Neutral Citation Number: [2018] EWHC 1826 (Pat)

Case No: HP-2015-000063

IN THE HIGH COURT OF JUSTICE
BUSINESS AND PROPERTY COURTS
INTELLECTUAL PROPERTY LIST (CHANCERY DIVISION)
PATENTS COURT

Rolls Building
Fetter Lane, London, EC4A 1NL

Date: 19 July 2018

Before :

MR JUSTICE ARNOLD

- -

Between :

KONINKLIJKE PHILIPS NV	**Claimant**
- and -	
(1) ASUSTEK COMPUTER INCORPORATION	**Defendants**
(2) ASUSTEK (UK) LIMITED	
(3) ASUS TECHNOLOGY PTE. LTD	
(4) HTC CORPORATION	
(5) HTC EUROPE CO. LTD	

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Mark Vanhegan QC and **Adam Gamsa** (instructed by **Bristows LLP**) for the **Claimant**
James Abrahams QC and **Joe Delaney** (instructed by **Taylor Wessing LLP**) for the **ASUS Defendants** and (instructed by **Hogan Lovells International LLP**) for the **HTC Defendants**

Hearing dates: 2-3, 6 July 2018

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Approved Judgment

I direct that pursuant to CPR PD 39A para 6.1 no official shorthand note shall be taken of this Judgment and that copies of this version as handed down may be treated as authentic.

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MR JUSTICE ARNOLD

MR JUSTICE ARNOLD :

Contents

Introduction

1. These proceedings concern three patents owned by the Claimant ("Philips"): European Patent (UK) No. 1 440 525, European Patent (UK) No. 1 685 659 and European Patent (UK) No. 1 623 511. Philips has declared that these patents are essential to the European Telecommunications Standards Institute (ETSI) Universal

Mobile Telecommunications System (UMTS) standard ("the Standard"), in particular the sections of the Standard that relate to the operation of the system known as High Speed Packet Access (HSPA).

2. The Defendants fall into two groups: the First, Second and Third Defendants ("the ASUS Defendants") and the Fourth and Fifth Defendants ("the HTC Defendants"). Both the ASUS Defendants and the HTC Defendants sell HSPA-compatible mobile phones. Philips alleges infringement of the patents by reason of their essentiality to the relevant versions of the Standard.

3. By a consent order dated 12 April 2017 it was agreed that the technical issues relating to the patents would be tried in two separate trials: Trial A concerning the validity and essentiality of EP (UK) 1 440 525 and Trial B concerning the validity and essentiality of the other two patents. Further technical issues that have subsequently emerged will if necessary be tried in a third trial, Trial C. Issues relating to Philips' undertaking to ETSI to grant licences on FRAND terms will if necessary be addressed in a fourth trial, Trial D.

4. This judgment concerns essentiality/infringement and validity of European Patent (UK) No. 1 623 511 ("the Patent") following Trial B. The Patent is entitled "Communication System". There is no challenge to the claimed priority date of 3 May 2003 ("the Priority Date"). The Defendants advanced a common case contending that their mobile phones did not infringe because the Patent is not essential to Release 6 of the Standard and that in any event the Patent is invalid for obviousness over a single item of prior art (two other items of prior art having been abandoned shortly before trial), namely the Physical Layer Standard for cdma2000 Release 0 version 3.0 dated 15 June 2001 ("C.S0002").

5. Philips does not seek to maintain the validity of the Patent as granted, but only as proposed to be amended.

6. There was no dispute between the parties as to the applicable legal principles, which are well established. Accordingly, there is no need to set them out in this judgment.

7. As in Trial A, the parties filed a substantial volume of evidence and submissions, although some of the material was directed to issues which have fallen away. Again, I have taken all the relevant material into account, but I do not consider it necessary to refer to all of it in this judgment.

8. This judgment is intended to be free-standing. For convenience it repeats a certain amount of material from my other judgments after Trials A and B, but it is based on the evidence and submissions concerning the Patent.

The witnesses

Dr Irvine

9. Philips' expert was Dr James Irvine. Dr Irvine received a PhD in error correcting and security coding theory with the Communications Division of the University of Strathclyde in 1994, after which he became a Research Fellow in the same group, focussing on methods of channel coding in GSM and UMTS.

10. During 1994 and 1995, Dr Irvine worked on the European Commission's Research into Advanced Communications in Europe (RACE) II ATDMA project, including on advanced Time Division Multiple Access (TDMA) air interfaces for third generation (3G) systems. This work involved closely monitoring the parallel CDMA project, Code Division Testbed (CODIT). He then worked on adaptive air interfaces, including in respect of power control, as part of an Engineering and Physical Sciences Research Council project in 1995-96, before moving on to communications services for high speed trains in 1996-97. During this time, he worked on the Adaptive Multi-Rate audio codec for UMTS.

11. From late 1997 until early 2012, Dr Irvine contributed to the Virtual Centre of Excellence in Mobile and Personal Communications Ltd project (Mobile VCE), a collaborative, not-for-profit, industrial-academic partnership, which undertakes industrially-led, strategic research, innovation and application of communications and information technologies. His first role was as Workpackage Leader of the Resource Management workpackage. Subsequently, he became Academic Co-ordinator. These roles included research on coding and resource management for 3G systems and co-ordinating multiple mobile networks in advanced 4G systems.

12. While working on the European RACE and Mobile VCE projects, Dr Irvine assisted companies with their 3GPP standardisation activities. In particular, Dr Irvine worked for Nokia and Siemens, carrying out simulations to support 3GPP standardisation work.

13. Dr Irvine has been a Reader in the Institute of Communications and Signal Processing at the Department of Electronic & Electrical Engineering of the University of Strathclyde since 2006 and has taught communications technologies at the University of Strathclyde since 1998. His principal research interest is in efficient resource management for mobile communication systems, including in respect of power control, modulation, coding, link adaptation, and handover.

14. Dr Irvine was elected President of the Institute of Electrical and Electronics Engineers (IEEE) Vehicular Technology Society (the society within the IEEE responsible for mobile radio) in 2008 and 2009 and has been re-elected to serve on their Board of Governors until 2020. He is currently Vice-President, with responsibility for publications. He has been appointed to the Steering Committee of the IEEE 5G Initiative as Working Group Chair for Community Development.

15. Dr Irvine is co-author of the book *Data Communications and Networks: An Engineering Approach* (2001). He is also a co-inventor of seven patents.

16. Counsel for the Defendants accepted that Dr Irvine had striven to give his evidence fairly and to assist the Court. I found him an excellent witness who was very lucid in his explanations; but he tried so hard to be fair that he sometimes assented to propositions without insisting upon objections or qualifications he had previously expressed. It is therefore important to consider his evidence as a whole.

Dr Brydon

17. The Defendants' expert was Dr Alastair Brydon. Dr Brydon received a BSc in Electronics from University of Manchester Institute of Science and Technology in

1984 and completed a doctorate in Medium Rate Data Transmission at High Frequency at UMIST in 1990. During his PhD, he also worked as a lecturer.

18. From 1989 to 1995 Dr Brydon was employed by BT Research Laboratories as a Senior Engineer, working on research and standardisation projects in respect of GSM, UMTS, DECT and TFTS mobile radio systems. His work resulted in patents in Europe and the US. He chaired the co-ordination group in the European Community's MONET project, which brought together 28 European telecommunication companies to develop fundamental aspects of the network standards for UMTS.

19. From 1995 to 1997 Dr Brydon worked for Cellnet as their Network Architecture Manager. From 1997 to 2001 he worked for Nokia Networks, where he was responsible for strategy and business development of mobile services in EMEA countries for four years.

20. In 2001 Dr Brydon co-founded Sound Partners Ltd (subsequently renamed Unwired Insight Ltd), a research and consultancy business focussing on mobile technology and services. Unwired Insight has provided technical and commercial advice and research in respect of 2G to 5G (inclusive) mobile communication systems to network operators, equipment manufacturers, investors and regulatory bodies.

21. Dr Brydon has authored more than 40 major reports and publications. He is a Chartered Engineer, a Fellow of the Institution of Engineering and Technology and a Senior Member of the IEEE.

22. Counsel for Philips accepted that Dr Brydon had done his best to assist the Court. I found Dr Brydon to be another very good witness.

23. Counsel for Philips submitted, however, that Dr Brydon was less well qualified in UMTS as at the Priority Date than Dr Irvine. Thus Dr Brydon had not only not attended any WG1 meetings, but also he had not worked behind the scenes on any proposals. Counsel submitted that Dr Brydon's lack of expertise had manifested itself in a number of misunderstandings of relevant provisions of the Standard, where he had ending up agreeing with Dr Irvine. I accept this submission. I would add that, as explained below, even in relation to cdma2000 (as to which both experts were equally inexpert), Dr Brydon ending up agreeing with points made by Dr Irvine regarding the standard which he initially disagreed with, in one case confessing that he (Dr Brydon) had not noticed part of the standard before Dr Irvine drew attention to it. It follows that I consider that Dr Irvine's evidence should be given more weight where they differ.

24. Counsel for Philips also submitted that, through no fault of Dr Brydon's, his evidence on obviousness had to be approached with caution due to the way in which he was instructed. As explained below, the Defendants' case is based on an 11 line passage on page 2-47 in C.S0002, a document which runs to 409 pages. Although Dr Brydon had initially reviewed C.S0002 as a whole, he was subsequently asked specifically to consider how cdma2000 would behave in a situation where a mobile hit its maximum power and received power control commands instructing it to go beyond that level and he was asked to consider specific sections of the document, and in particular page 2-47. Moreover, although Dr Brydon undertook both reviews before reading the Patent, it was only after reading the Patent that he looked in detail at section 5.1.2.6 of

TS 25.214 Release 5, which represents the key common general knowledge of the skilled person concerning the maximum transmission power limit on the uplink in UMTS. Counsel submitted that both features of the approach Dr Brydon was instructed to take would have accentuated the risk of hindsight. Again, I accept this submission, although for the reasons explained below the first point is more relevant to the Defendants' third case than their first or second cases, while the second point is more relevant to the first case.

Technical background

25. The parties agreed a single primer for both Trial A and B, which was primarily directed to EP (UK) 1 440 525. It included material which was not relevant to the Patent, which I have therefore omitted from the following account. I have also supplemented and updated my account from the expert evidence.

Mobile telecommunication standards

26. There are a number of standards for mobile telecommunication systems in operation in different countries. There have been a series of generations of standards, including the second generation (2G), third generation (3G) and fourth generation (4G). Each standard is periodically revised to introduce improvements and new features. New versions are typically called "Releases".

27. Global System for Mobile Communications (GSM) is a 2G system developed by ETSI based on time division multiple access (TDMA) and frequency division multiple access (FDMA) technology. The first version of the GSM standard was released in the late 1980s. By the Priority Date GSM had been commercially launched in many countries around the world, including the UK and throughout Europe. In the UK both GSM and GPRS (a 2.5G system) were in widespread use at the Priority Date.

28. UMTS is an example of a 3G system. Work on developing the UMTS standard was begun by ETSI in the mid-1990s and then continued by the 3rd Generation Partnership Project (3GPP).

29. The first full UMTS release, Release 99, was, despite the name, released in March 2000. By the Priority Date, Release 5 had been released and work was underway on Release 6, but Release 6 had not been finalised and product development had not started. The first commercial launch of UMTS (Release 99) was in Japan on 1 October 2001. By the Priority Date, UMTS was being rolled out in Europe and Korea. Release 4 of UMTS was commercially launched in the UK in March 2003.

30. IS-95 (later known as cdmaOne) is a 2G system developed primarily by Qualcomm based on code division multiple access (CDMA) technology. The first version of the IS-95 standard was released in the mid-1990s. By the Priority Date IS-95 had been commercially launched in many countries around the world, including in South Korea and the US, but not in the UK or elsewhere in Europe.

31. cdma2000 resulted from work on the evolution of IS-95 towards the third generation and was standardised by the 3rd Generation Partnership Project 2 (3GPP2). It was designed to be backwards compatible with IS-95. The standard had been released

prior to the Priority Date and had also been put into use commercially by this time in South Korea and the US. But it had not been put into use elsewhere, including the UK and Europe, by the Priority Date. Nor was future deployment in the UK being contemplated.

32. Prior to the Priority Date, 3GPP and 3GPP2 had been working independently on the standardisation of high speed data mobile systems.

Standard setting

33. The purpose of producing standards is to ensure that different items of equipment from different vendors will operate together. For example, a Mobile Station (MS) produced by one manufacturer must be able to work correctly with a Base Station (BS) and other network equipment from other manufacturers. From the consumer's and the network operator's perspectives, therefore, the whole system should work together seamlessly.

34. 3GPP was formed in 1998 to work on developing the UMTS standard. 3GPP is an international standardisation project which includes standard-setting organisations from around the world, for example the American National Standards Institute (ANSI) and the Chinese Wireless Telecommunication Standard (CWTS) as well as ETSI.

35. In the period 2001-2004 3GPP was divided into a number of technical specification groups (TSGs) which were responsible for different aspects of the system:

i) Radio Access Network (TSG-RAN);

ii) Core Network (TSG-CN);

iii) Service and System Aspects (TSG-SA);

iv) Terminals (TSG-T).

36. For present purposes, the Radio Access Network technical specification group (TSG RAN) is the most relevant group in 3GPP. TSG RAN in the period 2001-2004 was divided into different working groups, covering various matters related to the operation of base station equipment and mobiles. For example, Working Group 1 (RAN WG1) was responsible for the specification of the physical characteristics of the radio interface. RAN WG2 was responsible for the Radio Interface architecture and protocols (MAC, RLC), the specification of the Radio Resource Control (RRC) protocol, the strategies of Radio Resource Management and the services provided by the physical layer to the upper layers (see further below).

