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Satellite Access in FPLMTS

PhD Thesis

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Summary

This thesis demonstrates why satellite access to FPLMTS will be valuable and how the UMTS Network Architecture will support satellites and their spectrally efficient channel assignment schemes. It also highlights the need for FPLMTS *applications* to adapt to the wide range of communication facilities available depending on their terminal's environment and for B-ISDN to have protocols enabling this adaptation in mobile networks.

Original ideas include:

- Clearly defined valuable roles that satellites can play in accessing FPLMTS
- Giving the FES the pivotal role of guaranteeing communications with mobile terminals in a rigidly defined geographic area
- Developing the UMTS network architecture to allow network designers the freedom to implement the FES to mobile terminals communications in any way
- Developing the UMTS network architecture to allow FESs to control handovers within their geographic service area in a pre-emptive way, based on predictable satellite motion and traffic distribution
- A detailed study of the performance of DCA algorithms in these non-GEO satellite networks
- Recognition that UMTS cannot offer 2Mbit/s service at a marketable price in all environments and that UMTS applications will have to adapt to varying grades of communication services during a call.

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To my late father, Dr J Bryan Finean.

Contents

Glossary

AAC	Authentication and Access Control
Acts	Advanced Communications Technologies and Services
ADPCM	Adaptive Differential PCM
AHM	Authentication Handler in Mobile
AHN	Authentication Handler in Network
AMPS	American Mobile Phone System
AMSC	American Mobile Satellite Corporation
API	Application Programming Interface
AT&T	American Telephone and Telegraph
ATM	Asynchronous Transfer Mode
BC	Bearer Control function
beam	The coverage of a spot beam from a satellite antenna
B-ISDN	Broadband ISDN
blocking	The action of the network refusing allocation of a channel to a call request
BS	Base Station. The controlling entity that connects a terrestrial cell site to the core network and handles terminal mobility management. In satellite communications its equivalent is known as the FES.
Camel	Customized Application for Mobile Enhanced Logic
CAPI	Common API for ISDN application interfacing
CDMA	Code Division Multiple Access
CEC	European Commission
cell	In the geographically fixed frequency re-use plan context refers to a region of the Earth's surface to which channels are permanently assigned
C/I	(Carrier power received at the receiver) : (Interference, i.e. the power received at the receiver in the carrier bandwidth when the intended carrier is not being transmitted) ratio
C/I_{block}	C/I ratio below which channel assignment is blocked
CIC	Confidentiality and Integrity Control function
C/I_{min}	Minimum C/I ratio below which communication is impossible
$C/I_{try\ handover}$	C/I ratio below which handover is tried
CLIT	Current Location Information in Terminal
CMC	Combining and Multicast Control function
C_{new}	New Control point
C/N_0	(Carrier power) : (Noise power spectral density) ratio
codec	COder/DECoder
C_{old}	Old Control point
CPRM	Companhia Portuguesa Radio Marconi SA, Portugese international carrier
CPT	Control Point Transfer function
CS1	Capability Set 1 (the existing capabilities of the IN specified by the ITU-T)
CS2, CS3	Capability Sets 2 and 3 (the future capabilities of the IN to be specified by the ITU-T)
CSS	Cell Site Switch
C/T	(Carrier power) : (equivalent noise Temperature) ratio

CT-2	Cordless Telephone 2
Dacom	South Korean telecommunications company
DAMPS	Digital AMPS
dB	Decibels
dBi	Decibels gain with respect to an Isotropic antenna
dBW	Decibels with respect to 1W of power
DCA	Dynamic Channel Assignment
DDB	Distributed Data Base
DDI	Japanese new common carrier
DECT	Digital European Cordless Telephone
DP	Data Point
E_b/N_0	(Energy per bit) : (Noise power spectral density) ratio
EHM	Encryption Handler in Mobile
EHN	Encryption Handler in Network
ETSI	European Telecommunications Standardization Institute
EU	European Union
fading	Reduction in received power due to destructive interference between multiple paths
FCC	US Federal Communications Commission
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FES	Fixed Earth Station, the satellite equivalent of a BS in the UMTS Network Architecture. Also known as the Gateway or Hub in some mobile satellite proposals. It could be located wholly or in part on the satellites.
FPLMTS	Future Public Land Mobile Telecommunications Systems (ITU's worldwide third generation mobile systems)
G.711	ITU-T standard for PCM of voice frequencies in 64kbit/s
GaAs	Gallium Arsenide
GCA	Guaranteed Coverage Area
GEO	Geostationary Earth Orbit (at 35,786km altitude)
Glonass	The Russian position fixing system
GPS	Global Positioning System (the US Navy's new position fixing system)
GSM	Global System for Mobile communications (European second generation TDMA cellular system)
G/T	(Antenna Gain) : (equivalent noise Temperature) ratio for receiver
H.320	ITU-T videophone standard for narrowband ISDN
H.324	ITU-T videophone standard for PSTNs
HC	Handover Criteria
HCA	Handover Criteria Adjustment function
HD	Handover Decision function
HEO	Highly Elliptical Orbit
HI	Handover Initiation function
HOC	HandOver Control function
HSD	Inmarsat High Speed Data service
HUPN	Handover User Profile - Network
HUPU	Handover User Profile - User
IBC	Integrated Broadband Communications
IFRB	ITU Frequency Regulation Board

