IST Integrated Project No 507023 – MAESTRO

D6-5.2

SDMB Hub specification Document

(for R2)

Contractual Date of Delivery to the CEC:	December 2004
Actual Date of Delivery to the CEC:	27/12/2004
Author(s):	Paul Vincent(ASP)
Participant(s):	see table Document Authors
Workpackage:	WP06
Est. person months:	1.5
Security:	Pub.
Nature:	R
CEC release:	2.0
Version:	3.0
Total number of pages:	42

Abstract:

This report contains the deliverable D6-5.2 of the IST MAESTRO project which defines the requirements (functional, performances, interfaces) of SDMB Hub sub-systems for the release 2 and for the commercial system and estimates costs related to the hub development for the commercial system. This version superseded D6.5-1 for the commercial system, D6.5-1 still being the reference for the release 1.

Keyword list: SDMB,Hub, requirement, RNC, Node B

EXECUTIVE SUMMARY

This document contains deliverable D6-5.2 of the IST Integrated Project MAESTRO – Mobile Applications & sErvices based on Satellite and Terrestrial inteRwOrking (IST Integrated Project n° 507023).

MAESTRO project aims at studying technical implementations of innovative mobile satellite systems concepts targeting close integration & interworking with 3G and Beyond 3G mobile terrestrial networks.

MAESTRO aims at specifying & validating the most critical services, features, and functions of satellite system architectures, achieving the highest possible degree of integration with terrestrial infrastructures. It aims not only at assessing the satellite systems' technical and economical feasibility, but also at highlighting their competitive assets on the way they complement terrestrial solutions.

This is the fifth of eight tasks in Work Package 6 – «Architecture». The objective of this WP is to define the SDMB system:

- Identifying the Technical Requirements of the SDMB system
- Defining an SDMB system architecture that inter works with the 3GPP architecture and meets all system requirements,
- Defining the functions and interfaces of SDMB all sub-systems namely User Equipment, Intermediate Module Repeater, space segment, hub and service centre,
- Estimating the cost impacts of SDMB features on 3G handset and on BM-SC
- Estimating the manufacturing and installation costs associated to the intermediate repeater.
- Estimating the development cost of the hub.
- Analysing the impacts of SDMB system on the 3G mobile network.

The deliverable D6-5 – «SDMB Hub Specification Document» - expresses the functions, performance and interfaces of the product.

The task is lead by ASP and is supported actively by all MAESTRO partners.

This document includes both the specification of the commercial system and the specification of the key features/performances of this system that will be validated through the MAESTRO test-bed release 2.

COPYRIGHT

DOCUMENT HISTORY

Vers.	Issue Date	Content and changes
0.0	17 November 2004	1st Draft
1.0	19 November 2004	1st version sent for WP6 internal review
1.1	10 December 2004	Revised version after WP6 review
2.0.	21 December 2004	Final version
3.0.	27 December 2004	Final version for delivery

DOCUMENT AUTHORS

This document has been generated from contributions coming from most of the MAESTRO partners. The contributors are the following:

Partners company	Contributors
ASP ERCOM	• Catherine Dargeou & Paul Vincent • Daniel Braun & Laurent Doldi

DOCUMENT APPROVERS

This document has been verified and approved by the following partners:

Partners company	Approvers
ASP	• Nicolas Chuberre • Christophe Selier

TABLE OF CONTENTS

LIST OF TABLES

None

LIST OF FIGURES

1 INTRODUCTION

1.1 Background

This document will:

- Determine all requirements applying to the SDMB hub; Functional description from external equipment point of view:
    - Provided services : what is provided to external environment
    - Required services : what is expected from external environment
    - Split between user plane, control plane and O&M plane
- Define the SDMB hub architecture:
    - Internal and external interfaces definition
    - Sub-systems specifications

INPUT: WP3: «S-DMB Access Layer definition», EU/IST/FP5 MoDiS project deliverables.

OUTPUT: SDMB hub specification, estimation of the development cost of the SDMB hub.

1.2 Fields of application

This document is applicable to the teams in charge of designing, developing, integrating, verifying, validating and maintaining the MAESTRO S-DMB Hub. It is used during all the development phases and during the customer's operation.

2 DOCUMENTARY REFERENCE SYSTEM

2.1 Applicable documents

[UML1] «UML 2 Illustrated: Developing Real-Time & Communications Systems», L. Doldi, TMSO, Oct. 2003, ISBN 2-9516600-1-4

2.2 Applicable norms and standards

[3GP1] 3GPP TS 25.402: «Synchronization in UTRAN Stage 2»

[3GP2] 3GPP TS 25.433: «UTRAN Iub Interface NBAP Signalling»

[3GP3] 3GPP TS 29.846: «Multimedia broadcast / multicast service; CN1 procedure description», 1.2.0 (2004-02)

[3GP4] 3GPP TS 23.246: «Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description», V.6.1.0 (2003-12)

2.3 Reference documents

[Mae1] MAESTRO Deliverable D6-1: SDMB System Technical Requirement

[Mae2] MAESTRO Deliverable D6-2-2A: System Design Definition File

[Mae4] MAESTRO Deliverable D6-2-2B: System Design Definition File for R1

[Mae3] MAESTRO Deliverable D3-1: S-DMB Access Layer definition

3 TERMS, DEFINITIONS, ABBREVIATED TERMS AND SYMBOLS

3.1 Terminology and definitions

Version 1.4

BM-SC	Means the BM-SC as defined for MBMS and including specific SDMB features
Cell	Means the Terrestrial mobile network cell
Content	File or data stream transmitted by the SDMB system and possibly (for the Download service) completed by terrestrial retransmissions
Download delivery method	A delivery method that delivers some multimedia content with loose time constraints. The service is best map on 3GPP defined background traffic class capability.
End User	The End user owns the terminal, subscribes to the MNO & Mobile Portal services
Groupcast service	A service offered to end-user allowing to send in a cost efficient way the same content to a group of users. This may include streaming or download.
SDMB service	A push service that delivers a set of Multimedia content to several recipients. The service includes information, which allows the user equipment to process the content according to the end-user's rights and terminal capabilities. The access to the service may be restricted to a certain group of users which may have to pay a fee.
Relevant content	A multimedia content which is expected to interest the end user with respect to its user preference profile.
Service area	Refers to the area where the SDMB services are available. Basically it is defined taking into account a set of satellite spots providing the European coverage.
Spot area	Corresponds to the areas covered by a satellite spot beam. There is not necessarily a service continuity between two spot areas. We assume that the same data is datacast in a spot area and it differs from the data datacast in other spot areas.
Streaming delivery method	A delivery method that delivers some multimedia content with real time constraints. It may refers to TV or radio type of services. Such service is manually activated by the end-user. Content are played as soon as received by the end-user terminal. The service is best map on 3GPP defined streaming traffic class capability.
Terrestrial mobile network	The terrestrial mobile network(s) on which the SDMB system relies.
UE	The UMTS/GSM User equipment modified to include SDMB features.
User preference profile	The description of the SDMB-content related user preferences (preferred user services) in the UE.
User service	A consistent set of contents, distributed using a given delivery method.

3.2 Abbreviations

Version 1.5

2G	Second Generation (Mobile communication system)
3G	Third Generation (Mobile communication system)
3GPP	3rd Generation Partnership Project
A-CIT	Alcatel CIT, France (MAESTRO Partner)
AAC+	Improved Advanced Audio Coding
ABFN	Analogue Beam Forming Network
ACI	Adjacent Channel Interference
ACIR	Adjacent Channel Interference Ratio
ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
ADC	Analogue to Digital Conversion
AGC	Automatic Gain Control
AGILENT	Agilent Technologies Belgium SA, Belgium (MAESTRO Partner)
AM/AM	Amplitude – Amplitude transfer function
AM/PM	Amplitude – Phase transfer function
ASC	Ascom Systec AG, Swiss (MAESTRO Partner)
ASEL	Alcatel SEL AG, Germany (MAESTRO Partner)
ASP	Alcatel Space, France
AWE	AWE Communications GMBH, Germany (MAESTRO Partner)
AWGN	Additive White Gaussian Noise
BCF	Base Common Functions
BCH	Broadcast Channel
BER	Bit Error Rate
BLER	BLock Error Rate
BM-SC	Broadcast Multicast Service Center
BS	Base Station
BT	British Telecommunications PLC, United Kingdom (MAESTRO Partner)
BYTL	Bouygues Telecom, France (MAESTRO Partner)
CBS	Cell Broadcast Service
CCI	Co-Channel Interference
CCN	Contract Change Notice
CDD	Content Delivery Descriptor
CDMA	Code Division Multiple Access
CDN	Content Delivery Network
CNP	Combined Network Planning
COTS	Commercial Off The Shelf
CPICH	Common Pilot Channel
CTCH	Common Traffic Control Channel
DL	DownLink
DMB	Digital Multimedia Broadcasting
DRM	Digital Rights Management
DSP	Digital Signal Processing
DVB	Digital Video Broadcasting
DVB-S	DVB Satellite
EC	European Commission
EIRP	Equivalent Isotropically Radiated Power
ERCOM	Ercom Engineering Reseaux Communications, France (MAESTRO Partner)
ESA	European Space Agency
ESG	Electronic Service Guide
E-TF1	E-TFI, France (MAESTRO Partner)
ETSI	European Telecommunications Standard Institute
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FDM	Frequency Division Multiplex
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FHG/IIS	Fraunhofer Gesellschaft e.V., Germany (MAESTRO Partner)
FP5	5th Research Framework Program of the European Commission
FP6	6th Research Framework Program of the European Commission
FSS	Fixed Satellite Services
G/T	Figure of merit
GD	Group Delay
GEO	Geostationary Earth Orbit
GF	Gain Flatness
GFI	GFI Consulting, France (MAESTRO Partner)
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GUI	Graphic User Interface
GW	Gateway
HDFSS	High Density FSS
HLR	Home Location Register