37. Each working group held meetings bringing together delegates from many different stakeholders (predominantly large mobile handset, base station, or semiconductor manufacturers but also network operators) to propose and discuss contributions to the standard with a view to reaching agreement on what should be incorporated in the version of the standard being worked on.

38. At technical meetings and plenary meetings, the stakeholders would present temporary documents (T-docs) which might then form parts of Technical Reports (TRs) or be drawn together into Technical Specification (TS) documents.

Elements of a mobile telecommunications system

39. Figure 1 below shows the main components of a typical mobile telecommunications network in the 1990s and 2000s at a general level.

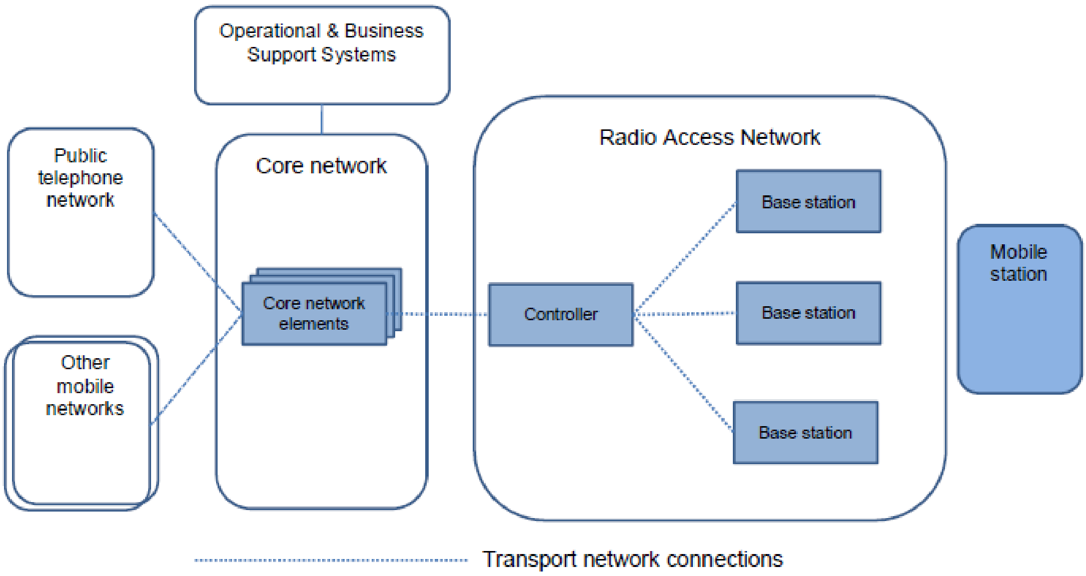


Figure 1 Components of a mobile network

40. Mobility is achieved within the network by facilitating "handover" of an MS between different cells (in this context a cell is a geographic area corresponding to the radio coverage of a BS transceiver) located within the RAN as the MS moves around with its user.

41. The RAN consists of BSs and controllers. A BS is a node of (or point in) the network which provides a number of functions. It sends and receives radio transmissions to and from MSs that are within the cell covered by that BS.

42. MSs are also known as User Equipment (UE) in UMTS. A BS can also be denoted BTS in GSM or Node B in UMTS.

43. The cells of a network are shown schematically below in Figure 2. A BS is found at the centre of each cell. In reality, however, the cells are of a very irregular shape and will have areas of overlap.

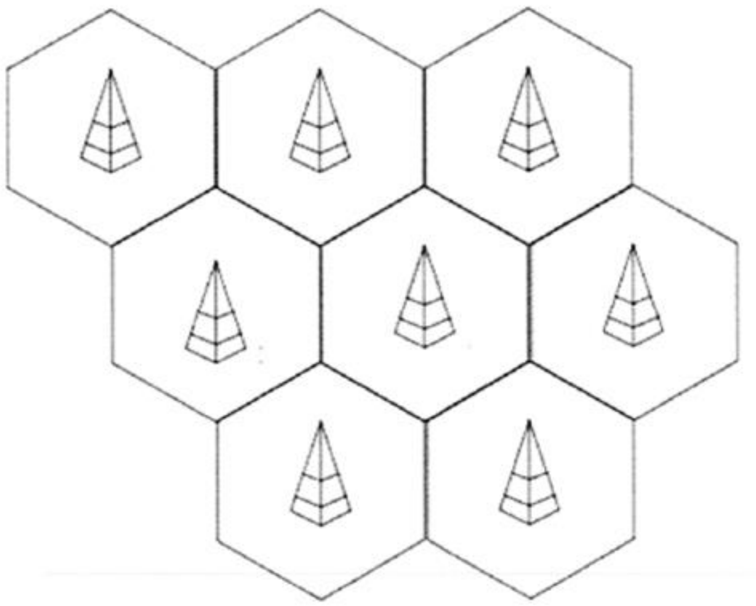


Figure 2 Schematic representation of cells

44. The BSs are connected to a controlling unit (the "Controller" in Figure 1). In GSM this is known as a Base Station Controller (BSC). In UMTS the controller is called a Radio Network Controller (RNC). One of the many functions of the controller is to facilitate handover of an MS between different BSs.

45. As indicated in Figure 1, the Core Network (CN) may interface with other networks such as the public telephone network and other mobile networks.

OSI seven layer model

46. The OSI (Open System Interconnection) model is a common way of describing different conceptual parts of communication networks.

47. The OSI model has seven layers. From top to bottom, these are as follows:

i) Layer 7, the Application Layer, which provides services to the user software applications (e.g. email delivery protocols and Hypertext Transfer Protocol (http));

ii) Layer 6, the Presentation Layer, performs translation and formatting of information received (which may include the functions of compression/decompression and/or encryption/decryption) to present to the application layer and provides an interface to the Session Layer;

iii) Layer 5, the Session Layer, which handles communications at a call level, initiating and terminating the communication between users;

iv) Layer 4, the Transport Layer, which provides communication of data between end users. End to end (i.e. terminal to terminal) error control forms part of this layer;

v) Layer 3, the Network Layer, which provides routing from where the data enters a network to where it leaves it;

vi) Layer 2, the Data Link Layer, which provides communication over an individual link within the network. Error control for the link is included in this layer; and

vii) Layer 1, the Physical Layer, which is concerned with the transmission of the data over the physical medium itself (i.e. protocols that specify how radio waves sent through the air represent data).

48. The seven layers are shown on both sides of Figure 3 under the images of the MSs and the horizontal arrows reflect the effective links between them (described as logical connections). The curved line shows how the data actually flows down through the layers to provide the required connectivity. It can be seen that the data flows from the Application Layer in one MS down to the Physical Layer where it can be transmitted (over the radio interface) to the Physical Layer of a router element (for example a RNC). The data flows up from the Physical Layer of the RNC to the Network layer where it can be passed to the Network Layer of another RNC and back down to the Physical Layer. Finally, having been transmitted from the Physical Layer of the RNC to the Physical Layer of a second MS, the data flows back up to the Application Layer.

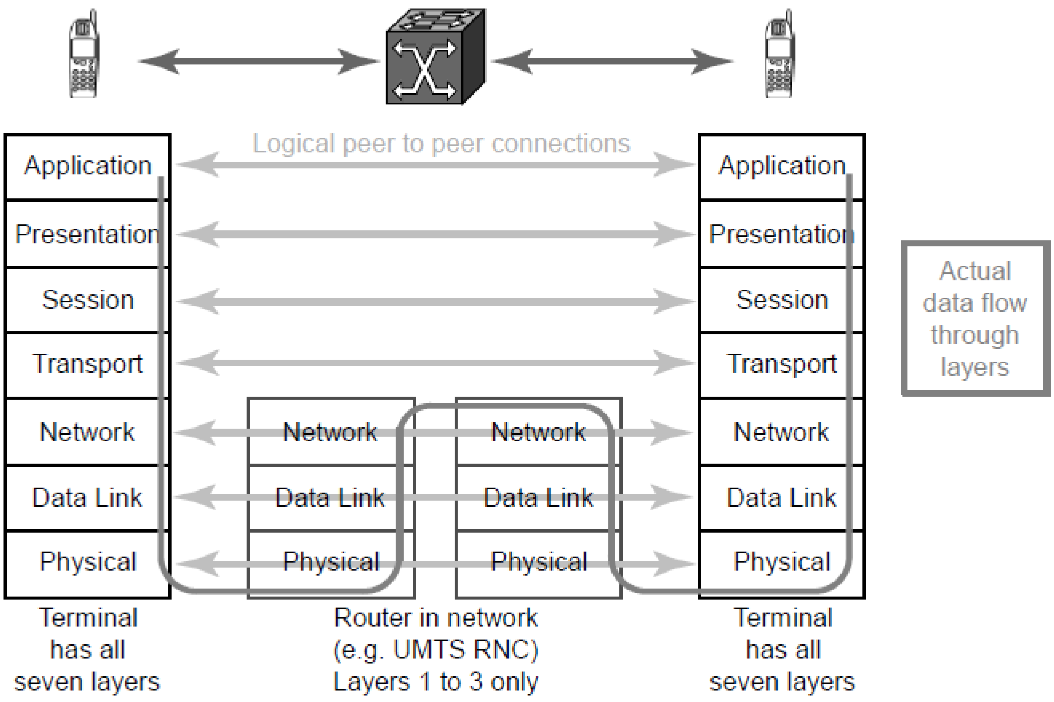


Figure 3 OSI Stack

49. One of the functions in the Data Link Layer is the Medium Access Control (MAC), whose functions include such matters as mapping between logical and transport channels and scheduling.

Channels

50. To facilitate the specification of mobile telecommunications systems, it is common practice to identify a number of types of "channels" with different roles.

51. For present purposes, the "physical channels" used to carry information over the radio interface between the MS and the BS are of particular interest. These channels are associated with the Physical Layer (see Figure 3).

52. Downlink (or forward) physical channels provide communication from the BS to the MS, whereas uplink (or reverse) physical channels provide communication from the MS to the BS.

53. Physical channels may provide a communication path that is dedicated to an individual MS (a dedicated channel), or provide communication between a BS and multiple MSs (a common channel). For example, broadcast physical channels provide communication from a BS to all of the MSs within its coverage area. A shared channel is similar to a common channel, but use of the channel resource is controlled by additional signalling.

54. Physical control channels carry control signals, used for the purposes of maintaining the operation of the system, whereas physical data channels carry user services (such as a voice call or data communication) and may include higher layer control signalling that is not related to the physical layer itself.

55. In some cases, mobile system specifications define other types of channel, which make use of the physical channels. For example, in the UMTS system, the physical layer provides a set of "transport channels" to the MAC layer above it. The MAC layer, in turn, provides a set of "logical channels" to the RLC layer above it. The UMTS logical channels are defined by the type of information they carry.

56. Typically, a mobile system specification defines which physical channels are used to carry each type of higher layer channel. For example, Figure 4 (taken from Holma and Toskala, *WCDMA for UMTS*, 2000) illustrates the mapping of transport channels to physical channels in the UMTS system in 2000.

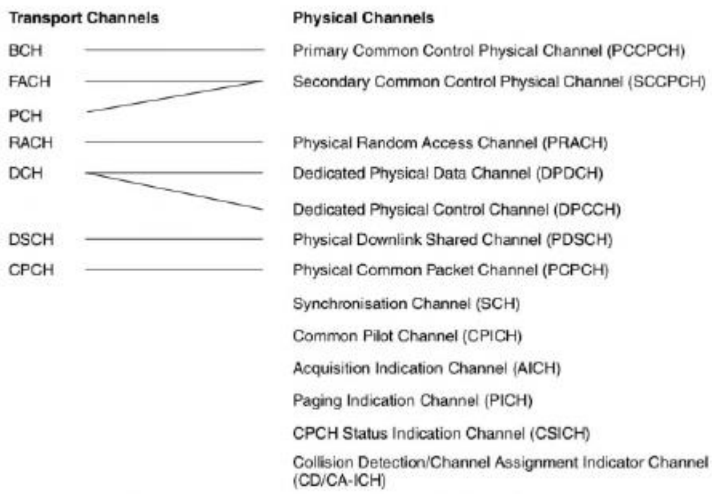


Figure 6.2. Transport channel to physical channel mapping

Figure 4: Transport channel to physical channel mapping

57. Other systems, such as GSM and cdma2000, have their own definitions and mappings of physical and other types of channels, based on similar principles.

Duplexing schemes

58. Duplexing is the process of achieving two-way communications in a system. The two main forms of duplex scheme that are used in cellular communication are Time Division Duplex (TDD) and Frequency Division Duplex (FDD).

59. In TDD bi-directional communication takes place on a single radio frequency channel. The system avoids collisions between uplink and downlink transmissions by transmitting and receiving at different times, i.e. the BS and the MS take it in turns to use the channel.

60. In FDD two (generally symmetrical) segments of spectrum are allocated for the uplink and downlink channels. In this way the BS and MS transmit simultaneously, but at different radio frequencies, thereby eliminating the need for either to transmit and receive at the same frequency at the same time. One consequence of the uplink and downlink transmissions being carried at different frequencies is that the attenuation experienced by each signal could be significantly different as the fast fading (as to which, see below) may differ on the uplink and downlink transmissions. In TDD systems, the fading is likely to be similar on the uplink and the downlink as they generally occur on the same frequency.