IMT-2000	International Mobile Telecommunications at 2,000MHz (a proposed new name for FPLMTS)
IN	Intelligent Network
INAP	IN Application Part (IN's SS7 signalling)
Inmarsat	International Maritime Satellite Organization
IP	Internet Protocol
Iridium	A Motorola proposal for global satellite PCN using LEO satellites
IS-41	US standard for cellular network interworking
IS-54	US second generation TDMA cellular standard (also known as DAMPS)
IS-95	US second generation CDMA cellular standard
ISDN	Integrated Services Digital Network
ISUP	ISDN Subscriber User Part (ISDN's SS7 signalling)
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunications Standardization Sector
K&R C	Kernighan and Ritchie C programming language, strictly as defined in the 1st Edition of their book (1978)
kbit/s	Data throughput unit of 1000 binary digits per second
KDD	Kokusai Denshin Denwa Co., Ltd., Japanese international carrier
KMT	Korea Mobile Telecommunications Corporation, South Korea
LAN	Local Area Network
L-band	Frequency band between 1GHz and 2GHz
LE	Local Exchange
LEO	Low Earth Orbit (altitudes around 1,000km)
LMT	Location area Monitor in Terminal
lossless	Adjective of coding algorithms where the decoded information is an identical replica of the original. Data compression algorithms should be lossless
lossy	Adjective of coding algorithms where the decoded information approximates to the original information but some of the less important detail may be lost or changed. Voice and video compression algorithms are usually lossy
LR	Location Register database
LUH	Location Update Handler
MAP	Mobile Application Part (GSM's mobility functions' SS7 signalling)
MCN	Marine Communications and Navigation Co., Chinese Inmarsat signatory
MEF	MEasurement Function
MEO	Medium Earth Orbit (altitudes around 10,000km)
modem	MOdulator/DEModulator
Monet	EU Race MObile NETwork project
MPEG	Moving Pictures Expert Group
N_0	Noise spectral density (noise power in 1Hz of measured bandwidth)
NEC	Nippon Electric Corporation
NiH_2	Nickel Hydrogen
OSI model	Open Systems Interconnection model (a 7-layer representation of communication networks' functionality)

paging	Network broadcast to a mobile to inform the mobile of an incoming call
PC	Personal Computer
PCM	Pulse Code Modulation
PCN	Personal Communications Network
PDC	Personal Digital Cellular (Japanese second generation TDMA cellular telephone)
PHP	Personal Handy Phone (Japanese cordless telephone)
PN code	Pseudo-random Number code used to spread signal bandwidth in CDMA systems
$power_{min}$	Minimum received power below which channel assignment is blocked
$power_{min}$	Minimum received power below which communication is impossible
$power_{try\ handover}$	Received power below which handover is tried
Pr(*x*)	The Probability that *x* happens
PSTN	Public Switched Telephone Network (traditional, wired telephone access)
Race	CEC's Research into Advanced Communications in Europe programme
RF	Radio Frequency (for FPLMTS this is around 2GHz)
rms	Root Mean Square measure of average power
RRT	ReRouting Triggering function
RX	Receive or received
Saint	EU Race SAtellite INTegration project
SB-ADPCM	Sub-Band Adaptive Differential Pulse Code Modulation
SBC	Switching and Bridging Control function
SCP	Service Control Point
SDB	Security Data Base
SES	ETSI technical committee for Satellite Earth Stations (standardizing satellite aspects of UMTS)
shadowing	Reduction in received power due to obstructions in the radio path
SHRN	Special Handover Request - Network
SHRU	Special Handover Request - User
SMG5	ETSI technical sub-committee Special Mobile Group number 5 (standardizing UMTS)
SS7	ITU-T Signalling System number 7
STET	Italy's state-owned telecommunications holding comany
T.120	ITU-T standard for multiplexing multimedia conferencing data streams
TCCN	Target Cells and Connections - Network
TCCU	Target Cells and Connections - User
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TG8/1	ITU-R Task Group 8/1 (standardizing FPLMTS)
Transit	The US Navy's old satellite position fixing system
TWTA	Travelling Wave Tube Amplifier
TX	Transmit or transmitted
UMTS	Universal Mobile Telecommunication System (European third generation mobile system)
UNI	User to Network Interface

UPT	Universal Personal Telecommunications
V.32	ITU-T 9.6kbit/s (maximum) modem standard
V.32bis	ITU-T 14.4kbit/s (maximum) modem standard
V.34	ITU-T 28.8kbit/s (maximum) modem standard
V.42	ITU-T modem error control procedures
VC	Virtual Channel
VSNL	Videsh Sanchar Nigam Ltd., Indian international carrier
WARC '92	1992 ITU World Administrative Radio Conference, Torremolinos
WRC '95	1995 ITU World Radio Conference