HPA	High Power Amplifier
HTML	Hyper Text Markup Language
HW	Hardware
I/O	Input / Output
IBO	Input Back-Off
IMR	Intermediate Module Repeater
IMT-2000	International Mobile Telecommunications 2000
IP	Internet Protocol
IRT	Intelligent Ray Tracing
IST	Information Society & Technology
ITU	International Telecommunication Union
KO	Kick-Off
LBS	Location Based Services
LDR	Large Deployable Reflector
LMS	Land Mobile Satellite
LNA	Low Noise Amplifier
LNB	Low Noise Block
LOGICACMG	LogicaCMG UK Limited, United Kingdom (MAESTRO Partner)
LOS	Line Of Sight
LTWTA	Linearised Travelling Wave Tube Amplifier
MAC	Medium Access Control
MAESTRO	Mobile Applications & sErvices based on Satellite and Terrestrial inteRwOrking
MBMS	Multimedia Broadcast/Multicast Service
MM	MultiMedia
MMI	Man Machine Interface
MMS	Multimedia Messaging Service
MNO	Mobile Network Operator
MoDiS	IST FP5 Mobile Distribution project - MObile DIgital broadcast Satellite
MP3	Moving Picture Experts Group Layer-3 Audio (audio file format/extension)
MPA	Multi-Port Amplifier
MPC	Multi-Port Combiner
MPD	Multi-Port Divider
MPEG4	Motion Picture Experts Group 4 (Standard - Compressed Video at 64 Kbps)
MSC	Mobile Switching Centre
MSPS	Motorola Toulouse SAS, France (MAESTRO Partner)
MSS	Mobile Satellite Services
NLOS	Non Line Of Sight
Node B	UMTS Base Station
O&M	Operation and Maintenance
OBO	Output Back-Off
OMA	Open Mobile Alliance
OMC	Operation and Maintenance Center
OMUX	Output Multiplexer
PA	Power Amplifier
P-CCPCH	Primary Common Control Physical Channel
PCDE	Peak Code Domain Error
PER	Packet Error Rate
PFD	Power Flux Density
PICH	Paging Indicator Channel
PIM	Protocol Interface Module
PLMN	Public Land Mobile Network
P-SCH	Primary Synchronisation Channel
PSSP	Public Security Service Provider
PTP	See p-t-pt
p-t-p	Point to Point
PVR	Personal Video Recorder
QoS	Quality of Service
R1	MAETRO Test Bed Release 1
R2	MAETRO Test Bed Release 2
RAN	Radio Access Network
RLC	Radio Link Control
RNC	Radio Network Controller
RNPT	Radio Network Planning Tool
RNS	Radio Network Subsystem
SAP	Service Access Point
S-CCPCH	Secondary Common Control Physical Channel
SDMB	Satellite Digital Multimedia Broadcasting
S-DMB	See SDMB
SES	SES Astra, Luxembourg (MAESTRO Partner)
SF	Spreading Factor
SFN	Single Frequency Network
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
SMS	Short Message Service
SLA	Service Level Agreement
SPH	Space Hellas SA, Greece (MAESTRO Partner)
S-SCH	Secondary Synchronisation Channel
SSPA	Solid State Power Amplifier
S-UMTS	Satellite UMTS
SW	Software
TBC	To Be Confirmed
TBD	To Be Defined
TDD	Time Division Duplex
T-UMTS	Terrestrial UMTS
TV	Television
TWTA	Travelling Wave Tube Amplifier
UCL	University College London, United Kingdom

	(MAESTRO Partner)
UDCAST	Udcast, France (MAESTRO Partner)
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UNIS	The University of Surrey, United Kingdom (MAESTRO Partner)
UoB	Alma Mater Studiorum Universita Di Bologna, Italy (MAESTRO Partner)
URAN	UMTS Radio Access Network
USB	Universal Serial Bus
UT	User Terminal
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network
Uu	UMTS air interface
W-CDMA	Wideband Code Division Multiple Access
WH	Walsh – Hadamard
WP	Work Package
WRC	World Radio Conference
XHTML	Extensible Hypertext Markup Language
XML	eXtensible Markup Language

4 GENERAL PRESENTATION OF THE PRODUCT

This chapter provides the Commercial Product presentation, without formal requirement.

4.1 Perspectives of the product

The SDMB hub in its context is represented in Figure 1. It has two external interfaces:

- Gmb*/Gi*, enabling the BM-SC+ to feed into the hub data to broadcast, including emergency messages,
- Uu* or Uu*+Iub*, sending to the satellite the data to transmit to the UEs, either through a direct link or through an IMR. The data to transmit through Iub* include user data and control messages to configure the IMR. The Iub* is present only if the IMR are not simple repeaters (on-channel or with frequency conversion) but are Node B based.

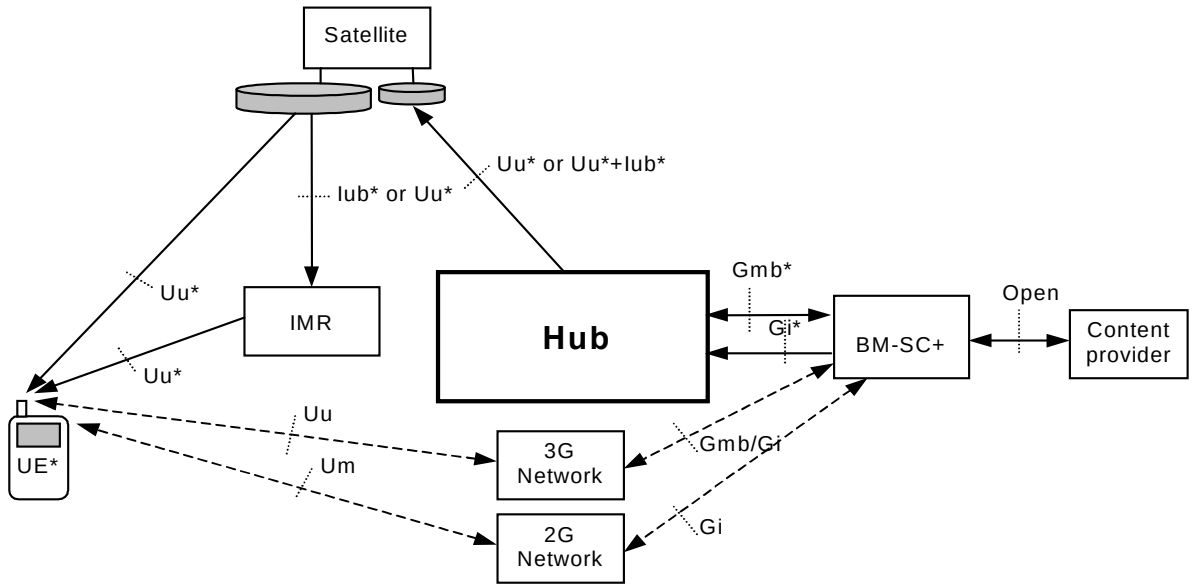

Figure 1 : The SDMB hub in its context

The SDMB hub is a new product, possibly partly based on existing equipment, such as a 3G Node B.

4.2 Definition of the market

The product will be used in the European Union.

4.3 Definition of the missions of the product

The operational missions entrusted to the SDMB hub are described in the document [Mae1]. Figure 2 shows a UML Use Case diagram [UML1] of the SDMB hub, depicting its main operational missions and which actors perform these missions.