Multiple access schemes

61. In any cellular network it is necessary to have a mechanism whereby individual users can be allocated a portion of the radio resources so that they can communicate with the BS using their MS for the duration of a communication. This mechanism is referred to as a “multiple access scheme”. Three of the most common multiple access schemes are TDMA, FDMA and CDMA.

62. CDMA is of most relevance to this case. In CDMA, several users are permitted to send information simultaneously over a single radio frequency channel. The transmissions of the different MSs are separated from each other through the use of codes. CDMA employs spread spectrum technology and a special coding scheme known as Code Division Multiplexing (CDM), where the BS assigns each MS one or more unique codes (known as spreading codes) within one cell. UMTS employs a version of CDMA called Wideband CDMA (WCDMA).

Functions of the radio transmission chain

63. Figure 5 shows the basic components of a radio link, or “transmission chain”, in UMTS.

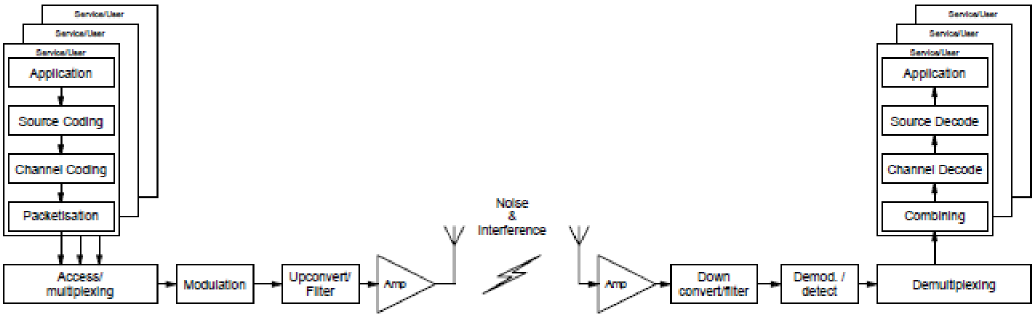


Figure 5 Radio transmission chain

64. Following the arrows in the diagram from the top left: as a first stage, data is taken from the Application Layer (the layer providing a service to the end user of the system) and "source encoded" into an efficient representation for use in the next stages of transmission. For example, source coding may involve an analogue audio speech signal being encoded into a digital signal and compressed.

65. After source coding, the data is channel coded. Channel coding adds symbols to the data to be transmitted in a particular pattern that allows corruption to be detected and corrected. This is particularly important for a radio link since, unlike wired transmission, it is likely that some amount of corruption will occur during wireless transmission.

66. The data is then grouped into packets ("packetized") and multiplexed to allow more efficient use of resources. Multiplexing includes combining data from different services for an individual user as well as combining data from other users. The data stream is then modulated and converted to radio frequency (RF) for transmission.

67. The final step before transmission is to amplify the signal. The amplification is usually variable so that only so much power is used as is needed to reach the receiver.

68. The receiving system performs the same steps outlined above, but in reverse order. Detection of the received signal is more complicated than modulating the transmitted signal because the receiver has to cope with noise, interference and multipath propagation (discussed below).

Repetition coding and channel coding

69. Repetition coding and channel coding are two ways to protect a transmission system against errors introduced by the transmission medium, both of which introduce redundancy. A simple form of repetition coding is to create a codeword in which the same information is repeated multiple times. Repetition coding reduces the rate of transmission of information, but enhances the probability of detection.

70. Channel coding works by encoding additional symbols. These additional symbols are added to the transmitted data in such a way that if the data symbols are corrupted during transmission this can be recognised and errors in the data can potentially be corrected. A simple example of a channel code is where a single bit is added to the end of binary words to make the number of binary 1s in the word even (i.e. if the number of 1s in the original word was even, the additional bit would be 0, but if it were odd, the additional bit would be 1 to make the overall number of 1s even). This

is called a Single Parity Check (SPC) code. If any single bit is corrupted (i.e. 0 becomes a 1 or a 1 becomes a 0), the SPC code will detect the error as the number of 1s in the resulting word will be odd.

71. A Cyclic Redundancy Check (CRC) code adds redundant bits to a packet of user data based on the remainder of a polynomial division. In some contexts, CRC bits are referred to as a Frame Check Sequence (FCS). When the receiver gets a packet of data – the frame – it calculates the same CRC, and compares the result to the contents of the received FCS. If the calculated value is different from the one that was sent, it can be concluded that some alteration has been made to the message between the time the two functions were calculated, i.e. between the transmitter and the receiver. An error will have occurred. This is schematically illustrated in Figure 6.

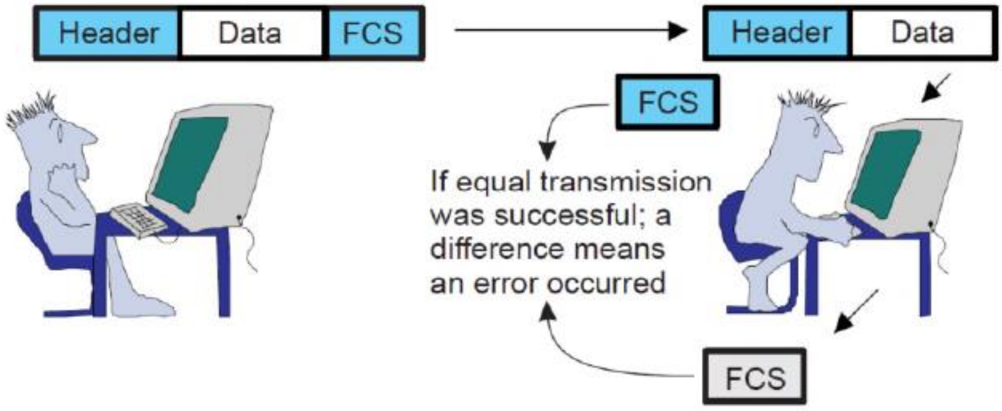


Figure 6 Frame Check Sequence to check for transmission errors

Noise and interference

72. Both noise and interference can affect and limit wireless communications. It is therefore important for the levels of noise and interference to be measured in order to determine the optimum power for radio transmissions.

73. The Signal-to-Noise Ratio (SNR) is a measurement which compares the level of a wanted signal to the level of background thermal noise. Thermal noise is approximately white, meaning that its power spectral density is uniform throughout the frequency spectrum. The amplitude of the random white noise is commonly modelled as a Gaussian probability density function, often described as Additive White Gaussian Noise (AWGN).

74. A related measurement is the Signal-to-Interference Ratio (SIR). Although the terms SNR and SIR are often used interchangeably, noise and interference are not identical phenomena. Interference is any unwanted radio frequency signals that arrive at the receiving antenna from other intended (e.g. BS or MS) or unintended (e.g. electronic equipment, vehicle engines) transmitters.

Signal transmission and detection

75. Information is transmitted on a radio signal by altering its amplitude, frequency or phase, or a combination of these, based on the information to be conveyed, in a

process known as modulation. The information is recovered from the radio signal by detecting these changes in the received signal's characteristics in a process known as demodulation.

Power control

76. Power control is a fundamental radio resource management feature of mobile telecommunication systems which affects the quality of service experienced by individual users and the overall capacity of the system.

77. As an MS moves around a network, its radio environment changes because of its distance from BSs, obstructions to the radio signals, and reflection, refraction and diffraction caused by surrounding objects leading to multiple propagation paths.

78. Power control is relevant to both the downlink and the uplink of mobile systems, although the specific requirements may depend on the nature of each system.

79. In the context of CDMA systems, the power control mechanism must be able to respond to slow fading and fast fading of the radio signals, as explained below, and also address the so-called "near-far" problem on the uplink/reverse link.

80. *Near-far problem.* The "near-far" problem is illustrated in Figure 15**.**

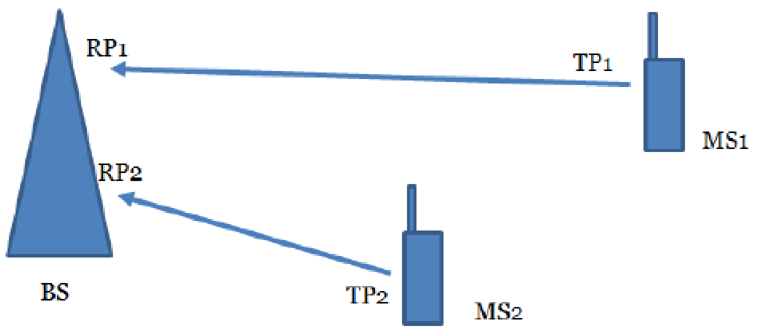


Figure 15 Near-far problem

81. Figure 15 depicts two mobile stations, MS1 and MS2, which are at different distances from the BS. In a CDMA system, the signals of the two mobile stations are sent at the same time and on the same frequency, and are distinguished by means of different codes.

82. Because MS1 is at a larger distance from the base station than MS2, the signal of MS1 is likely to suffer a greater loss of power on its way to the base station than the signal of MS2 (although other aspects of the radio transmission, such as buildings and multipath propagation, will also have a bearing). If MS1 and MS2 transmitted the signals at the same power level, the MS1 signal would be much weaker at the base station than the MS2 signal (Received Power RP1 < RP2). There is a risk that the MS2 signal might cause excessive interference, and thus prevent reception of the signal from the more distant MS1 by the BS.

83. Because of this, uplink power control in CDMA systems is designed to ensure the BS receives equivalent power levels from all MSs within its coverage area. Hence, for

example, MS1 would generally transmit at a higher power level than MS2 to deliver the same service.

84. *Slow fading.* As an MS moves further from a BS, or behind an obstruction such as a building or a hill, its signal gradually becomes weaker, for example over a period of seconds. As the MS moves closer to the BS, or emerges from the shadow of the obstruction, the signal recovers. This effect is referred to as slow fading.

85. *Multipath (fast) fading.* Like other forms of electromagnetic radiation, the radio frequencies utilised in mobile telecommunications are reflected, refracted and diffracted by interactions with the surrounding environment, such as buildings, street furniture and trees. Radio signals therefore do not follow one straight path between BS and MS, instead many paths can be taken and the signal received at the MS or BS will be a composite of all the various paths taken. This is known as multipath propagation.

86. Depending on the path taken by the radio signal, it will be attenuated (i.e. reduced in strength) and phase shifted (i.e. re-aligned with respect to time) by different amounts. The composite signal received will likewise vary in accordance with the signals received from each individual path. For example, if there is a great deal of subtractive interference or cancellation (due to phase shifting) in the composite signal, it will be received at a reduced power in comparison to a signal that has travelled over a direct path.

87. Additionally, since the MS and the environment around it do not remain static during operation (for example, vehicle movements may affect the path taken by the radio signal), the multipath phenomenon is also dynamic. As a result, the composite signal can rapidly change in power, for example over a period of milliseconds as illustrated in Figure 16 (taken from Holma and Toskala). This effect is known as multipath fading or fast fading. It can be modelled by a statistical model known as Rayleigh fading.

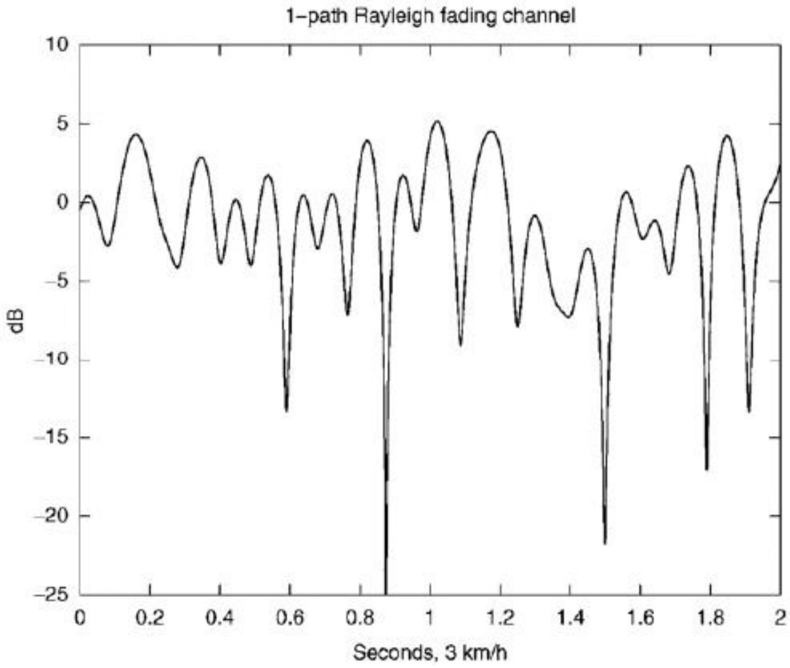


Figure 3.5. Fast Rayleigh fading as caused by multipath propagation

Figure 16 Fast Rayleigh fading caused by multipath propagation

88. Mobile systems based on CDMA have particularly stringent requirements for power control, because users share the same spectrum at the same time and are differentiated only in the code domain. The power transmitted by any device in such a system may create interference for nearby devices operating in the same radio channel.

89. *Power control techniques.* There are two general approaches to the dynamic control of power levels in a mobile system, referred to as "open-loop" and "closed-loop" control. Most mobile systems apply both methods.

90. Open-loop power control requires no feedback from the receiver to the transmitter. The transmitter of a signal (either MS or BS) makes an estimate of the radio propagation conditions, typically based on an estimate of path loss between the MS and BS, and sets its transmission power accordingly (the higher the received signal power, the lower the transmitter power set and vice-versa). This approach relies on the propagation conditions being similar in both directions (uplink and downlink). Given that the geographic distance is the same in each direction, it is a reasonable starting point, although the conditions may be quite different if the uplink and downlink operate on different frequencies. Open-loop power control is often used at the start of a connection, when it is not possible to apply closed-loop techniques.

