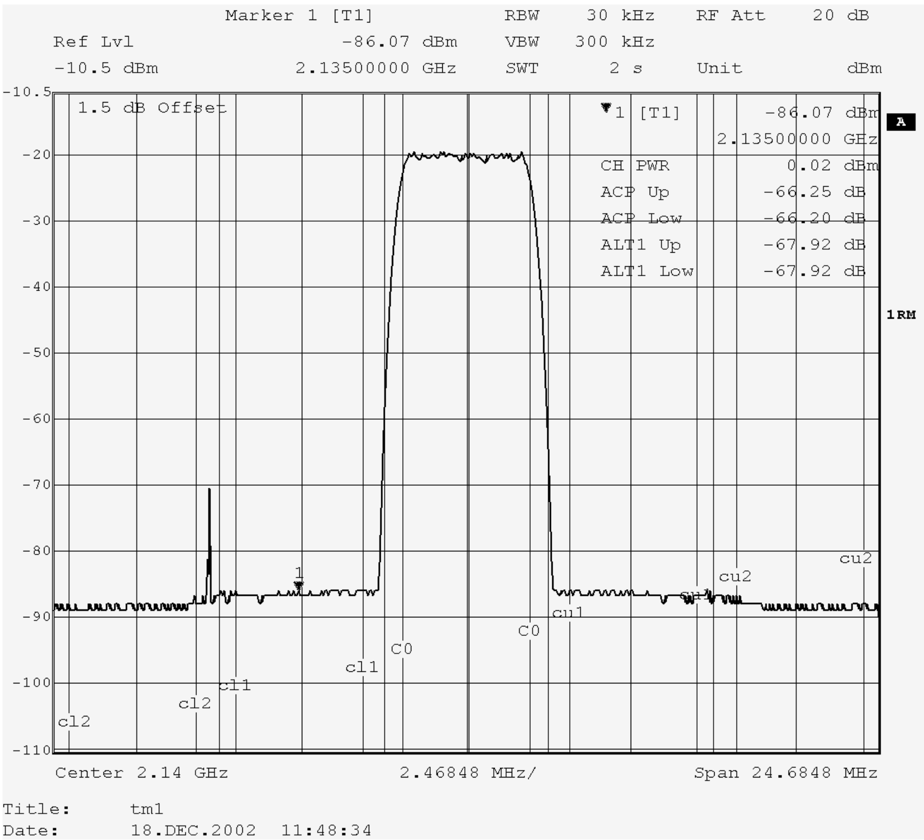
- Occupied bandwidth (Test model 1 with 32 DPCH): 4.04 MHz



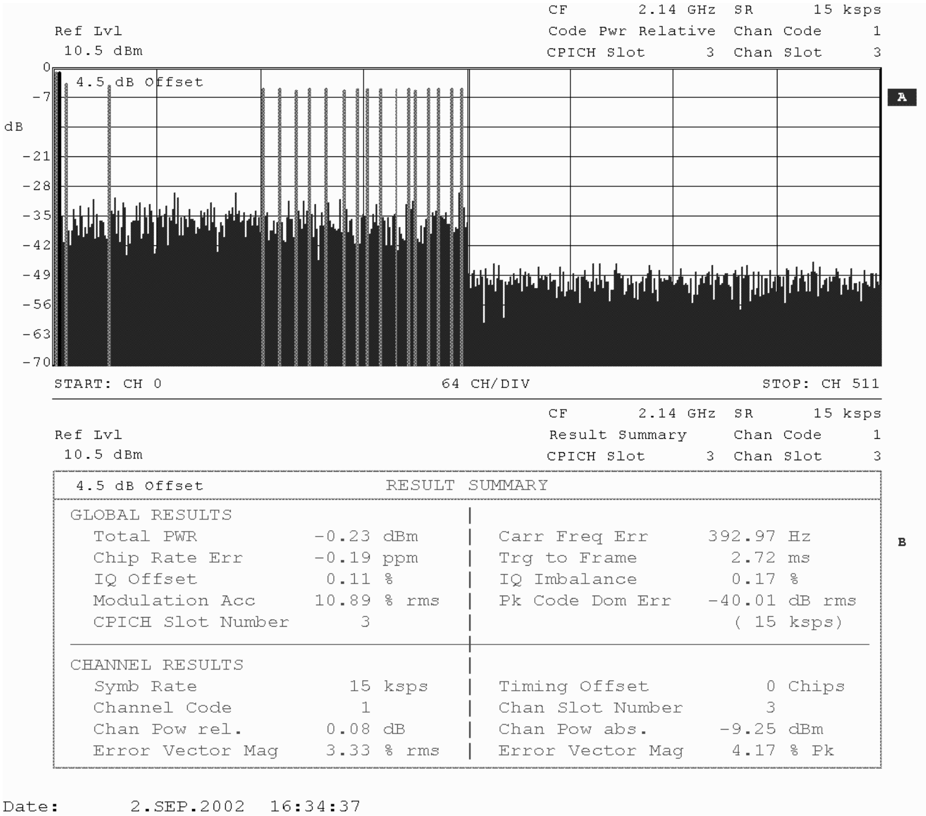
- ACLR (Test model 1 with 16 DPCH): -49.57 dB @ +5 MHz, -49.13 dB @ -5 MHz, -69.05 dB @ +10 MHz, -68.11 dB @ -10 MHz