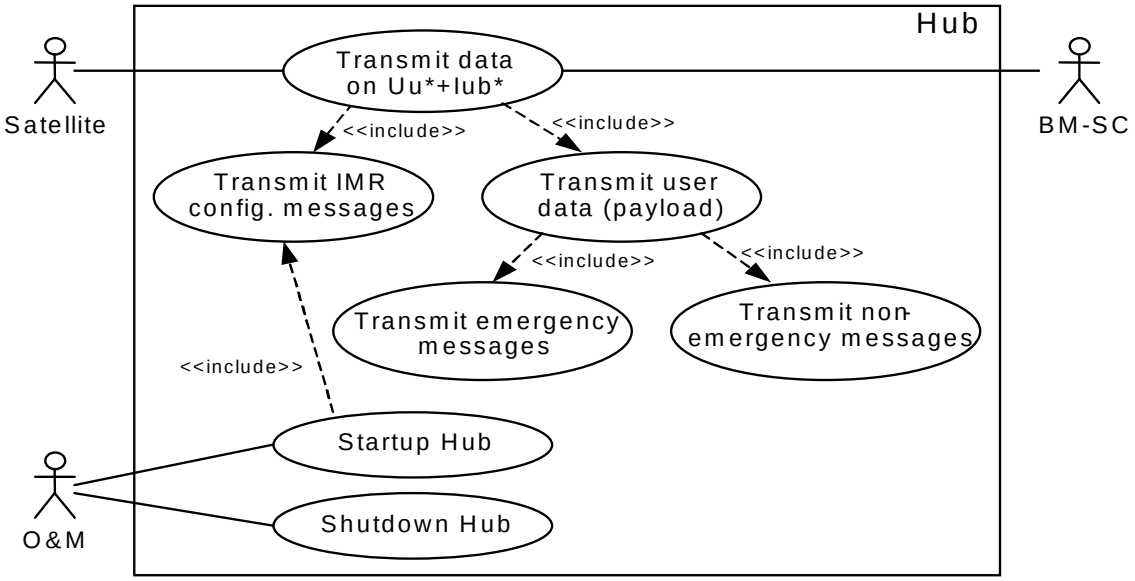

Figure 2 : Use Case diagram of the SDMB hub

4.4 Category of users and associated characteristics

The category of users and associated characteristics of the SDMB hub are described in the document [Mae1].

4.5 Operating environment

See section 4.1.

4.6 Dimensioning

One hub transmits data over 1 to 6 spots.

4.7 Hypotheses

- As system baseline, it is assumed that there is no on-board duplication, i.e. the feeder uplink is not duplicated inside the satellite to transmit the direct and indirect service down-link.
- An unidirectional link is used towards UE and IMR.
- The baseline for the hub design is to use frequency conversion repeaters.
- The hub transmits only towards one satellite, the multi-satellite feature for the hub is for further study..
- Several BM-SCs may interface with one hub.

5 COMMERCIAL PRODUCT REQUIREMENTS

This section addresses the requirements of the commercial product, derived from the Mission Requirements.

5.1 External Interface requirements

Reference **MAE-D6-5-C-REQ-001**

The Hub shall support the Gmb* signalling plane interface with the BM-SC to control the establishment of broadcast bearers.

*

Reference **MAE-D6-5-C-REQ-002**

The Hub shall support the Gi* interface with the BM-SC.

*

Reference **MAE-D6-5-C-REQ-003**

The Hub shall support the unidirectional downlink Uu* interface with the UE.

*

Reference **MAE-D6-5-C-REQ-004**

The Hub may support the unidirectional Iub* interface with the Node B based IMR.

*

5.2 Operational requirements

5.2.1 Operations preparation

5.2.1.1 Development system

Not applicable

5.2.1.2 Associated validation system

Not applicable

5.2.1.3 Associated maintenance system

Not applicable

5.2.2 Operability

5.2.2.1 General requirements for operability

Reference **MAE-D6-5-C-REQ-040**

The hub shall be configured and supervised via a remote and a local O&M machine.

*

5.2.2.2 Ergonomics – human factors

Not applicable, as the hub is not directly handled by the end-users.

5.2.3 Operation scenarios

This section defines the applicable operational scenarios, considering the interactions between the product and its users or externals systems. These scenarios are defined as UML 2.0 sequence diagrams [UML1]. Each scenario describes a use case from Figure 2.

5.2.3.1 Specification of scenario «transmit data on Uu*+Iub*»

If the IMR are based on existing Node Bs (already in operation, with cells created in the T-UMTS frequency bands), additional cells must be created in the 2.17-2.2 GHz IMT 2000 MSS frequency band. Then in each cell, the channels necessary for SDMB must be created (SCH, S-CCPCH, etc.).

The UML Sequence Diagram in Figure 3 illustrates that the hub must first transmit the configuration commands (Tx_IMR_config) to the IMR through the satellite, then the configuration commands shall be repeated periodically, or data shall be transmitted to the SDMB end-users.

The configuration commands are repeated periodically because as the satellite does not provide any return link, the hub is not informed of their correct reception and execution. For example an IMR can be off while a configuration command is transmitted.

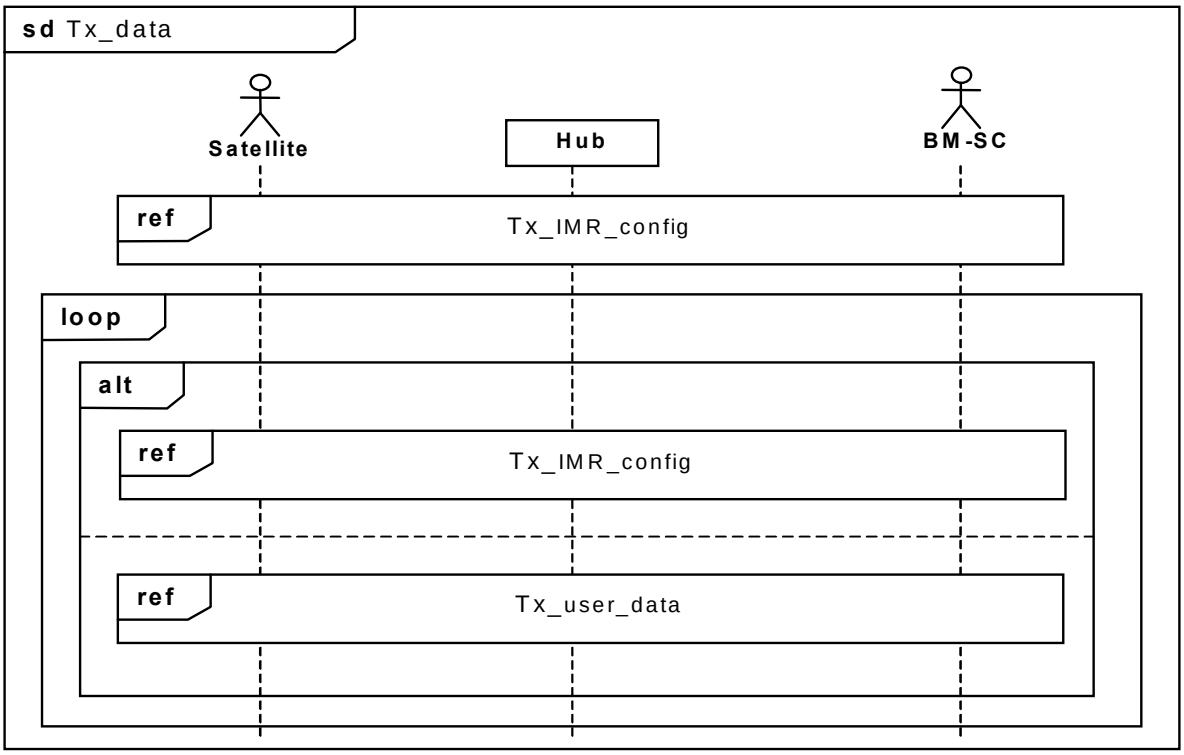

Figure 3 : Sequence diagram «transmit data »

5.2.3.2 Specification of scenario «transmit IMR config»

The Sequence Diagram in Figure 4 shows the hub transmitting the configuration commands (Tx_IMR_config) to the IMR through the satellite, repeated periodically.

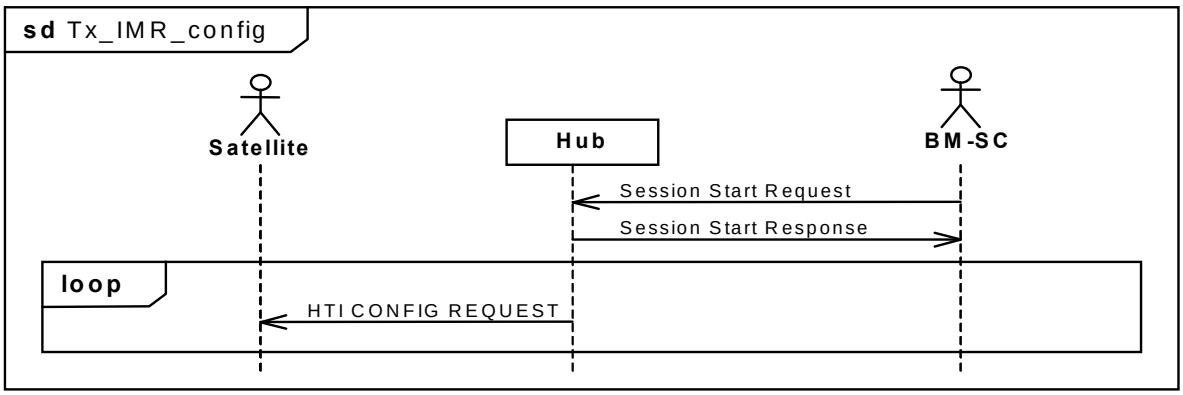

Figure 4 : Sequence diagram «transmit IMR config»

5.2.3.3 Specification of scenario «transmit user data»

The Sequence Diagram in Figure 5 shows the hub transmitting user data to the IMR through the satellite. Each FACH Data Frame carrying the data is transmitted both on the direct link to the UEs and on the indirect link to the IMRs.