91. Closed-loop power control uses a feedback loop from the signal receiver to the signal transmitter to control the transmitted power level. For example, on the uplink the BS receiving the MS signal may feedback "power up" or "power down" commands to control the MS transmitter, according to whether the received power level is too low or too high, respectively. Closed-loop power control allows the system to accommodate situations where the signal propagation conditions are different for the uplink and downlink of a system.

92. As part of closed-loop power control it is common to use a combination of “outer-loop” and “inner-loop” control.

93. Outer-loop power control is a mechanism to set a target for inner-loop power control. Typically, the quality of service of a received signal is assessed in some way, for example by determining the error rate of the decoded data. If the error rate of the received data is too high or too low, then the system increases or decreases, respectively, the target power level or SNR for inner-loop power control.

94. Inner-loop power control aims to achieve a defined target level for some parameter of a received signal, such as its SNR. Typically, these are parameters that can be determined quickly, so that power control commands can be returned to the transmitter promptly, to deal with fast fading.

UMTS Release 5

95. At the Priority Date, the most recent finalised version of the Standard was Release 5. Release 5 included the following features.

96. *Transport Formats*. RLC processes, whether for the downlink or uplink, pass data in the form of a logical channel to the MAC. The network side of the RRC and the RLC are in the controller in the UMTS network, the RNC. The MAC is implemented in the BS. The MAC is responsible for scheduling data between logical channels and passing it in the form of transport channels to the physical layer. The MAC sends the transport channel data in Transport Blocks, which the physical layer processes before sending the data to the receiver over one or more physical channels.

97. This is described in TS 25.302 v4.7.0 at section 7.1 and illustrated in Figure 6 reproduced below, which shows three transport channels.

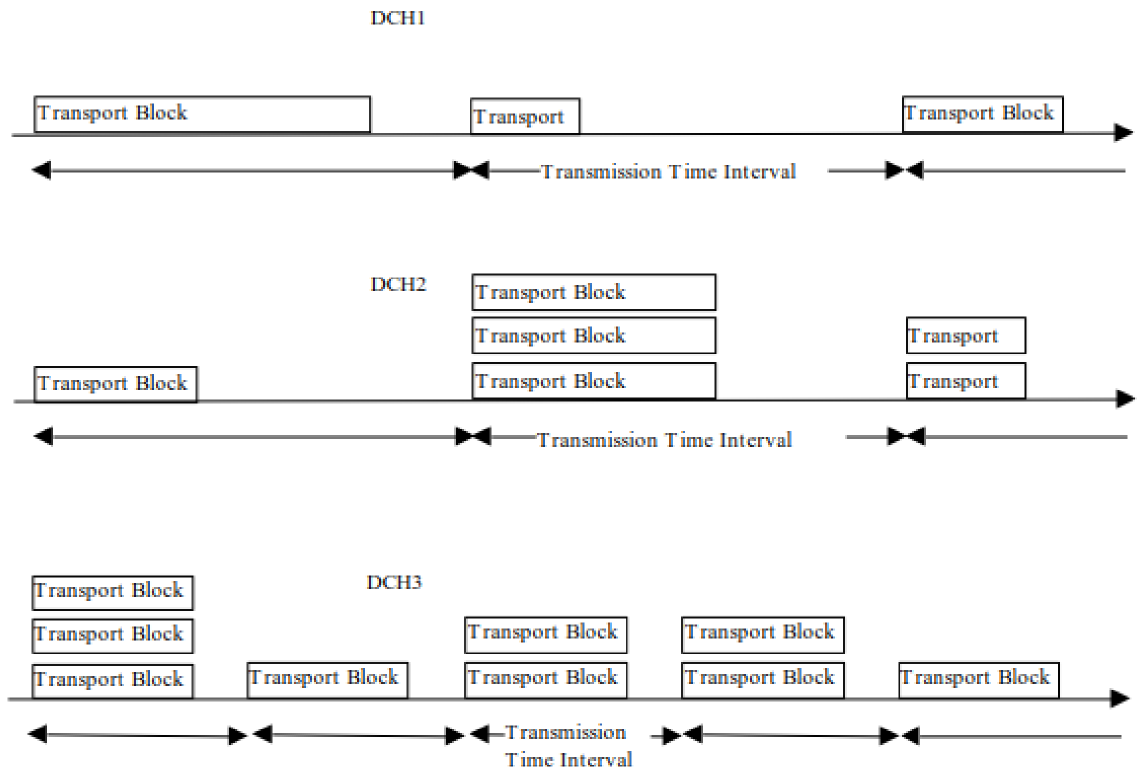


Figure 6: Exchange of data between MAC and L1

98. Rather than upper layers specifying exactly how much data must be sent, some control is devolved to the MAC at the transmitter side to allow for very responsive changes to the amount of data passed from the upper layers or in response to the channel capacity. This is done by the RRC on the network side specifying a range of different formats – termed Transport Formats – which may be used for each transport channel.

99. The combination of a Transport Format and a transport channel is a Transport Format Combination (TFC). The set of possible TFCs is called a Transport Format Combination Set (TFCS). The MAC on the transmitter side chooses the most appropriate TFC from the TFCS for a particular block. The Transport Format Combination Indicator (TFCI) specifies which TFC is being used.

100. The Transport Blocks are passed to the physical layer for transmission. Cyclic Redundancy Check (CRC) bits are added to the Transport Blocks, which may be concatenated (small blocks) or segmented (large blocks). Channel coding is then performed. The encoded blocks are then transmitted over one or more 10 ms radio frames.

101. The Transport Format includes the number of bits in the block, the coding rate, types of error protection and the Transmission Time Interval (TTI) length. The TTI is the periodicity at which a set of Transport Blocks is transferred by the physical layer on the radio interface. It is always a multiple of 10 ms, the length of one radio frame. In Release 4, TTIs could be 10, 20, 40 or 80 ms long. Transport Blocks may vary in size and configuration between TTIs, but not within a TTI.

102. The MAC of the MS selects the TFC from the TFCS depending on the priority of the channel, the amount of data to be sent and the channel conditions. The TFC is chosen each TTI. Accordingly, the Transport Format may be changed on a TTI-by-TTI basis to adapt the power available as a result of changes in channel conditions. Conversely, the Transport Format cannot be changed within the TTI.

103. Particular TFCs can be in one of three states: supported, excess-power and blocked. These states are applied to the various TFCs so that the candidates for the MS to choose from are less likely to lead to the maximum transmission power being exceeded.

104. *Power control*. In the Release 5 uplink, open-loop power control is used for initial access only. For initial access, the transmission power of the uplink is based on a measurement of the received common pilot. This reference signal is sent at a predetermined power level. After a connection is established, closed-loop power control is used. On the uplink, this is vital to deal with the near-far problem, i.e. signals should be received at the BS at approximately equal power so that quality of service targets are met, but without causing unnecessary interference to other users. Thus MSs that are further away from the BS typically transmit at higher power. The network seeks to achieve a given signal quality (for example, a bit error rate) and uses outer and inner loop control to achieve that quality.

105. Signal quality can only be measured over relatively long periods of time. In order to calculate the bit error rate, the entire data block must be received and decoded. Depending on the TTI which is used, it may take between 10 ms and 80 ms for the entire block to be transmitted, which means that estimates of signal quality are only available every 10 to 80 ms. Since the power control algorithm needs to respond to fast fading which occurs much more quickly than this (unless the mobile is moving very slowly or stationary), a two-stage approach is taken. Long-term, i.e., tens of milliseconds, estimates of signal quality are derived from decoding the transmitted stream, and short-term, i.e., millisecond by millisecond, estimates of fading are derived from the received signal strength.

106. UMTS power control takes these different aspects into account by having an inner loop which operates on a slot by slot basis and measures received signal power, and an outer loop which operates block by block and measures received signal quality. The outer loop operates in the RNC and sets an SIR target based on the number of errors in the received signal. It then sends this target to the BS for use until the next block is received and the target can be updated. The outer loop operates at a rate between about 10 Hz and 100 Hz.

107. The inner loop runs in the BS. The BS estimates the SIR over the last slot, and compares it to the target SIR. If the received SIR is below the target value, it signals the MS to increase its power, while if the received SIR is above the target, it signals the MS to reduce its power. The inner loop operates at 1500 Hz. The transmission power is stepped up or down in step sizes of 1 or 2 dB each slot (i.e. every 2/3 ms), every other slot or every five slots.

108. A power difference is applied between the DPDCH (the Dedicated Physical Data Channels) and the DPCCH (the Dedicated Physical Control Channel) using gain factors. The gain factor β_c is applied to the DPCCH and the gain factor β_d is applied to

the DPDCHs. The β_d gain, and hence the transmission power of the data, depends on the choice of TFC. The gains can either be signalled by the network for a particular TFC or calculated by the MS by reference to gains signalled for a reference TFC. In this way, the power of the DPDCHs is set relative to the DPCCH.

109. *TPC commands*. Transmit Power Control (TPC) commands are used by the inner loop to adjust the transmission power in a stepwise fashion on a slot-by-slot basis. There is a general inverse correlation between channel quality and the TPC commands, leading to a general inverse correlation between channel quality and transmission power.

110. *Maximum transmit power*. MS transmissions in the uplink are subject to a maximum transmit power. This may be set by the network or be a feature of the MS.

111. As noted above, the TFC may be changed at the MAC layer on a TTI-by-TTI basis. On that timescale, the MS can autonomously adjust the Transport Format and hence the transmission power of Transport Blocks. In that way, it has some ability to manage its own uplink power budget and to minimise the risk of reaching the maximum transmit power limit.

112. If, as a result of received power-up commands, the MS would nevertheless exceed its maximum transmit power, section 5.1.2.6 of TS 25.214 specifies that the MS scales down the power of all channels equally so that it transmits at maximum power (but no more). The ratio of powers of different channels is maintained. The result of this scaling is that it is likely that errors will increase, and hence the outer loop will increase the SIR target over a period of many TTIs (leading to the MS being further instructed to increase its transmission power). Assuming no improvement in the channel in the meantime, the MS will be unable to respond to the increased SIR target and the network will reconfigure the uplink channels in order to reduce the outer loop SIR target. If this fails to remedy the situation and it is not possible to maintain the connection, the MS will shut off its transmitter. Should the channel quality subsequently improve, the BS will send power-down commands and the scaling will be reduced. The scaling is applied or changed on a slot-by-slot basis.

<u>The Patent</u>

113. The specification begins at [0001]-[0005] by summarising existing transmitter power control schemes. Figure 2 shows the variation in channel quality over time without any transmit power control. Figure 3 shows the corresponding inverse variation in transmit power that would be provided by a perfect TPC scheme to maintain a constant signal quality.

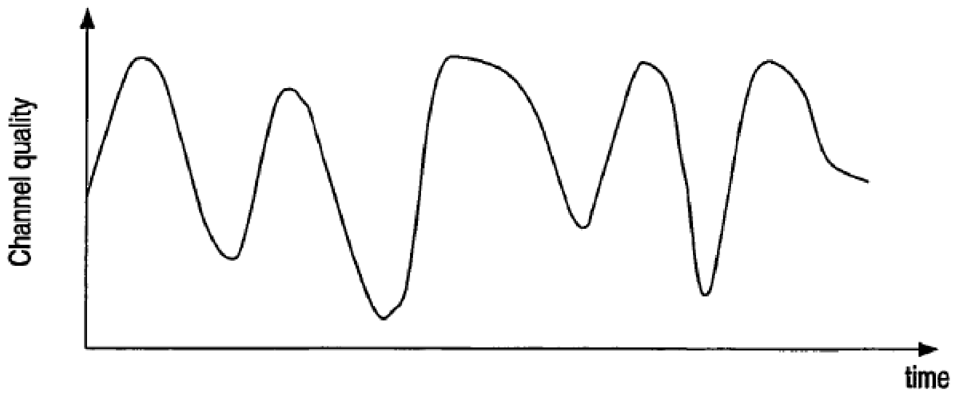


FIG.2

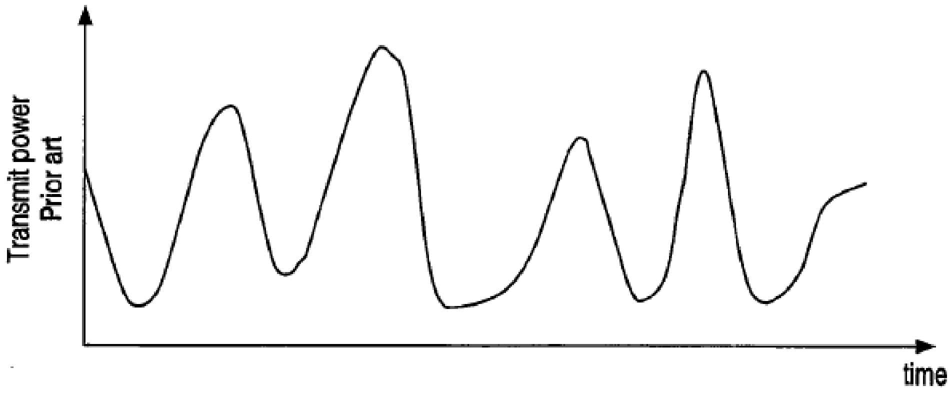


FIG.3

114. At [0006] the specification identifies two problems:

> "One problem with the TPC schemes described above is that power consumption of the transmitter increases when channel conditions are poor, and therefore the schemes may not be power efficient. Another problem is that the increase in transmitted power increases the interference to other users, which can degrade system efficiency."