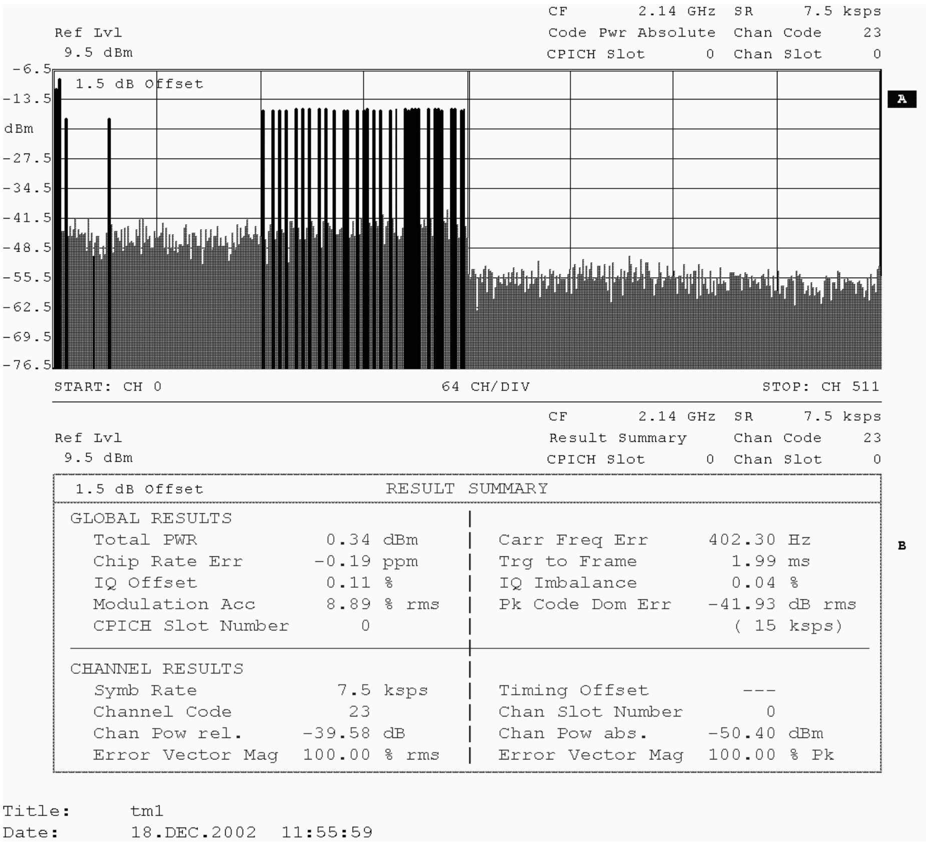
- ACLR (Test model 1 with 32 DPCH): -66.25 dB @ +5 MHz, -66.20 dB @ -5 MHz, -67.92 dB @ +10 MHz, -67.92 @ -10 MHz. This time low level transceiver predistorsion was suppressed.



- EVM (Test model 4): 1.26 % rms @ Pmax-3 dB, 1.66 % rms @ Pmax-18 dB
- PCDE (Test model 3 with 16 DPCH): -40.01 dB



- PCDE (Test model 3 with 32 DPCH): -41.93 dB



- Reference sensitivity: -116.5 dBm
- Dynamic range:

  Wanted signal = -91 dBm
  Noise = -73 dBm
  BER = $1.2 \cdot 10^{-5}$

  If we increase the noise level up to -72 dBm, then BER equals 10^{-3}, and the dynamic range is 17 dB. Let's see what happens when all signal levels are offset by 5 dB (the difference between the reference sensitivity in the LLI interface and 25.104 reference sensitivity):

  Wanted signal = -86 dBm
  Noise = -68 dBm
  BER = $9 \cdot 10^{-5}$

  If we increase the noise level by 1 dB (-67 dBm), BER equals $5 \cdot 10^{-3}$. We can see that dynamic range performance is similar to that on the antenna interface.