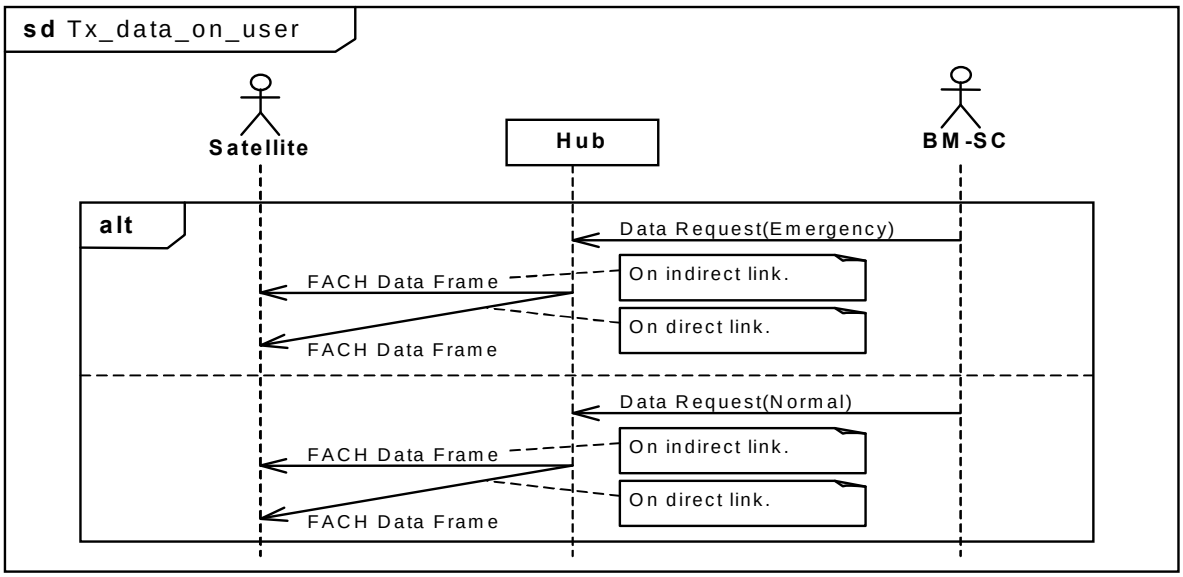

Figure 5 : Sequence diagram «transmit user data»

As for any service the hub shall not repeat an emergency message automatically, the BM-SC is in charge to ask several transmissions.

5.3 Functional requirements

5.3.1 Specification of the product states

The SDMB hub functional architecture, represented in Figure 6: The hub functional architecture, without Iub transmission, contains the following functional entities:

- a SSN (SDMB Support Node), to interface the hub with the BM-SC,
- a RNC, to control the Node B and to transmit data from BM-SC over Uu,
- a Node B,
- a Radio Transmitter, to transmit the Uu signals for the direct and indirect links to the satellite.

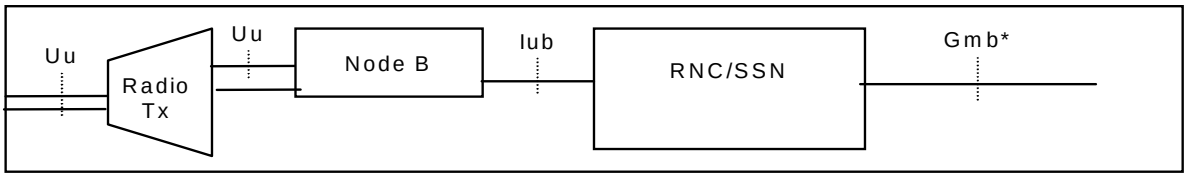

Figure 6 : The hub functional architecture (baseline)

- The previous architecture corresponds to the solution where the IMRs are transparent repeaters, the hub has 2 Tx outputs at different frequencies and a configurable delay for one output.. For the option where the IMRs are based on Node B, the HTI Tx is added, as depicted in Figure 7.
- As an option, a HTI Tx (Hub To IMR Transceiver), to convert the bi-directional Iub interface into a unidirectional Iub interface, named Iub*,

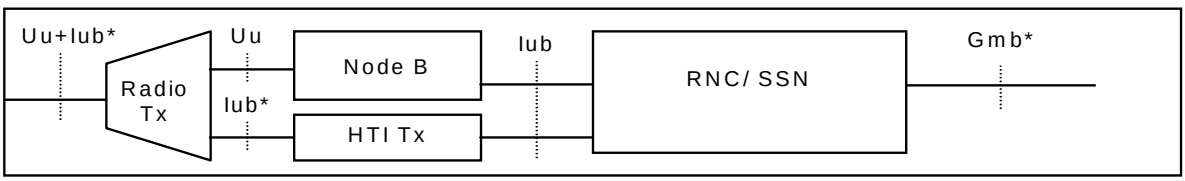

Figure 7 : The hub functional architecture (with Iub Tx option)

5.3.2 Protocol stack

The SDMB hub protocol architecture, represented in the figure below gives the protocol stacks used for the external interface towards the UE and the BM-SC.

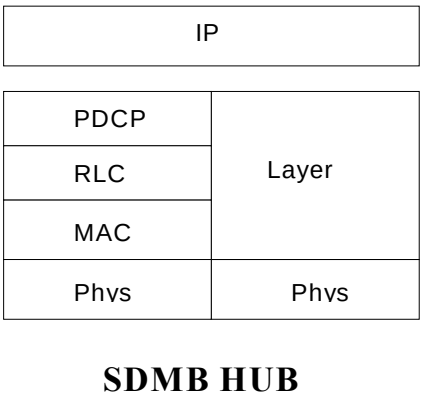

Figure 8 : The hub protocol architecture

5.3.3 Function Controller (RNC/SSN)

Reference **MAE-D6-5-C-REQ-011**

The hub shall be able to delay the direct link transmission versus the indirect one to insure coherent reception of both signals by the SDMB terminal Rake receiver taking into account the delay caused by IMR.

*

Reference **MAE-D6-5-C-REQ-012**

The hub shall be transparent to the deployment of on-channel repeaters, i.e. the hub shall not include any feature related to the on-channel repeater.

*

Reference **MAE-D6-5-C-REQ-013**

As an option, the hub should be able to transmit an unidirectional Iub on the indirect link (Node B based IMR).

*

Reference **MAE-D6-5-C-REQ-014**

The Hub shall support the 3GPP stack for MBMS broadcast and UE idle mode (BCCH) as defined in D3-1.

*

Reference **MAE-D6-5-C-REQ-015**

The Hub shall support at least one algorithm for radio Resource Management as defined in D3-1.

*

Reference **MAE-D6-5-C-REQ-016**

The Hub shall support the Flow control procedure as defined in D3-1.

*

Reference **MAE-D6-5-C-REQ-021**

The Hub will support neither static nor dynamic power control at physical channel level. (power commands may be transmitted to the satellite via the space segment control).

*

The following requirements verifies the system requirements as defined in MAESTRO Deliverable D6-1, SDMB System Technical Requirement [Mae1]:

Reference **MAE-D6-5-C-REQ-029**

The SDMB hub shall be designed without any interface/protocol on the return link with the UEs and the IMRs.

*Satisfies: **[MAE-D6-1-C-REQ-004]***

*

Reference **MAE-D6-5-C-REQ-030**

To process the Emergency notifications, the hub may use priority mechanisms impacting some ongoing data transfer.

*Satisfies: **[MAE-D6-1-C-REQ-105]***

*

Reference **MAE-D6-5-C-REQ-031**

The hub shall provide procedures to modify the number and capacity of the transport/logical channels per spot area (the impact on the on-going broadcast sessions is TBD).

*Satisfies: **[MAE-D6-1-C-REQ-043]***

*

Reference **MAE-D6-5-C-REQ-032**

The hub shall provide background as well as streaming traffic class capabilities.

*Satisfies: **[MAE-D6-1-C-REQ-045]***

*

Reference **MAE-D6-5-C-REQ-033**

The hub shall be able to support multi-vendor terrestrial repeaters, i.e. the interfaces from the hub to the IMR shall be public or standardised.

*Satisfies: **[MAE-D6-1-C-REQ-093]***

*

Reference **MAE-D6-5-C-REQ-034**

The hub shall collect informations like requested QOS, data size per download/streaming session to be able to charge for the satellite capacity usage.

*Satisfies: **[MAE-D6-1-C-REQ-108]***

*

5.3.4 Function Radio (Node B/Radio Tx)

Reference **MAE-D6-5-C-REQ-017**

The Hub shall provide 3GPP standardised UTRA FDD W-CDMA carriers between the S-DMB hub and the UE via satellite segment.

*

Reference **MAE-D6-5-C-REQ-005**

The hub shall transmit per spot beam two identical W-CDMA signals: one for the direct link towards SDMB terminals and one for the indirect link towards the SDMB IMRs.