115. At [0008] the specification states that it is an object of the invention "to contribute to improved efficiency".

116. There follows a consistory paragraph at [0009]:

> "According to a first aspect of the invention there is provided a radio station comprising transmitter means for transmitting over a channel in a predetermined time period a data block comprising information symbols and parity check symbols and control means responsive to an indication of a reduction in channel quality according to a first criterion for decreasing the data transmit power and responsive to an indication within the

> predetermined time period of an increase in channel quality according to a second criterion for increasing the data transmit power."

117. As the skilled person would appreciate, the concept of *decreasing* transmit power in response to an indication of a reduction in channel quality is the opposite of the usual response of a power control system, which is to *increase* transmit power as the channel quality reduces. The same goes for the corresponding concept of increasing transmit power in response to an indication of increasing channel quality.

118. The specification explains the advantage of this approach at [0010]:

> "By decreasing the data transmit power while the channel quality is poor, power is saved and interference is reduced."

Thus the invention seeks to address the problems identified in [0006].

119. Both [0009] and [0010] use the expression "data transmit power". This expression is not used in the preceding paragraphs of the specification, and it is not defined anywhere in the specification. It is used repeatedly in the remainder of the specification, however.

120. The specification continues:

> "[0011] The data block may be transmitted on one data signal or on a plurality of data signals simultaneously, and the decrease and increase in data transmit power may comprise decreasing and increasing the transmit power of one or more data signals. If a plurality of data signals is used, they may be transmitted on a plurality of carrier frequencies, or use Code Division Multiple Access (CDMA).
>
> [0012] Between the times of the first and second criteria being met, transmission of the data block may either be suspended or continue at a lower power level, possibly with a reduced data rate.
>
> [0013] Transmission of a control signal, such as a pilot signal, may continue between the time of the first and second criteria being met.
>
> [0014] If transmission of the data block is suspended when the first criterion is met, then when the second criterion is met, transmission of the data block may resume either from the point of suspension, or from the point in the data block that would have been reached had the transmission not been suspended, or from some point in between."

121. The specification states at [0023] that the data block is transmitted by the transmitter means "in a predetermined time period of duration t_F", which "may be part of a frame structure comprising a plurality of such time periods". In [0022] it is said that, as an example, "the period of time t_F for transmitting the data block may be 10ms". It was common ground between the experts that the skilled person would understand that in UMTS t_F is a TTI, which is a time within which fast fading may be experienced.

122. The specification notes that the invention may be used with closed-loop or open-loop power control ([0023]). If closed-loop power control is used, the transmitter may transmit a control signal as a pilot signal which the receiver may use to monitor the quality of the received signal ([0025]).

123. The specification explains at [0026] by reference to Figure 4 how transmit power varies over time in accordance with the invention.

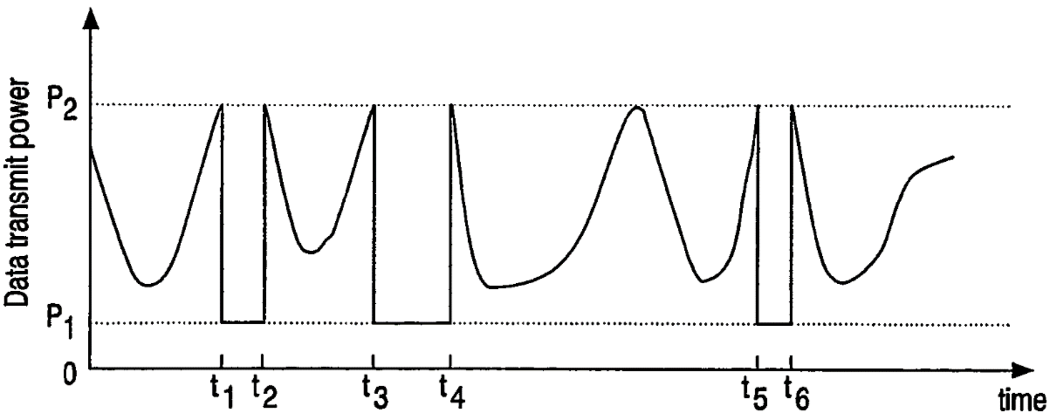


FIG.4

124. If the channel quality degrades to an extent determined by a first criterion, instead of increasing the transmit power above the level P_2, the transmitter instead decreases the "transmit power of the data" to a lower level, P_1. This occurs at times t_1, t_3 and t_5. When the channel quality increases to an extent determined by a second criterion, the "transmit power of the data" is increased and normal power control resumed. This occurs at times t_2, t_4, and t_6. The three periods $t_1 - t_2$, $t_3 - t_4$ and $t_5 - t_6$ therefore represent periods during which channel quality is particularly low. The specification refers (in Figure 6) to the transmitter being in a "'bad channel' state" during these periods. Outside those periods, the transmitter performs conventional power control; but during those periods, the transmitter does not.

125. At [0027] the specification gives five examples of the first criterion, for determining when to decrease the data transmit power. The most important one for present purposes is:

> "(e) receipt of a TPC command which, if obeyed, would increase transmit power or short term mean transmit power above a predetermined transmit power level P_2."

126. At [0030] the specification explains:

> "… after decreasing the data transmit power following the first criterion being met and before the second criterion is met, the transmission of data may be either
>
> a) switched off, or

> b) continued at a reduced and constant level, or
>
> c) continued at a reduced and varying level, to some extent tracking variations in channel quality".

127. At [0031] the specification explains that, where the transmitter transmits a plurality of data signals simultaneously, the power levels P_2 and P_1 can relate either to the transmit power level of one of the data signals or to the total combined transmit power of a plurality of the data signals. In the former case, the reduction to the transmit power is effected by reducing the power of that signal, and in the latter case it "may be effected by reducing the transmit power level of one or more of the data signals".

128. At [0032] the specification states that the first criterion can be applied a plurality of times during the predetermined time period. It describes an example by reference to Figure 7 in which the first radio station transmits three data signals simultaneously, with the power levels P_2 and P_1 "relating to "the total combined transmit power of the three data signals":

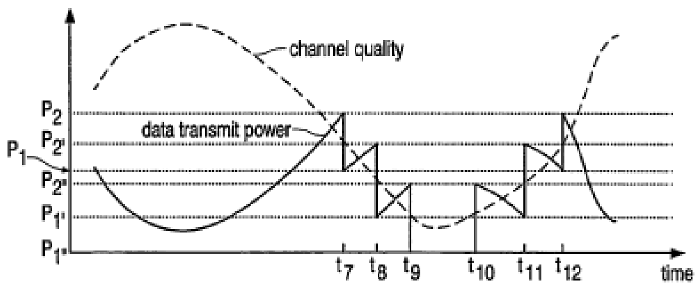


FIG.7

129. In this example, the transmit powers of the three signals are reduced to zero progressively, as the channel conditions worsen. The first signal is switched off at t_7, the second signal is switched off at t_8, and the third signal is switched off at t_9. The signals are switched back on progressively as the channel quality improves at t_{10}, t_{11}, and t_{12}. The line marked "data transmit power" shows the total combined transmit power of the data signals.

130. At [0033] the specification explains:

> "… after decreasing the transmit power following the first criterion being met and before the second criterion is met, any control signal transmitted by the first station 100 may be either
>
> a) switched off, or
>
> b) continued with varying power to continue to track the changes in channel quality to some extent, or
>
> c) continued at a constant level".

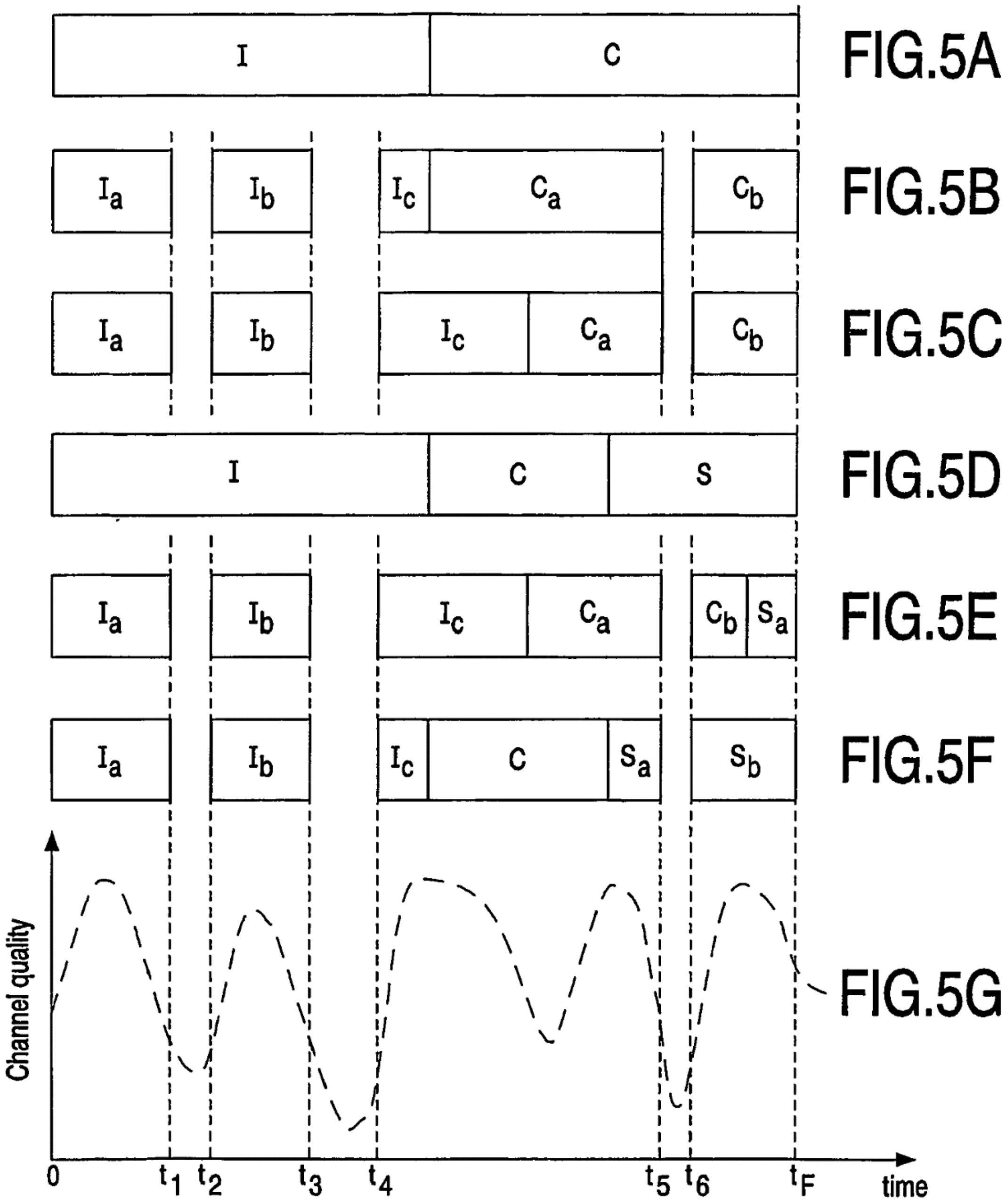
131. At [0034] the specification gives four examples of the second criterion, for determining when to increase the data transmit power (i.e. exiting the bad channel state). The most important one for present purposes is:

> "b) the quality of the first channel 160 exceeds a predetermined level as indicated by a message received on the second channel 260."

132. At [0035] the specification states:

> "If the first radio station transmits a plurality of data signals simultaneously as described above and if the second criterion is applied a plurality of times during the predetermined time period, the order in which the second criterion is applied to the different data signals may depend on factors such as … the relative priority of each data signal …"

133. At [0036]ff the specification describes by reference to Figure 5 a number of options for transmission of a data block comprising information symbols I and parity check symbols C in accordance with the invention (although some of these fall outside the claims as proposed to be amended):



134. It is not necessary to describe all of these options, but the following points should be noted. First, Figure 5 shows the data block being transmitted within t_F in every case. Second, the specification explains at [0038] that the second option illustrated in Figure 5B "is to suspend transmission of the data block symbols during the periods t_1 to t_2, t_3 to t_4 and t_5 to t_6 while maintaining the timing of the symbols of the data block relative to the time period 0 to t_F". Thirdly, in the fourth option illustrated in Figure 5D and described at [0041] the data block includes spare capacity S.