- Adjacent channel selectivity:

  Wanted signal = -115 dBm
  Interfering signal (+/- 5 MHz) = -52 dBm
  BER = 0 %

  If we offset all the signals by 5 dB, we get the next results:

  Wanted signal = -110 dBm
  Interfering signal (+/- 5 MHz) = -47 dBm
  BER = 0 %

  We can increase the interfering signal level until -35 dBm, and the BER keeps in 0 %. We cannot increase the interfering level over -35 dBm because then the low level transceiver could be damaged.

- Blocking:

  Wanted signal = -115 dBm
  Interfering signal (1900 to 1940 MHz and 1960 to 2000 MHz) = -40 dBm
  Interfering signal frequency is changed at 1 MHz steps.
  BER = 0 %

  If we offset the signal levels by 5 dB:

  Wanted signal = -110 dBm
  Interfering signal = -35 dBm
  BER = 0 %

  We haven't performed the blocking test for interfering signal level higher than -35 dBm, because then the low level transceiver could be damaged.

As a summary of the measurements performed, it can be said that the "LLI" interface is very similar to the antenna interface, except that the power in the "LLI" interface is about 0 dBm, and the sensitivity is lower than in the antenna interface. The measurements results show that it is possible to connect a repeater system to the low level interface.

Conclusions

We have shown the necessity and the advantages of the LLI interface. The feasibility of this interface has been demonstrated by means of measurements on the “LLI” interface of real node B’s. We would like to ask TSG RAN to endorse this SI proposal in order to continue studies regarding the LLI interface.

Study Item Description

Title Optional RF Low Level Interface in FDD Base Stations

1 3GPP Work Area

X	Radio Access
	Core Network
	Services

2 Linked work items

none

3 Justification

Many companies have shown interest in the feasibility of an optional RF low level interface (LLI) in the FDD Base Stations and the possibilities it offers, e.g.:

1. the flexibility in radio network deployment, which should be one of the characteristics of a 3G system,
2. it is not necessary to attenuate a high power signal before feeding an active external distribution system (lower power consumption, positive environmental effects),
3. it facilitates the sharing of the infrastructure among operators, especially in locations where it is difficult to find sites, or where operators are forced by regulators to share the infrastructures,
4. it allows the placement of one or several base stations in a centralised position with separate RF power amplifiers distributed closer to the subscriber positions, thus reducing interference while meeting the unwanted emissions requirements.
5. by placing the base stations at one location, less supporting infrastructure is required and maintenance is simplified.

4 Objective

The study item shall identify the application scenarios and the relevant parameters that best characterise the LLI. It shall assess the pros and cons of the introduction of such an optional interface in the base station and investigate the impact of the LLI into the radio network performance on a single or multioperator environment. Therefore it shall include scenarios for the investigation of the RF mono-carrier and multicarrier performances, e.g.:

- impact of the use of the LLI on the network performance parameters
- RRM and O&M aspects for connecting external active network elements
- Transmit characteristics
- Receive characteristics
- Potential regulatory implications

If necessary RAN WG3 and SA WG5 shall be involved for evaluation of any impact in O&M aspects.
Submission of initial results is planned for RAN4 #27.
The conclusion of the study item is planned for RANP #21.

5 Service Aspects

None

6 MMI-Aspects

None

7 Charging Aspects

None

8 Security Aspects

None

9 Impacts

Affects:	USIM	ME	AN	CN	Others
Yes			X		O&M, RRM
No	X	X		X	
Don't know					

10 Expected Output and Time scale (to be updated at each plenary)

New specifications						
Spec No.	Title	Prime rsp. WG	2ndary rsp. WG(s)	Presented for information at plenary#	Approved at plenary#	Comments
TR xx.yyy.	Feasibility Study of the new optional RF low level interface	WG4		RAN#19	RAN#19	

Affected existing specifications				
Spec No.	CR	Subject	Approved at plenary#	Comments

11 Work item rapporteurs

José Alberto Martín (Telefónica)

12 Work item leadership

TSG-RAN WG4

13 Supporting Companies

Tekmar Sistemi
Mikom
Allgon
Telefonica
Marconi
TDF

14 Classification of the SI

	Building Block (go to 14b)

14b The SI is a Building Block: parent Feature is Radio Interface Improvement Feature