*

Reference **MAE-D6-5-C-REQ-006**

The hub shall generate several W-CDMA signals (one per spot beam) with different scrambling code for the direct link.

*

Reference **MAE-D6-5-C-REQ-035**

Every W-CDMA signal shall be transmitted by the hub using a different 5MHz frequency channel, i.e. for a system configuration with 6 spots, 6 times 5 Mhz-channels will be transmitted by the hub for the direct link covering a 30 Mhz frequency band.

*

Reference **MAE-D6-5-C-REQ-007**

The feeder uplink for the direct link shall use Ka frequency band (27.5/30 GHz) as baseline.

*

Reference **MAE-D6-5-C-REQ-008**

The feeder uplink for the direct link may use Ku frequency band (13.75/14.5 GHz) or C frequency band (5.850/6.725 or 7.025/7.075 GHz) as option.

*

Reference **MAE-D6-5-C-REQ-009**

The hub shall generate several W-CDMA signals (one per spot beam) with different scrambling code for the indirect link.

*

Reference **MAE-D6-5-C-REQ-010**

The feeder link for the indirect link shall use Ka frequency band (27.5/30 GHz) as baseline.

*

Reference **MAE-D6-5-C-REQ-042**

The feeder uplink for the indirect link may use Ku frequency band (13.75/14.5 GHz) or C frequency band (5.850/6.725 or 7.025/7.075 GHz) as option.

*

Reference **MAE-D6-5-C-REQ-039**

The hub shall compensate the loss due to rain to maintain the same link budget between the hub and the satellite. Output power may be reduced in good weather conditions and increased in case of rainy conditions at the hub location.

*

5.3.5 Function Antenna

For Further Study with inputs from WP2 link budget analysis.

5.4 Performance requirements

Reference **MAE-D6-5-C-REQ-018**

The Hub shall be compliant to the frequency error requirement given in TS 25.104 section 6.3, i.e. an accuracy of ±0.05 ppm (TBC: this precision is coming from the 3GPP spec for a 2Ghz frequency but needs to be confirmed for a Ka band frequency)

*

Reference **MAE-D6-5-C-REQ-020**

The Hub shall be able to support a S-CCPCH data rate up to 384 kb/s. (Minimum: TBC).

*

Reference **MAE-D6-5-C-REQ-041**

The output EIRP per channel is TBD.

*

Reference **MAE-D6-5-C-REQ-037**

The hub shall minimize any buffering delay and not exceed few seconds to respect the system performances.

Satisfies: ***[MAE-D6-1-C-REQ-056]***

Satisfies: ***[MAE-D6-1-C-REQ-115]***

*

Reference **MAE-D6-5-C-REQ-036**

The Hub shall be able to synchronise the transmission of the indirect and direct links to achieve signal recombination by the SDMB terminal rake receiver. The precision shall be +/- 1 µs. The time difference shall be in the range [0 µs , 40 µs] (**TBC**).

*

5.5 Capacity requirements

Reference **MAE-D6-5-C-REQ-019**

The Hub shall be able to transmit up to 8 S-CCPCHs per frequency channel.

*

Dimensioning:

Reference **MAE-D6-5-C-REQ-023**

The Hub shall be able to support the Gmb* and Gi* interfaces with more than one BM-SC (max number for further study).

*

Reference **MAE-D6-5-C-REQ-024**

The Hub shall provide several spot beams (equivalent with several UMTS cells). At least six spot beams shall be supported by one hub for European coverage.

*

5.6 Security Requirements

For further study.

5.7 RAMS requirements

5.7.1 Reliability

For further study.

5.7.2 Availability and Continuity

Reference **MAE-D6-5-C-REQ-025**

In case of Hub failure, the service shall be maintained in all the spot beams covered by the Hub. See annex for details about the solutions.

Satisfies: ***[MAE-D6-1-C-REQ-081]***

Satisfies: ***[MAE-D6-1-C-REQ-125]***

*

5.7.3 Maintainability

For further study.

5.8 Environment requirements

5.8.1 Mechanical Interface Requirements

5.8.1.1 Dimensions, Mass

For further study.

5.8.2 Environmental Constraints

These requirements are caused by the environmental conditions to which the product is subjected but also by those which it can create while it is being set up and used in a nominal situation or otherwise.

The environmental conditions should not cause any deterioration or alteration in the performance of the product.

The environments are specified for all the stages of the product's lifecycle from the moment it is produced. For example storage and operational environments.

5.8.2.1 Mechanical environment

For further study.

5.8.2.2 Natural environment

These requirements are defined in terms of pressure, temperature TBD, and humidity.

5.8.2.3 Radiation environment

Requirements on electromagnetic compatibility. For further study.

5.8.3 Power Supply Requirements

For further study

5.9 Design and Development requirements

5.9.1 Interfaces

5.9.2 Reusability

For further study.

5.9.3 S/W technologies and processes

For further study

5.9.4 Particular instructions for materials and procedures

For further study.

5.9.5 Robustness

For further study.

5.9.6 Efficiency margins

For further study .

5.9.7 Expansion capability - Potential for additional services

For further study.

5.9.8 Portability

For further study.

5.9.9 Mechanical design

These requirements deal with measures defined for the mechanical design of the product.

5.9.10 Electrical design

T*hese requirements deal with measures defined for the electrical design of the product.*

5.9.11 Production

For further study.

5.10 Integrated Logistic Support requirements

For further study.

5.10.1 Test and trouble-shooting support equipment

For further study .

5.10.2 Deployment configuration requirements

For further study.

5.10.3 Databases

Not applicable.

5.10.4 Packaging, handling, storage and transport

For further study.

5.11 Result Assurance requirements

5.11.1 Requirements relating to the qualification of the product

For further study.

5.11.2 Requirements relating to the acceptance conditions of the product

For further study.

5.11.3 Requirements relating to the verification of the product

For further study.

5.11.4 Strategy relating to the validation of the product

For further study

5.11.5 Applicability of the Commercial Product requirements to the Test Bed R2

The aim of this section is to review each Commercial Product requirements of the chapter 5, to indicate its applicability in the scope of the test bed R2 :

- A stands for "fully Applicable",
- PA stands for "Partially Applicable",
- NA stands for "Not Applicable",

PUID	*§ N°*	*Requirements Specification*	*MAE TBR2 App.*	*MAE TBR2 Justification*
	§5	**5 Commercial Product Requirements**		
	§5.1	**5.1 External Interface requirements**		
[MAE-D6-5-C-REQ-001]	§5.1	The Hub shall support the Gmb* signalling plane interface with the BM-SC to control the establishment of broadcast bearers.	PA	
[MAE-D6-5-C-REQ-002]	§5.1	The Hub shall support the Gi* interface with the BM-SC.	PA	
[MAE-D6-5-C-REQ-003]	§5.1	The Hub shall support the unidirectional downlink Uu* interface with the UE.	PA	Part of Uu interface is supported with the UE
[MAE-D6-5-C-REQ-004]	§5.1	The Hub may support the unidirectional Iub* interface with the Node B based IMR.	NA	
	§5.2	**5.2 Operational requirements**		
	§5.2.2	**5.2.2 Operability**		
	§5.2.2.1	**5.2.2.1 General requirements for operability**		
[MAE-D6-5-C-REQ-040]	§5.2.2.1	The hub shall be configured and supervised via a remote and a local O&M machine.		
	§5.3	**5.3 Functional requirements**		
	§5.3.3	**5.3.3 Function Controller (RNC/SSN)**		
[MAE-D6-5-C-REQ-011]	§5.3.3	The hub shall be able to delay the direct link transmission versus the indirect one to insure coherent reception of both signals by the SDMB terminal Rake receiver taking into account the delay caused by IMR.	NA	
[MAE-D6-5-C-REQ-012]	§5.3.3	The hub shall be transparent to the deployment of on-channel repeaters, i.e. the hub shall not include any feature related to the on-channel repeater.	A	
[MAE-D6-5-C-REQ-013]	§5.3.3	As an option, the hub should be able to transmit an unidirectional Iub on the indirect link (Node B based IMR).	NA	
[MAE-D6-5-C-REQ-014]	§5.3.3	The Hub shall support the 3GPP stack for MBMS broadcast and UE idle mode (BCCH) as defined in D3-1.	PA	*Partly compliant since MBMS is not supported in release 2, only 3GPP R99 data broadcast and UE idle mode are supported.*
[MAE-D6-5-C-REQ-015]	§5.3.3	The Hub shall support at least one algorithm for radio Resource Management as defined in D3-1.	NA	
[MAE-D6-5-C-REQ-016]	§5.3.3	The Hub shall support the Flow control procedure as defined in D3-1.	NA	