135. Figure 6 is a flow chart illustrating a method of operation in accordance with the invention.

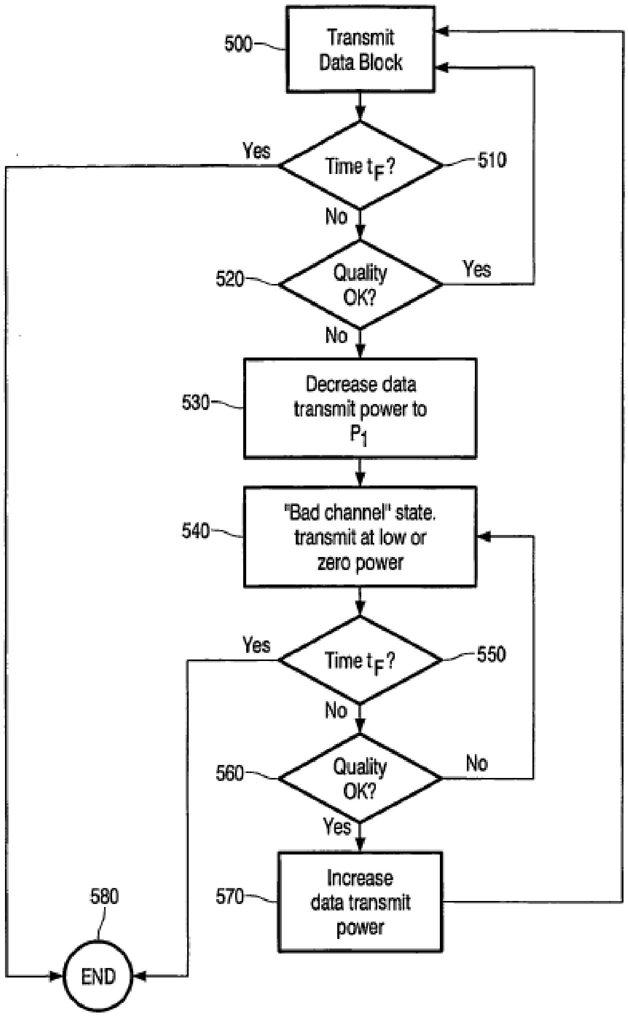


FIG.6

136. As can be seen from the flow chart, and as the specification explains at [0045], transmission of the data block by the first radio station commences at 500. At 510 the first radio station tests whether "the time t_F at which the predetermined time period expires" has been reached. If t_F has been reached, transmission of the data block ends at 580. If it has not been reached, the channel quality is checked and the data transmit power decreased if appropriate at 520, 530 and 540. At 550 the first radio station again tests whether "the time t_F at which the predetermined time period expires" has been reached. If t_F has been reached, transmission of the data block ends at 580. If it has not been reached, the channel quality is checked and the data transmit power increased if appropriate at 560 and 570.

<u>The claims</u>

137. As proposed to be amended, broken down into integers and omitting reference numerals, claim 1 is as follows:

"[1] A radio station comprising transmitter means for transmitting over a channel in a predetermined time period (0 to t_F) a data block comprising information symbols (I) and parity check symbols (C) and

[2] control means responsive to an indication of a reduction in channel quality according to a first criterion for decreasing the data transmit power and

[3] responsive to an indication within the predetermined time period of an increase in channel quality according to a second criterion for increasing the data transmit power,

[4] <u>wherein, during operation, after decreasing the transmit power following the first criterion being met and before the second criterion is met, the transmission of the data block continues at a lower power level</u>."

138. Claims 2-8 as granted are to be deleted by amendment. New claim 2, amended from claim 9, is as follows:

> "A radio station as claimed in ~~any of~~ claim~~s~~ 1 ~~to 8~~, wherein the indication of a reduction in channel quality according to the first criterion is an indication to increase transmit power above a predetermined threshold (P2)."

139. New claim 3, amended from claim 10, is as follows:

> "A radio station as claimed in claim <u>2</u> ~~9~~, wherein the indication to increase transmit power is a received command."

140. It is common ground that it is only necessary to consider claim 3.

<u>The skilled person</u>

141. There is relatively little dispute as to the identity of the person skilled in the art to whom the Patent is addressed. It is common ground that the Patent is addressed to a person working on power control as part of the air interface of a cellular communications system, that the skilled person would have a degree in electronic engineering (or a similar subject) and would have worked in the mobile communications industry for at least two and probably at least three years and that the skilled person might be working on developing a standard or on implementing one.

142. Such dispute as there was related to the question of how focussed on UMTS the skilled person would be. The starting point in considering this question is the geographical location of the skilled person. Counsel for the Defendants accepted that common general knowledge was restricted to information which was common general knowledge in the UK, but nevertheless disputed that the skilled person was located in the UK. I do not understand the distinction which he sought to draw. Information can only be common general knowledge if it is generally known to the relevant class of persons. To be common general knowledge in the UK, it must be generally known to the relevant class of persons in the UK.

143. There is little doubt that, at the Priority Date, the relevant class of persons in the UK was working on UMTS or equipment that was intended to comply with UMTS. UMTS had become the European standard for 3G, and there was no prospect of cdma2000 being deployed in the UK. Dr Irvine's evidence was that the skilled person in the UK would not have worked on cdma2000 or participated or followed 3GPP2 standardisation. For his part, Dr Brydon was not aware of anyone in the UK working on 3GPP2 standards at the Priority Date. Nor did he know of anyone working on implementing cdma2000 in the UK at that date. Moreover, he agreed with Dr Irvine that the skilled person would not have a detailed knowledge of the 3GPP2 standards, whereas the skilled person would have a detailed knowledge of the UMTS Release 4 and 5 Technical Specifications. Accordingly, I accept Philips' contention that the skilled person's background and experience would be in UMTS.

144. On the other hand, I also accept the Defendants' point that the skilled person would not be restricted to UMTS, since the claims of the Patent are not limited to UMTS and cover any CDMA system. It follows that the skilled person could be someone with a background in UMTS who has just been hired to implement the power control aspects of cdma2000-compliant equipment in the UK. Whether there would have been a commercial market for cdma2000-compliant mobile phones in the UK is irrelevant. In principle, the skilled person could be working on designing and building a cdma2000-compliant phone for a foreign market such as the US or Korea.

145. Counsel for Philips submitted for the first time in his oral closing submissions that the skilled person would not have been capable of implementing the power control aspects of cdma2000 using his common general knowledge. I agree with counsel for the Defendants that this submission is (i) not open to Philips, (ii) wrong in law and (iii) contrary to the evidence. It is not open to Philips because it was neither foreshadowed in Philips' skeleton argument nor put to Dr Brydon in cross-examination. Counsel for Philips submitted that he did not have to put the point to Dr Brydon because Dr Brydon gave no evidence to the contrary. I do not accept this: Dr Brydon gave evidence in his reports based on the skilled person implementing the power control aspects of cdma2000. The submission is wrong in law, because if the skilled person could not implement the power control aspects of cdma2000 using his common general knowledge, the claims would be insufficient, contrary to Philips' case. The submission is contrary to the evidence, because Dr Irvine expressly accepted, consistently with Dr Brydon's evidence, that the skilled person would be able to implement the power control aspects of cdma2000.

146. Although I accept the Defendants' case that the skilled person would not be restricted to UMTS and could be working on implementing the power control aspects of cdma2000, I do not accept that it follows that, as counsel for the Defendants argued, the limited extent of the skilled person's common general knowledge with regard to cdma2000 compared to UMTS has no bearing on the question of obviousness. I shall return to this point below.

Common general knowledge

147. There is no dispute that everything I have set out in the technical background section was part of the skilled person's common general knowledge.

148. Nor is there any dispute that the operation of cdma2000 would be common general knowledge to the level of detail described in chapter 14 of the second edition of Holma and Toskala, *WCDMA for UMTS* (2002), but no further. Holma & Toskala states at page 383:

> "The basic power control procedure is rather similar in the MC mode [i.e. cdma2000] and UTRA FDD [i.e. UMTS]. Fast closed-loop power control is available in both uplink and downlink. Many of the details are different, however. First of all, the power control command rates are different: 1500 Hz with a normal step size of 1 dB in UTRA FDD and 800 Hz in the MC mode. In the MC mode the fast closed-loop power control does not operate on its own in the uplink, but open-loop power control is also active."

Construction

149. There are two issues as to the interpretation of the claims. The first is relevant to infringement, the second to validity.

Data transmit power

150. Integers [2] and [3] refer to decreasing and increasing "the data transmit power". The Defendants contend that this means the total transmit power of the transmitter, and thus the claim does not cover the situation where the transmit power on a single physical channel is deceased or increased, but the total transmit power remains the same. Philips disputes this.

151. The Defendants rely upon two main points in support of their contention. First, they point to [0006] and [0010] and argue that these paragraphs make it clear that the purpose of the invention is to reduce the total transmit power since "power is saved and interference reduced" only if total transmit power is decreased.

152. Secondly, the Defendants point to [0031] and Figure 7 and argue that this part of the specification makes it clear that, while it is possible to reduce the transmit power of only one or two signals out of three, the effect is a reduction in total transmit power. Moreover, the Defendants say it is significant that Figure 7 shows the total transmit power of the three signals labelled as "data transmit power".

153. Philips argues that the Patent clearly distinguishes, at [0010]-[0013], [0030] and [0033], between transmission of data on the one hand and control signals on the other hand. Furthermore, whereas the specification states at [0030] that the data transmission may be continued at a "reduced and constant" or "reduced and varying" level, it states at [0033] that the control signal may be "continued with varying power" or continued "at a constant level", with no mention of its being reduced. Thus the control signal may increase when the data transmission reduces.

154. In my judgment Philips' construction is the correct one. I agree with the Defendants that the skilled person would understand from [0006] and [0010] the invention aims to reduce the total transmit power, and that the claims cover systems which achieve that,

but it does not necessarily follow that the skilled person would think that the patentee was intending to restrict the claims to such systems.

155. As for [0032], it seems to me that, if anything, this passage supports Philips' construction. As the Defendants themselves point out, it shows the transmit power of three data signals being separately reduced. It is clear from this that the transmit power of one or more data signals may be reduced while the transmit power of one or more data signals is unchanged i.e. the data signals can be treated independently of each other. Moreover, this passage refers repeatedly to "the total combined transmit power" of the three signals, in contradistinction to the "transmit power" of the individual signals. This suggests that in the claim "data transmit power" refers to the transmit power of a single data signal. The fact that Figure 7 is labelled "data transmit power" rather than "total combined transmit power" does not carry weight given the clear description in [0032].

156. Turning to the passages relied on by Philips, I agree with Philips that these make it clear to the skilled person that there can be a control signal separate from the data signal whose transmit power may be increased when the transmit power of the data signals is decreased. I would add that, although the specification refers at [0035] to "the relative priority of each data signal" in the context of applying the second criterion to a plurality of data signals, it would be a small step for the skilled person to realise that the transmit power of the individual signals could be adjusted in accordance with their relative priorities.

Predetermined time period

157. Philips contends that the "predetermined time period" referred to in integers [1] and [4] is the period over which a single data block comprising information bits and parity check bits is transmitted. The Defendants contend that it means any finite period within which the radio station can decrease and increase the data transmit power and thus may cover multiple data blocks.

158. In my judgment Philips is clearly right on this issue. The specification clearly states at [0022] and [0023] that the predetermined time period t_F is the period within which "the data block" is transmitted. This is also shown in Figure 5. The passages describing the Figure 5B option at [0038] and the Figure 6 flow chart at [0045] confirm this. The fact that the Figure 5D option includes spare capacity does not indicate anything different, since it is still clear that the data block is transmitted within t_F. Nor does [0045] indicate that transmission of the data block can exceed t_F as counsel for the Defendants suggested.

159. Furthermore, as noted above, the experts were agreed that the skilled person would understand that in UMTS the predetermined time period is a TTI. The experts were also agreed that the skilled person would know that, in UMTS, TFCs can be reconfigured on a TTI-by-TTI basis, but the only known method of power control within a TTI was the conventional stepwise adjustment of power in accordance with the inner-loop power control scheme. Thus the skilled person would appreciate that one of the key advantages of the invention is that it enables the transmission power of a data block to be controlled during a TTI (in particular by using TPC commands as an indication of the change in channel quality) in response to fast changing channel conditions.

160. Yet further, as counsel for Philips pointed out, on the Defendants' construction the claims would be anticipated by the TFC reconfiguration on a TTI-by-TTI basis power control method employed in Releases 99, 4 and 5 of UMTS, which were common general knowledge. There is no rational reason why the skilled person would think that the patentee intended the claims to cover that method.

161. Finally, I agree with counsel for Philips that it is not legitimate to construe the claims by reference to Release 6 of UMTS, which is post-Priority Date, as counsel for the Defendants sought to do. I do not consider that this assists the Defendants anyway.

Infringement

162. It is common ground that, if "data transmit power" is construed in the manner that I have concluded is correct, then the Defendants have infringed claim 3 of the Patent since their phones comply with Release 6 of UMTS.

C.S0002

163. As noted above, the Defendants' obviousness case is based on an 11 line passage on page 2-47 of C.S0002, which is page 113 of a 409 page document. As I will explain, there is a dispute between the parties as to what the passage in question discloses. Before turning to consider that passage, I must put it in context.

164. C.S0002 is the Physical Layer Standard for cdma2000. Long as it is, it was common ground between the experts that the skilled person would not be able to understand it in isolation, but would have to refer at least to parts of C.S0005-0-2, the Upper Layer (Layer 3) Signalling Standard for cdma2000 (reference 5 in C.S0002), which is 1168 pages long, and C.S0011-A, Recommended Minimum Performance Standards for Dual-Mode Spectrum Mobile Stations, March 2001 (reference 11 in C.S0002). C.S0002 contains a detailed table of contents which enables the skilled person readily to find the sections dealing with transmission power and power control, but the skilled person would not be able to understand those sections on their own. An added difficulty is that the cdma2000 specifications are structured in quite a different way to the UMTS specifications. Dr Irvine's evidence was that it took him several weeks to read and understand the relevant parts of the various documents. It is common ground that, once the skilled person had read and understood the relevant sections, he would notice that (as stated in Holma & Toskala) some aspects of power control in cdma2000 were similar to power control in UMTS, but there were also differences. I shall return to this point below.

165. C.S0002 is Release 0 of the Physical Layer Standard. By the Priority Date, it had been succeeded by Releases A, B and C. The version current at the Priority Date was Release C Version 1.0. On the other hand, Release 0 had been widely deployed in networks, tens of millions of Release 0 phones had been made to work with those networks and network operators had not upgraded their networks to Releases A or B.

166. Release 0 of cdma2000 (also known as 1xRTT) was often referred as a 2.5G standard because it did not meet the IMT-2000 transmission rate requirements for 3G. At the Priority Date, UMTS Release 5 was over 30 times as fast as cdma2000 Release 0 in the downlink. UMTS supported more users, had lower power fluctuations, reduced signalling overhead and a 27% capacity enhancement over cdma2000. UMTS had a

faster closed-loop response time than cdma2000 (1500Hz compared to 800Hz), and an associated faster response to fast fading. Accordingly, the skilled person would consider UMTS Release 5 to be technically superior in terms of power control than cdma2000, and in particular Release 0.

Disclosure of the power control aspects of C.S0002

167. *The reverse link (uplink) channels*. The reverse link (uplink) channels are shown in Figure 2.1.3.1.1-1 on page 2-57 of C.S0002 which is reproduced below.

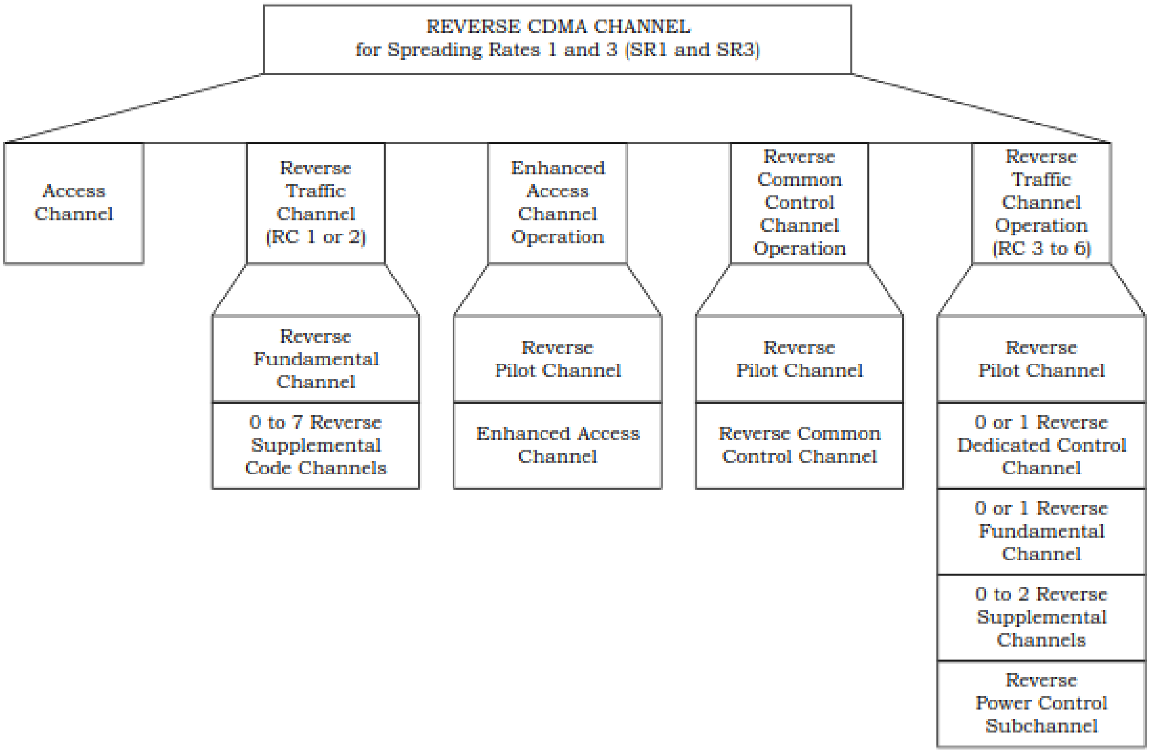


Figure 2.1.3.1.1-1. Reverse CDMA Channels Received at the Base Station

168. RC in this figure is short for Radio Configuration. This is defined at page 1-9 as a set of Forward (downlink) and Reverse (uplink) Traffic Channel transmission formats that are characterised by physical layer parameters such as data rates, modulation characteristics and spreading rates. It can be seen that the Reverse Traffic Channel for RC 3 to 6 comprises:

i) the Reverse Pilot Channel;

ii) 0 or 1 Reverse Dedicated Control Channels;

iii) 0 or 1 Reverse Fundamental Channels;

iv) 0, 1 or 2 Reverse Supplemental Channels; and

v) the Reverse Power Control Subchannel.

169. Power control of those channels is set out in section 2.1.2.3 from page 2-36 to page 2-54. There are three elements, which although described as "independent" are not strictly independent:

i) open-loop estimation;

ii) closed-loop estimation; and

iii) code channel attribute adjustment for RC 3 to 6.

170. In summary, the MS performs open-loop power control based on the received power of the downlink pilot channel. The MS performs closed-loop power control in accordance with power control messages from the BS. These closed-loop power control commands are summed with the open-loop estimate for the traffic channels in RC 1 and 2 and for the Reverse Pilot Channel in RC 3 to 6. Finally, the MS adjusts the power of the traffic channels in RC 3 to 6 relative to the Reverse Pilot Channel using code channel attribute adjustment. The "traffic pilot ratio" is determined as part of the code channel attribute adjustment by parameters including the data rate, frame length and adjustments signalled by the BS.

171. *Open-loop power control*. The open-loop power control works on the assumption that the path loss in the forward and reverse links will be the same, but there is a frequency difference between those links (C.S0002 uses FDD to separate downlink and uplink transmissions) so the path loss is unlikely to be the same. While the distance-based path loss and slow fading will be reasonably accurate, fast fading will not be because it is strongly frequency-dependent.

172. The transmission power of the MS will be increased when the downlink received power reduces, and vice-versa. There are a number of correction factors which depend on the interference in the cell, the mobile speed, the data rate, the error target and the propagation environment.

173. C.S0002 sets out an open-loop power control formula for a number of different scenarios. Thus the formula used for initial access on the Access Channel is set out at pages 2-37 to 2-38.

174. The basic open-loop power control function is adjusted to take into account the method that cdma2000 uses for access. To access the system, the MS sends a series of access probes (signals that the BS recognises as a request to access the system). If the BS does not respond to an access probe, it is sent again at a higher power level.

175. When the BS starts receiving the signal transmitted by the MS, closed-loop power control can begin. Nevertheless, open-loop power control continues, which the skilled person would consider to be old-fashioned and less satisfactory than the UMTS system of closed-loop power control only.

176. Open-loop power control for the Reverse Traffic Channel with RC 1 and 2 is dealt with in section 2.1.2.3.1.4 on pages 2-42 to 2-44. Open-loop power control for the Reverse Traffic Channel with RC 3 to 6 is dealt with in section 2.1.2.3.1.5 on pages 2-45 to 2-46.

177. The MS continues to measure the received power from the BS, and the open-loop power estimate can continue to vary. Following receipt of power control bits as part of closed-loop power control, the sum of these closed-loop control bits is applied to the open-loop estimate. The output power of the Traffic Channels in RC1 and 2 and the Pilot Channel in RC 3 to 6 is therefore affected by both open-loop and closed-loop power control.

178. *Closed-loop power control*. The BS compares the received power level against a target value (which is an implementation option not specified in C.S0002). The BS then sends power control commands to the MS to tell it to raise or lower its power on the Forward Power Control Subchannel. Power control commands are normally transmitted by the BS at a rate of one bit every 1.25 ms (a "power control group" or PCG) i.e. 800 bits per second. There are 16 PGCs per 20 ms frame and each PCG can carry 12 bits i.e. 12 power control subchannels supporting 12 users.

179. The power control commands are carried on a Forward Power Control Subchannel which is transmitted on either the Forward Fundamental Channel or the Forward Dedicated Control Channel. In addition, the Common Power Control Channel is used by the BS for transmitting common power control subchannels for the power control of multiple Reverse (uplink) Common Control Channels and Enhanced Access Channels.

180. The MS adds the power control corrections to the value from the open-loop power control algorithm. For RC 1 and 2, this provides the output power of the traffic channels, whereas for RC 3 to 6, this provides the output power of the Reverse Pilot Channel and code channel attribute adjustment is used to determine the output power of the traffic channels relative to the Pilot Channel.

181. Section 2.1.2.3.2 on pages 2-46 to 2-47 deals with closed-loop power control. This specifies that a basic MS which does not support the Reverse Supplemental or Reverse Supplemental Code Channels must support a power control step of 1 dB i.e. when told to increase or decrease its power by the closed-loop power control it will increase or decrease it by 1 dB. MSs supporting the Reverse Supplemental or Reverse Supplemental Code Channels must also support a step size of 0.5 dB. MSs supporting RC 3 to 6 may also support a step size of 0.25 dB. The skilled person would recognise that the closed-loop power control scheme for UMTS can go "four times as fast" as C.S0002 because it has double the frequency and twice the step size.

182. *Code channel attribute adjustment*. For RC 3 to 6, the open-loop and closed-loop power control described above control the power on the Reverse Pilot Channel. Section 2.1.2.3.3 describes how the power on the other reverse channels in these RCs is controlled with reference to the Reverse Pilot Channel through a number of adjustment factors as necessary on a frame-by-frame basis. The adjustment factors are in steps of 0.125 dB. Different correction factors are either specified in the standard and fixed or transmitted to the MS in connection set up messages or power control messages.

183. In the case of the Reverse Traffic Channels with RC 3 to 6, the Reverse Pilot Channel is adjusted by the sum of six different attribute adjustment factors as described in section 2.1.2.3.3.2 at pages 2-49 to 2-54. Page 2-53 specifies that the MS must maintain the ratio of the powers of the Reverse Fundamental Channel, Reverse

Supplemental Channels and Reverse Dedicated Control Channel to the Reverse Pilot Channel to within ±0.25 dB of the figure given by the formula.

184. The skilled person would regard this approach of multiple overlapping adjustment factors as being more complex, unwieldy and less efficient than the UMTS approach in which a single gain factor is used to set the power of a channel (or group of channels) relative to the uplink Dedicated Physical Control Channel.

185. The rate of change of MS output power is constrained by section 2.1.2.4 on page 2-54 to be less than 1.2 dB per PCG for the open-loop. The MS is given 0.5 ms to come within 0.3 dB of a new power level for a 1 dB step in the closed-loop.

186. *Maximum uplink transmission power*. Section 2.1.2.1 on page 2-34 states that the MS "shall not exceed the maximum specified power levels under any circumstances".

187. The MS may be commanded to transmit above its maximum allowed power as a result of open-loop or closed-loop power control. Page 2-47 describes how the MS must respond in two paragraphs, the first relating to RC 1 and 2, the second relating to RC 3 to 6.

188. The first paragraph states:

> "For the Reverse Traffic Channel with Radio Configurations 1 or 2, if the mobile station is unable to transmit at the requested output power level, it shall terminate transmission on at least one Reverse Supplemental Code Channel not later than the transmission of the next 20ms frame to maintain the requested output power on the Reverse Fundamental Channel."

189. Thus if the maximum power limit is encountered in RCs 1 and 2, one or more Reverse Supplemental Code Channels are terminated by (and, the skilled person would understand, preferably at) the next frame boundary in order to maintain the requested power of the Reverse Fundamental Channel. The skilled person would understand that the Reverse Supplemental Code Channels cannot be reconfigured, since they have a fixed frame length and a fixed data rate.

190. The second paragraph (the disputed paragraph) states:

> "[1] For the Reverse Traffic Channel with Radio Configuration 3 through 6, if the mobile station is unable to transmit at the requested output power level, it shall reduce the data rate on the Reverse Fundamental Channel, or reduce the transmission power or terminate transmission on at least one of the following code channels that are active: the Reverse Fundamental Channel, the Reverse Supplemental Channels, or the Reverse Dedicated Control Channel. [2] The mobile station shall perform this action not later than the 20 ms frame boundary occurring no later than 40 ms after determining that the mobile station is unable to transmit at the requested output power level. [3] The mobile station should attempt to reduce the transmission power, the data rate, or terminate transmission

> first on the code channel with the lowest priority. [4] The mobile station shall transmit at the commanded output power level on the Reverse Pilot Channel."

I have numbered the four sentences for identification.

Interpretation of the disputed paragraph

191. On its face, the disputed paragraph appears to disclose three different options for the MS if the requested output power level exceeds the maximum allowed, namely:

i) reduce the data rate on the Reverse Fundamental Channel;

ii) reduce the transmission power on at least one of the Reverse Fundamental Channel, the Reverse Supplemental Channels or the Reverse Dedicated Control Channel; or

iii) terminate transmission on at least one of the Reverse Fundamental Channel, the Reverse Supplemental Channels or the Reverse Dedicated Control Channel.

192. The dispute is as to *how* and *when* the skilled person would understand that the transmission power was to be reduced (i.e. what appears to be the second option). As will appear, these two questions are linked.

193. When approaching this dispute, it is important to appreciate two points which are common ground. First, reducing the data rate on a channel will generally allow a corresponding reduction in its transmission power level. This means that the distinction between reducing the data rate and reducing the transmission power is not as clear-cut as the language suggests. Secondly, reducing the data rate of a channel can only be done at a frame boundary, because it involves changing the channel coding to reconfigure the channel. This raises the question of what the MS is to do during the intervening period.

194. Philips contends that the skilled person reading the disputed paragraph in context as at the Priority Date would understand that there were in fact two possible courses of action for the MS:

i) the MS would ignore any further power up commands within the existing frame and freeze the existing power levels of the channels until it could make a data rate change on one or more of the three specified channels, which would take place at the next possible 20 ms frame boundary, but within the 40 ms time limit, so that at that time the commanded output power level of the Reverse Pilot Channel would be achieved; or

ii) the MS would terminate the transmission of one or more of the three specified channels, and that termination would preferably also occur at a frame boundary (although it would be possible mid-frame).