PUID	*§ N°*	*Requirements Specification*	*MAE TBR2 App.*	*MAE TBR2 Justification*
[MAE-D6-5-C-REQ-021]	§5.3.3	The Hub will support neither static nor dynamic power control at physical channel level. (power commands may be transmitted to the satellite via the space segment control).	A	
[MAE-D6-5-C-REQ-029]	§5.3.3	The SDMB hub shall be designed without any interface/protocol on the return link with the UEs and the IMRs.	A	
[MAE-D6-5-C-REQ-030]	§5.3.3	To process the Emergency notifications, the hub may use priority mechanisms impacting some ongoing data transfer.	NA	
[MAE-D6-5-C-REQ-031]	§5.3.3	The hub shall provide procedures to modify the number and capacity of the transport/logical channels per spot area (the impact on the on-going broadcast sessions is TBD).	PA	
[MAE-D6-5-C-REQ-032]	§5.3.3	The hub shall provide background as well as streaming traffic class capabilities.	A	
[MAE-D6-5-C-REQ-033]	§5.3.3	The hub shall be able to support multi-vendor terrestrial repeaters, i.e. the interfaces from the hub to the IMR shall be public or standardised.	PA	Only on-channel repeater is used for TBR2 therefore there is no specific interface between Hub and IMR
[MAE-D6-5-C-REQ-034]	§5.3.3	The hub shall collect informations like requested QOS, data size per download/streaming session to be able to charge for the satellite capacity usage.	NA	
	§5.3.4	**5.3.4 Function Radio (Node B/Radio Tx)**		
[MAE-D6-5-C-REQ-017]	§5.3.4	The Hub shall provide 3GPP standardised UTRA FDD W-CDMA carriers between the S-DMB hub and the UE via satellite segment.	A	
[MAE-D6-5-C-REQ-005]	§5.3.4	The hub shall transmit per spot beam two identical W-CDMA signals: one for the direct link towards SDMB terminals and one for the indirect link towards the SDMB IMRs.	NA	
[MAE-D6-5-C-REQ-006]	§5.3.4	The hub shall generate several W-CDMA signals (one per spot beam) with different scrambling code for the direct link.	NA	
[MAE-D6-5-C-REQ-035]	§5.3.4	Every W-CDMA signal shall be transmitted by the hub using a different 5MHz frequency channel, i.e. for a system configuration with 6 spots, 6 times 5 Mhz-channels will be transmitted by the hub for the direct link covering a 30 Mhz frequency band.	NA	
[MAE-D6-5-C-REQ-007]	§5.3.4	The feeder uplink for the direct link shall use Ka frequency band (27.5/30 GHz) as baseline.	NA	
[MAE-D6-5-C-REQ-008]	§5.3.4	The feeder uplink for the direct link may use Ku frequency band (13.75/14.5 GHz) or C frequency band (5.850/6.725 or 7.025/7.075 GHz) as option.	NA	
[MAE-D6-5-C-REQ-009]	§5.3.4	The hub shall generate several W-CDMA signals (one per spot beam) with different scrambling code for the indirect link.	NA	
[MAE-D6-5-C-REQ-010]	§5.3.4	The feeder link for the indirect link shall use Ka frequency band (27.5/30 GHz) as baseline.	NA	

PUID	*§ N°*	*Requirements Specification*	*MAE TBR2 App.*	*MAE TBR2 Justification*
[MAE-D6-5-C-REQ-042]	§5.3.4	The feeder uplink for the indirect link may use Ku frequency band (13.75/14.5 GHz) or C frequency band (5.850/6.725 or 7.025/7.075 GHz) as option.		
[MAE-D6-5-C-REQ-039]	§5.3.4	The hub shall compensate the loss due to rain to maintain the same link budget between the hub and the satellite. Output power may be reduced in good weather conditions and increased in case of rainy conditions at the hub location.	NA	
	§5.4	**5.4 Performance requirements**		
[MAE-D6-5-C-REQ-018]	§5.4	The Hub shall be compliant to the frequency error requirement given in TS 25.104 section 6.3, i.e. an accuracy of ±0.05 ppm (TBC: this precision is coming from the 3GPP spec for a 2Ghz frequency but needs to be confirmed for a Ka band frequency)	A	
[MAE-D6-5-C-REQ-020]	§5.4	The Hub shall be able to support a S-CCPCH data rate up to 384 kb/s. (Minimum: TBC).	A	
[MAE-D6-5-C-REQ-041]	§5.4	The output EIRP per channel is TBD.		
[MAE-D6-5-C-REQ-037]	§5.4	The hub shall minimize any buffering delay and not exceed few seconds to respect the system performances.	A	
[MAE-D6-5-C-REQ-036]	§5.4	The Hub shall be able to synchronise the transmission of the indirect and direct links to achieve signal recombination by the SDMB terminal rake receiver. The precision shall be +/- 1 µs. The time difference shall be in the range [0 µs , 40 µs] (**TBC**).	NA	
	§5.5	**5.5 Capacity requirements**		
[MAE-D6-5-C-REQ-019]	§5.5	The Hub shall be able to transmit up to 8 S-CCPCHs per frequency channel.	PA	
[MAE-D6-5-C-REQ-023]	§5.5	The Hub shall be able to support the Gmb* and Gi* interfaces with more than one BM-SC (max number for further study).	NA	
[MAE-D6-5-C-REQ-024]	§5.5	The Hub shall provide several spot beams (equivalent with several UMTS cells). At least six spot beams shall be supported by one hub for European coverage.	NA	
	§5.7	**5.7 RAMS requirements**		
	§5.7.2	**5.7.2 Availability and Continuity**		
[MAE-D6-5-C-REQ-025]	§5.7.2	In case of Hub failure, the service shall be maintained in all the spot beams covered by the Hub. See annex for details about the solutions.	NA	

6 TEST BED R2 REQUIREMENTS

6.1 Traceability from the applicable Commercial Product requirements to the Test Bed R2 Product requirements

The aim of this section is to summarize all the Commercial Product requirements tagged as "fully **A**pplicable" or "**P**artially **A**pplicable" in the section 5.11.5 and to associate them the Test Bed Product Requirement verifying them in the Test Bed R2 scope.

Concerning the SDMB hub, the difference between R1 and R2 are the following:

- test bed R1: the feature to be validated is the handling of FACH by the RNC simulator; the validation will be performed by asking the RNC to set up one cell (in the Node B) and checking that the Node B answers correctly (NBAP procedure CELL SETUP RESPONSE). Then asking the RNC to transmit an FACH data frame, and checking that in the Node B log that the data frame has been received.
- test bed R2: to validate the Gmb* and Gi* interfaces, a BM-SC connected to the hub shall transmit data, and it shall be verified that they are delivered through the Uu interface.

PUID	*§ N°*	*Requirements Specification*	*MAE TBR2 App.*	*MAE TBR2 Justification*	*verified by...*
	§5	**5 Commercial Product Requirements**			
	§5.1	**5.1 External Interface requirements**			
[MAE-D6-5-C-REQ-001]	§5.1	The Hub shall support the Gmb* signalling plane interface with the BM-SC to control the establishment of broadcast bearers.	PA		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-009]** The RNC shall interface with the BM-SC using ethernet link from which it receives data to broadcast.
[MAE-D6-5-C-REQ-002]	§5.1	The Hub shall support the Gi* interface with the BM-SC.	PA		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-009]** The RNC shall interface with the BM-SC using ethernet link from which it receives data to broadcast.
[MAE-D6-5-C-REQ-003]	§5.1	The Hub shall support the unidirectional downlink Uu* interface with the UE.	PA	Part of Uu interface is supported with the UE	MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-003]** The Node B shall comply to the 3GPP specifications described in TS 25.104
	§5.2	**5.2 Operational requirements**			
	§5.2.2	**5.2.2 Operability**			
	§5.2.2.1	**5.2.2.1 General requirements for operability**			
[MAE-D6-5-C-REQ-040]	§5.2.2.1	The hub shall be configured and supervised via a remote and a local O&M machine.			

PUID	*§ N°*	*Requirements Specification*	*MAE TBR2 App.*	*MAE TBR2 Justification*	*verified by...*
	§5.3	**5.3 Functional requirements**			
	§5.3.3	**5.3.3 Function Controller (RNC/SSN)**			
[MAE-D6-5-C-REQ-012]	§5.3.3	The hub shall be transparent to the deployment of on-channel repeaters, i.e. the hub shall not include any feature related to the on-channel repeater.	A		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-014]** The hub shall not be impacted by the use of on-channel repeaters even the output Tx power shall not be modified since it is tuned to simulate the pathloss between the satellite and the UE.
[MAE-D6-5-C-REQ-014]	§5.3.3	The Hub shall support the 3GPP stack for MBMS broadcast and UE idle mode (BCCH) as defined in D3-1.	PA	*Partly compliant since MBMS is not supported in release 2, only 3GPP R99 data broadcast and UE idle mode are supported.*	MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-015]** The RNC simulator shall transmit all the required channels (see D3.1 for the details) to allow the UE to reach the idle mode.
[MAE-D6-5-C-REQ-021]	§5.3.3	The Hub will support neither static nor dynamic power control at physical channel level. (power commands may be transmitted to the satellite via the space segment control).	A		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-010]** The RNC shall feature a simplified MMI (Man Machine Interface) to modify parameters such as: - SIB content - Node B configuration parameters - Internal parameters (e.g. : name of the source file to transmit, ...)
[MAE-D6-5-C-REQ-029]	§5.3.3	The SDMB hub shall be designed without any interface/protocol on the return link with the UEs and the IMRs.	A		
[MAE-D6-5-C-REQ-031]	§5.3.3	The hub shall provide procedures to modify the number and capacity of the transport/logical channels per spot area (the impact on the on-going broadcast sessions is TBD).	PA		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-010]** The RNC shall feature a simplified MMI (Man Machine Interface) to modify parameters such as: - SIB content - Node B configuration parameters - Internal parameters (e.g. : name of the source file to transmit, ...)
[MAE-D6-5-C-REQ-032]	§5.3.3	The hub shall provide background as well as streaming traffic class capabilities.	A		

PUID	*§ N°*	*Requirements Specification*	*MAE TBR2 App.*	*MAE TBR2 Justification*	*verified by...*
[MAE-D6-5-C-REQ-033]	§5.3.3	The hub shall be able to support multi-vendor terrestrial repeaters, i.e. the interfaces from the hub to the IMR shall be public or standardised.	PA	Only on-channel repeater is used for TBR2 there-fore there is no specific interface between Hub and IMR	
	§5.3.4	**5.3.4 Function Radio (Node B/Radio Tx)**			
[MAE-D6-5-C-REQ-017]	§5.3.4	The Hub shall provide 3GPP standard-ised UTRA FDD W-CDMA carriers between the S-DMB hub and the UE via satellite segment.	A		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-013]** The Node B should output data over a 3GPP standardised UTRA FDD W-CDMA carrier in the UMTS frequency range : 2.11GHz = F = 2.17GHz.
[MAE-D6-5-C-REQ-042]	§5.3.4	The feeder uplink for the indirect link may use Ku frequency band (13.75/14.5 GHz) or C frequency band (5.850/6.725 or 7.025/7.075 GHz) as option.			
	§5.4	**5.4 Performance requirements**			
[MAE-D6-5-C-REQ-018]	§5.4	The Hub shall be compliant to the frequency error requirement given in TS 25.104 section 6.3, i.e. an accuracy of ±0.05 ppm (TBC: this precision is coming from the 3GPP spec for a 2Ghz frequency but needs to be confirmed for a Ka band frequency)	A		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-003]** The Node B shall comply to the 3GPP specifications described in TS 25.104
[MAE-D6-5-C-REQ-020]	§5.4	The Hub shall be able to support a S-CCPCH data rate up to 384 kb/s. (Minimum: TBC).	A		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-006]** The RNC shall support a FACH user rate of 384kbps.
[MAE-D6-5-C-REQ-041]	§5.4	The output EIRP per channel is TBD.			
[MAE-D6-5-C-REQ-037]	§5.4	The hub shall minimize any buffering delay and not exceed few seconds to respect the system performances.	A		
	§5.5	**5.5 Capacity requirements**			
[MAE-D6-5-C-REQ-019]	§5.5	The Hub shall be able to transmit up to 8 S-CCPCHs per frequency channel.	PA		MAE-D6-5.2-TB **[MAE-D6-5-T-REQ-004]** The hub (RNC simulator and Node B) shall be able to generate multiple S-CCPCH.

6.2 Test Bed R2 specific requirements

Reference **MAE-D6-5-T-REQ-001**

The hub shall demonstrate a broadcast link towards the UE using a multicast adressing scheme.

Satisfies: ***[MAE-D6-1-T-REQ-062]***

Satisfies: ***[MAE-D6-1-T-REQ-108]***

*

Reference **MAE-D6-5-T-REQ-014**

The hub shall not be impacted by the use of on-channel repeaters even the output Tx power shall not be modified since it is tuned to simulate the pathloss between the satellite and the UE.

Verifies: ***[MAE-D6-5-C-REQ-012]***

*

Reference **MAE-D6-5-T-REQ-002**

The hub shall be composed of a node B and a RNC emulator.

Satisfies: ***[MAE-D6-1-T-REQ-028]***

*

Reference **MAE-D6-5-T-REQ-003**

The Node B shall comply to the 3GPP specifications described in TS 25.104

Satisfies: ***[MAE-D6-1-T-REQ-030]***

Satisfies: ***[MAE-D6-1-T-REQ-032]***

Verifies: ***[MAE-D6-5-C-REQ-003]***

Verifies: ***[MAE-D6-5-C-REQ-018]***

*

Reference **MAE-D6-5-T-REQ-004**

The hub (RNC simulator and Node B) shall be able to generate multiple S-CCPCH.

Comment: *Under study, since Node B capability is only one S-CCPCH per cell*

Satisfies: ***[MAE-D6-1-T-REQ-038]***

Verifies: ***[MAE-D6-5-C-REQ-019]***

*

Reference **MAE-D6-5-T-REQ-013**

The Node B should output data over a 3GPP standardised UTRA FDD W-CDMA carrier in the UMTS frequency range : 2.11GHz = F = 2.17GHz.

Satisfies: ***[MAE-D6-1-T-REQ-078]***

Verifies: ***[MAE-D6-5-C-REQ-017]***

*

Reference **MAE-D6-5-T-REQ-005**

The Node B should interface on one side to the propagation channel and on the other side to RNC.

Satisfies: ***[MAE-D6-1-T-REQ-029]***

*

Reference **MAE-D6-5-T-REQ-006**

The RNC shall support a FACH user rate of 384kbps.

Satisfies: ***[MAE-D6-1-T-REQ-047]***

Verifies: ***[MAE-D6-5-C-REQ-020]***

*

Reference **MAE-D6-5-T-REQ-007**

The RNC simulator should feature broadcast support adapted to MAESTRO platform constraints.

Satisfies: ***[MAE-D6-1-T-REQ-035]***

*

Reference **MAE-D6-5-T-REQ-008**

The RNC simulator shall include an internal data generator used to generate extra S-CCPCH.

Satisfies: ***[MAE-D6-1-T-REQ-036]***

*

Reference **MAE-D6-5-T-REQ-009**

The RNC shall interface with the BM-SC using ethernet link from which it receives data to broadcast.

Satisfies: ***[MAE-D6-1-T-REQ-049]***

Satisfies: ***[MAE-D6-1-T-REQ-072]***

Verifies: ***[MAE-D6-5-C-REQ-001]***

Verifies: ***[MAE-D6-5-C-REQ-002]***

*

Reference **MAE-D6-5-T-REQ-010**

The RNC shall feature a simplified MMI (Man Machine Interface) to modify parameters such as:

Satisfies: ***[MAE-D6-1-T-REQ-051]***

Verifies: ***[MAE-D6-5-C-REQ-031]***

Verifies: ***[MAE-D6-5-C-REQ-021]***

- SIB content
- Node B configuration parameters
- Internal parameters (e.g. : name of the source file to transmit, ...)

*

Reference **MAE-D6-5-T-REQ-011**

The RNC simulator shall send all data required for FACH configuration within the system information 5.

Satisfies: ***[MAE-D6-1-T-REQ-037]***

*

Reference **MAE-D6-5-T-REQ-015**

The RNC simulator shall transmit all the required channels (see D3.1 for the details) to allow the UE to reach the idle mode.

Verifies: ***[MAE-D6-5-C-REQ-014]***

*

Reference **MAE-D6-5-T-REQ-012**

The Output power level of the Node B shall be:

Satisfies: ***[MAE-D6-1-T-REQ-031]***

- Minimum : 30 dBm
- Maximum : 43dBm

*

7 ESTIMATION OF THE DEVELOPMENT COST OF THE SDMB HUB

This section provides an estimate of the development cost of the SDMB hub, corresponding to the Commercial Product version. Two versions exist for the SDMB hub, depending on the choice made:

- either the hub transmits Iub* (in addition to Uu*) to the satellite, to feed Node B based terrestrial repeaters (IMRs)
- or the hub transmits Uu* only to the satellite, to feed simple terrestrial repeaters

In addition, the hub can de designed to be fault tolerant or not.

To achieve a complete evaluation of the recurrent and non-recurrent cost associated to the development of an SDMB hub, the following feature list has been drafted :

- Support of frequency conversion IMR
- Support of Node B based IMR
- Redundancy
- MBMS Release 6
- MBMS Release 7
- Inter-working with several BM-SCs.

As conclusion, ROM (Rough Order of Magnitude) prices will be presented.

7.1 SDMB hub with Iub* and Uu* transmission

This version of the SDMB hub corresponds to IMRs based on a Node B, i.e. not simple Uu* repeaters. The equipment in the following table is based on the physical architecture shown in Figure 8.

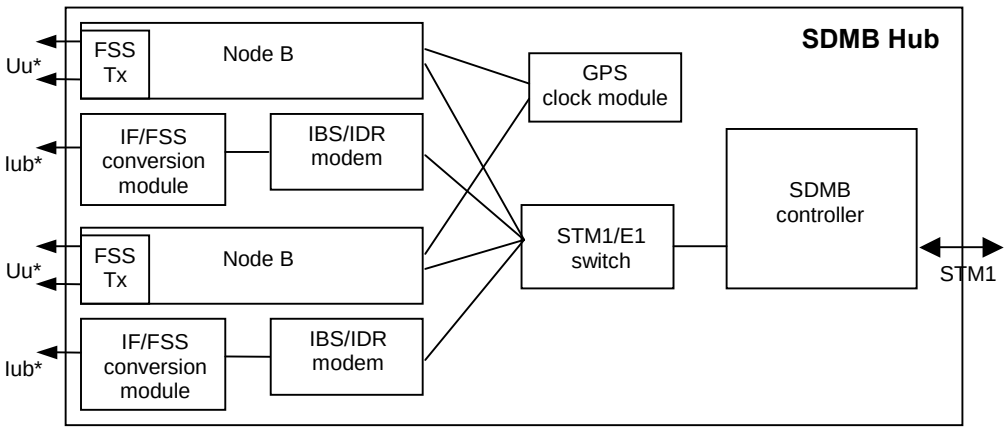

Figure 8: SDMB hub with Iub and Uu transmission physical architecture

Item	Quantity	Unit price	Price
Node B (for direct link) for n (TBD) carriers, with GPS synchronisation capability. No Tx diversity is required.	TBD		
48 V power supply for Node B(s)	TBD		
Hub controller hardware (implements the RNC, SSN and HTI Tx functions)	1		
Hub controller software	1		
Switch optical STM1 - electrical E1 (Hub controller to Node B)	1 (TBC)		
GPS receiver	1		
IBS/IDR modem (for indirect link)	TBD		
IF/FSS conversion module (for indirect link)	TBD		
2GHz/FSS conversion module (for direct link)	1		
Power amplifier for FSS signals	TBD		
Tx antenna for FSS signals	TBD		
Pylon for antennas	TBD		
O&M access	1		
Local maintenance terminal	1		
Cabinet	1		
Voltage regulator (TBD)	TBD		
UPS (battery backup)	TBD		
Fan - cooler			
Cables and connectors	TBD		
Hub assembly (wiring etc.)	1		
		Total:	

The number of Node Bs required depends on the number of spot beams (one spot beam corresponds to one 5 MHz UMTS carrier) and on the number of Tx carriers supported by each Node B. Generally, a Node B supports a minimum of two carriers. For example if the Node B can transmit over two carriers and if the hub targets one satellite with two spot beams, then one Node B is enough.

The redundancy to provide fault tolerance is not included, except the redundancy provided by default by equipments such as some Node Bs.

7.2 SDMB hub with Uu* transmission

This version of the SDMB hub corresponds to simple Uu* terrestrial repeaters, whose physical architecture is shown in Figure 9.

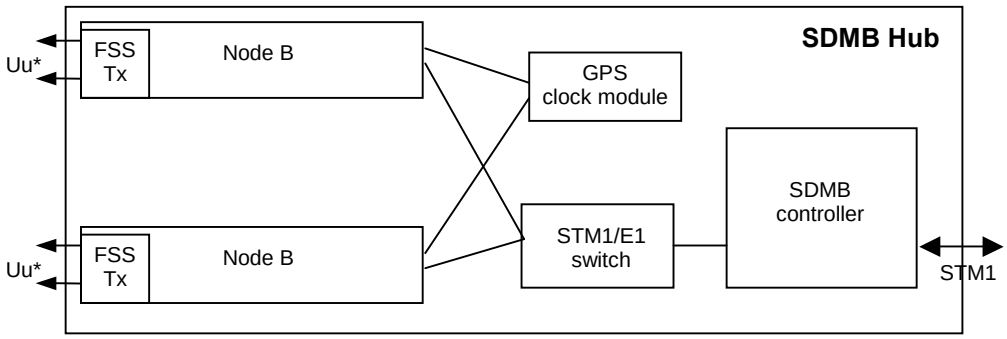

Figure 9: SDMB hub with Uu transmission physical architecture

Compared to the hub with both Iub* and Uu* transmission, the devices removed are the IBS/IDR modem and the IF/FSS conversion module. Therefore, the price of such a hub can be estimated by subtracting the price of these devices to the price of the hub with both Iub* and Uu* transmission.

7.3 SDMB hub, fault tolerant

This version with redundancy and monitoring is depicted in Figure 8. Its development cost is approximately twice the cost of a non-redundant hub, with or without Iub transmission (but counting the developments costs only once), plus the development cost of the failure monitor and switching and alerting systems and their procurement cost.

8 ANNEX

8.1 Two kinds or redundancy

To prevent this, two solutions exist:

- either having spare hubs ready to backup the other(s)
- or using fault tolerant hubs

A spare hub in a different physical location protects for example against the physical destruction (winds, thunder, flood etc.) of the active hub or of a part of it, or against a failure in the power distribution lasting longer than the UPS backup capability.

A fault tolerant hub prevents against an internal hub failure, such as hard disk or power supply failure: when one equipment in the hub has failed, it must be replaced by a redundant equipment, either automatically or by physical human intervention.

The problems are: how to detect that an equipment in the hub has failed, and how to replace it if possible automatically.

8.2 Detection of a failure inside the hub

Several means can be used to detect that a failure has occurred or will occur inside a hub, such as:

- power supply monitoring
- temperature and fan(s) speed monitoring
- cabinet intrusion monitoring
- watch-dog checking that the CPU(s) are running

In any case, the hub must contain a device to detect the failures and transmit them. But such a device cannot detect any failure: for example it cannot detect that a strong wind has moved the Tx antenna away, which does no longer feed the satellite .

8.3 The SDMB system should be monitored

This raises a more general problem in the SDMB system: how to detect that the whole system (at least the space segment) works, as no return link is provided by the satellite(s)? A solution would be to use at least one UE per spot beam, monitoring the reception of some dummy SDMB test data, periodically transmitted by the SDMB system. If the UE does not receive the test data within a certain delay, an alarm must be generated, indicating that the corresponding spot beam contains a faulty device (either the satellite, or one of its associated hubs). The dummy test data periodically transmitted to the monitoring UE(s) should not increase the power consumption of the UEs of the regular SDMB customers.

8.4 Switching to the redundant chain inside a hub

Once the fault-detection device in the hub detects a failure, it must switch the hub to its redundant chain, in addition to transmitting an alarm: the data traffic coming from the BM-SC(s)

must be passed to the redundant SDMB controller (a loss of a few seconds of traffic should not be a problem as carrouseling is used to repeat the data, and missing data can be retrieved through the terrestrial UMTS network). A possible hub redundant architecture is shown in Figure 10.

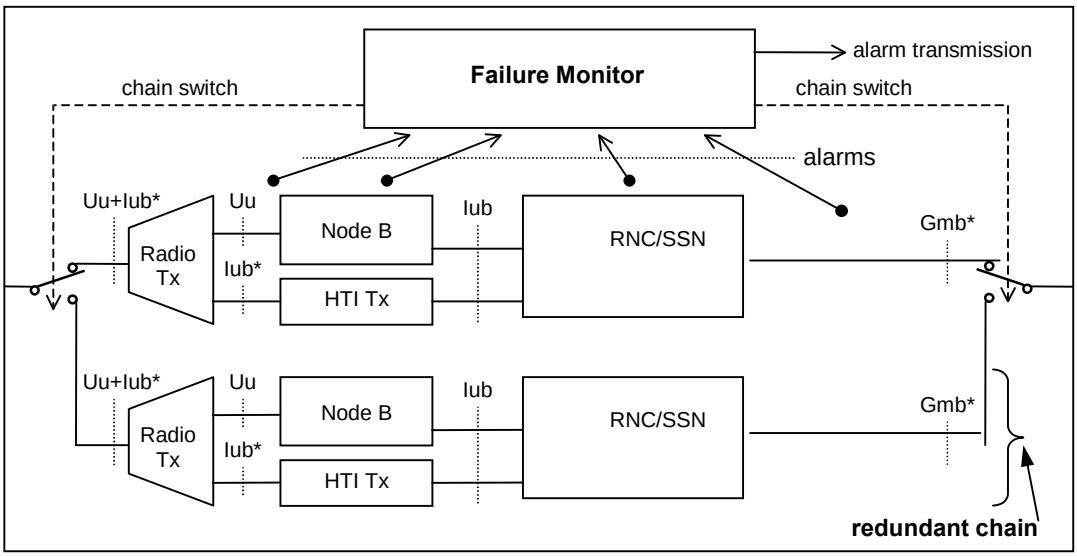

Figure 9 : The hub with redundant architecture

The depicted architecture should be refined, as it has certainly some drawbacks (for example, the RF power amplifier, located in the Radio Tx block, shall be powered down before switching, to avoid transmitting into an infinite impedance load).

For better reliability, the two chains should not be powered by the same power supplies. Naturally, the failure monitor shall have its own power supply. In addition, the failure monitor shall transmit periodically a signal to indicate that it is running correctly.

Once the hub has switched to its redundant chain, this shall be indicated by transmitting an alarm. Then a technician must come, repair the hub and switch it back to its nominal chain.

INDEX OF THE REQUIREMENTS