This was Dr Irvine's interpretation.

195. The Defendants contend that the skilled person would understand that there was a third possibility, namely a direct and immediate reduction in transmission gain on one or more of the three specified channels. This was Dr Brydon's interpretation.

196. The Defendants rely heavily on the language of sentences [1] and [3] of the disputed paragraph as showing that there are three options rather than two, and that one of the options is to reduce transmission power on one or more of three channels as distinct from reducing the data rate on one or terminating the transmission on one or more of three channels. The Defendants also contend that their interpretation is supported by technical reasons which I will consider below.

197. Philips points out that these sentences must be read in the context first of the disputed paragraph as a whole and secondly of the power control aspects of C.S0002 as a whole. Philips contends that, read as a whole and in context, the skilled person would conclude that the meaning of the disputed paragraph was that set out in paragraph 194 above.

198. Before turning to consider these contentions in more detail, it is convenient to begin by noting that it is common ground that the skilled person reading C.S0002 would notice certain similarities between the power control scheme in C.S0002 and that in UMTS Release 5:

i) Both systems provide a lead control channel (the Reverse Pilot Channel in the case of C.S0002 and DPCCH in the case of UMTS) which is subject to fast closed-loop power control.

ii) The other channels are follower channels that have their transmit power set by reference to the lead channel. (In C.S0002 this is done in the third step of power control, the code channel attribute adjustment.) Normal power control depends, therefore, on maintaining the power ratios between the follower channels and the lead channel.

iii) Both standards provide for a maximum transmit power.

iv) Both standards have a paragraph dealing with the situation where the MS receives a power up command which would take the MS above its maximum transmit power.

199. It is also common ground that the skilled person would be aware from his common general knowledge that the approach that was adopted in UMTS Release 5 for dealing with this situation was for the MS to ignore any further power up commands within the existing frame and freeze the existing power levels of the channels, maintaining the ratio between them (a procedure known as "clipping"). Philips contends that this would colour the skilled person's thinking when trying to understand the disputed paragraph. That was Dr Irvine's opinion, and although Dr Brydon did not agree, I consider that Philips is correct about this. Being familiar with how power control worked in UMTS, but much less familiar with how it worked in cdma2000, would be bound to affect the skilled person's reading of the document.

200. Philips contends that sentences [2] and [4] are key to the skilled person's understanding of the disputed paragraph. Although the technical considerations

relating to these two sentences are linked, it is convenient to deal with them separately and in reverse order.

201. Sentence [4] states that the MS "shall transmit at the commanded output power level on the Reverse Pilot Channel". In his first report, Dr Brydon noted that one possibility was for the MS to freeze the power levels of all the channels until the data rate could be changed at a frame boundary, but discounted this because, as he put it in paragraph 10.23 in the context of the first option, "this would result in the MS departing from the *requirement* to 'transmit at the commanded output power level on the Reverse Pilot Channel' for some time [emphasis added]" and, as he put it in paragraph 10.28 in the context of all the options, "there would be a period of up to 40ms (i.e. 32 power control steps) when the R-PICH would depart from the *requirement* in the final sentence of page 2-47 to transmit it at the commanded output power level [emphasis added]". Similarly, he said at paragraph 10.24 that the second and third options "provide a way of reacting to the situation immediately and allowing the R-PICH to transmit at the commanded power level *as required* [emphasis added]".

202. Dr Brydon took the same view in his second report, where he said in paragraph 7.13 that the interpretation he adopted in his first report "would allow the MS to 'transmit at the commanded output power level on the Reverse Pilot Channel' as *required* by the final sentence on page 2-47 [emphasis added]", otherwise "the power level of R-PICH and other important channels could depart from their ideal values for up to 40 ms".

203. In paragraph 5.8 of his third report, however, Dr Brydon said this (emphasis added):

> "Dr Irvine suggests that I have misconstrued the final sentence of page 2-47. I do not interpret the sentence as a *requirement* for an immediate response when a mobile reaches its maximum power level. The paragraph has already set a deadline for undertaking changes and I do not think this sentence is intended to set a different one. My point is that it would be a natural approach to react quickly in these circumstances, in order to maintain power control of the R-PICH."

204. In cross-examination Dr Brydon confirmed that he did not consider that sentence [4] required an immediate response. He went on to say that sentence [4] "sets the aspiration, if you like, for the pilot channel." When I queried his use of the word "aspiration" and asked whether he disagreed that the word "shall" indicated that the sentence was mandatory, Dr Brydon replied:

> "It becomes mandatory when the time limit applies. That is my reading of the paragraph. Clearly, this paragraph gives the mobile station a period of time in which to respond to this situation and having done so, it then must transmit at the commanded power level. What I am saying is, in an ideal world, it would be transmitting at that power level all the time, so it may not be possible to do that, but ideally, the handset should do, and reducing the transmission power is something that enables the handset to do that immediately."

205. Dr Irvine's evidence in paragraph 86(f) of his second report, replying to Dr Brydon's first report, was that:

> "If the final sentence were interpreted in the way Dr Brydon suggests, reducing the rate of the channel could never be an option for reducing power in its own right, as it can never occur immediately. The mobile would always have to reduce power first and then change the data rate of a channel."

206. It was put to Dr Irvine in cross-examination that sentence [4] was mandatory. Dr Irvine agreed, but pointed out that that "contradicts what else is going on". Later it was put to Dr Irvine that, if the MS clipped the transmission powers, then during the time period of up to 40 ms, the MS would not be complying with the last sentence. Consistently with his evidence in his second report, Dr Irvine replied:

> "Again, it is not a very well written paragraph, I would assume that the fact that you are given a particular amount of time in order to undertake the changes means that the last sentence of the paragraph is also subject to that time limit. The difficulty is, if you interpret the last sentence of [the] paragraph as having to operate all the time, then you cannot actually implement the time delays that are specified in the paragraph."

207. Counsel for the Defendants submitted in his closing submissions that an important indication that pointed towards Dr Brydon's interpretation of the disputed paragraph was that sentence [4] mandated that the Reverse Pilot Channel transmitted at the commanded level, and that that pushed the skilled person in the direction of taking immediate action. As counsel for Philips pointed out, however, it was in the end common ground between the experts that sentence [4] had to be read as being subject to the implicit qualification that it only applied after the expiry of the 40 ms time limit.

208. This is significant for three reasons. First, as can be seen from the extracts quoted above, this removes the principal basis which Dr Brydon had given in his first report for discounting the possibility that the MS would clip the transmission powers of the channels. Secondly, Dr Irvine was cross-examined on the basis that, whatever interpretation of the disputed paragraph was adopted, it involved non-compliance with one or more other mandatory parts of C.S0002. If sentence [4] is interpreted in the way that the experts ultimately agreed, however, then it is possible to avoid non-compliance with mandatory aspects of the standard on Philips' interpretation. As I shall explain, the same is not true of the Defendants' interpretation. Thirdly, if sentence [4] is interpreted in the way that the experts ultimately agreed, then it does not push the skilled person in the direction of taking immediate action.

209. I turn next to sentence [2]. This states that the MS "shall perform this action not later than the 20 ms frame boundary occurring no later than 40 ms after determining that the mobile station is unable to transmit at the requested output power level". This means that, by comparison with RC 1 and 2, the MS in RC 3 to 6 has an extra 20 ms in which to take action. The question which arises is why the skilled person would think the MS was given more time in RC 3 to 6. A related question is why the skilled person would think that the disputed paragraph appears to treat the Reverse

Fundamental Channel differently to the Reverse Supplemental Channels and the Reverse Dedicated Control Channel in giving reducing the data rate as an option for the former, but not the latter.

210. In the case of RC 1 and 2, the action required is simply termination. This must take effect by (or preferably at) the start of the next 20 ms frame. Turning to RC 3 to 6, it was common ground between the experts that the Reverse Fundamental Channel data rate may vary on a frame-by-frame basis and the MS can unilaterally change the rate on that channel to reduce transmission power (according to the code channel attribute adjustment described above). Dr Irvine's unchallenged evidence was that the time period allowed in RC 1 and 2 would be sufficient for this, and the extended time period provided for RC 3 to 6 would not be required. By contrast, the MS cannot autonomously reconfigure the other channels, so it would have to request a new data rate for those. Dr Irvine thought that this indicated the reason why the MS was given an additional 20 ms for RC 3 to 6.

211. Dr Brydon's evidence in paragraph 7.12 of his second report was that (i) the Reverse Fundamental Channel could be reconfigured within the time period allowed for RC 3 to 6, but (ii) it was "unlikely" that the Reverse Supplemental Channels and the Reverse Dedicated Control Channel could be reconfigured within that period.

212. So far as point (i) is concerned, if Dr Brydon was intending to suggest that this could not be done within the time period allowed for RC 1 and 2, this is contrary to Dr Irvine's evidence. Not only was Dr Irvine's evidence unchallenged, but also I find it convincing.

213. So far as point (ii) is concerned, Dr Irvine explained in paragraphs 46 to 49 of his third report and in cross-examination that the additional 20 ms provided time for the BS to respond to a request for a new data rate using mini-messages sent within a 5 ms frame which were provided for by parts of the cdma2000 standard dealing with higher layer signalling. Dr Brydon told me that hearing the explanation given by Dr Irvine orally had modified his view, because he had not noticed the part of the standard that permitted mini-messages to be sent within a 5 ms frame part way through a 20 ms frame before (despite it being referred to in Dr Irvine's third report). Dr Brydon accepted that this increased the probability of the BS being able to respond within the extra 20 ms, but expressed the view that this was not guaranteed.

214. Dr Brydon pointed out in his second report, and Dr Irvine accepted in his third report, that, if 80 ms frames were being used on the Reverse Supplemental Channels (which is a permitted option), then it would not be possible to reconfigure in time. Dr Irvine's view was that this was a trade-off between the time that could be allowed for the traffic channel to be reconfigured and the speed of response to different channel conditions, and that the skilled person could conclude that in this situation the only option was to terminate mid-frame. Although Dr Brydon didn't make the point, Dr Irvine accepted in cross-examination that the same applied to 40 ms frames on the Reverse Supplemental Channels (which is also a permitted option).

215. Counsel for the Defendants put it to Dr Irvine, and Dr Irvine accepted, that there were "a large number" of scenarios in which it might not be possible to reconfigure, but the only other specific scenarios which were identified during Dr Irvine's evidence were if the request or the response were lost. Counsel for the Defendants suggested in his

closing submissions that 40 ms and 80 ms frames could also be used on the Reverse Dedicated Control Channel, but my understanding of the specification is that the Reverse Dedicated Control Channel has a frame of 20 ms or 5 ms in RC 3 to 6 (20 ms in RC 1 and 2).

216. Counsel for the Defendants submitted that the uncertainty as to whether the data rate on the Reverse Supplemental Channels and the Reverse Dedicated Control Channel could be reconfigured in time provided a technical reason for the skilled person to interpret the disputed paragraph in the manner contended for by the Defendants. I do not accept this submission. In my judgment the skilled person would understand that the disputed paragraph proceeds on the basis that, in RC 3 to 6, the MS can and will (apart from some exceptional circumstances) take the appropriate action within the extended period allowed. The skilled person would understand that the Reverse Fundamental Channel was different to the other two types of channels for the reasons explained above, and that the extended time limit was provided to enable reconfiguration of the Reverse Supplemental Channels and the Reverse Dedicated Control Channel.

217. A related point is what the MS should do after taking one of the actions specified in the disputed paragraph. As was common ground between the experts, C.S0002 does not specify what the MS should do next. Dr Irvine's opinion was that this was because, once changes were made on a frame boundary, normal power control can continue. Thus this omission is perfectly consistent with Dr Irvine's interpretation of the disputed paragraph. It is less consistent with Dr Brydon's interpretation.

218. I now turn to sentence [3]. Counsel for the Defendants relied upon the acceptance by Dr Irvine in cross-examination that, when read together with sentence [4], sentence [3] was telling the skilled person that the MS must sacrifice one of the other channels in order to allow the Reverse Pilot Channel to be transmitted at the commanded output level. But this acceptance was predicated upon (i) counsel putting it to Dr Irvine that sentence [4] was mandatory and Dr Irvine replying that that was contradictory and (ii) counsel then saying he would come to that and asking Dr Irvine to accept that "in its own terms" that was what the end of the disputed paragraph was saying. Moreover, counsel then put it to Dr Irvine that, if the MS transmitted the Reverse Pilot Channel at the commanded output level, it would also transmit the other channels at their commanded output levels apart from the one sacrificed, to which Dr Irvine replied, "That is where the tension comes in". Thus the answers relied upon by counsel for the Defendants must be seen in the context of the other evidence concerning sentences [2] and [4] considered above.

219. This takes me to another important point relied upon by Philips, which is relevant both to the point discussed in the preceding paragraph and more generally. Dr Irvine gave evidence in paragraphs 86(b) and (d) of his second report that Dr Brydon's interpretation of the disputed paragraph, which allowed the relative powers of the channels to be varied on an interim basis prior to the change in channel configuration, introduced a contradiction with section 2.1.2.3.3 of C.S0002, and in particular page 2-53. As discussed above, this mandates that the MS maintains the power ratio of the other channels to the Reverse Pilot Channel to within 0.25 dB. Dr Irvine went on in paragraph 89 of his second report to say that a scheme to sacrifice power on one channel to allow other channels to follow power control commands was not merely

not described in the disputed paragraph, but was not permitted since the MS must keep the prescribed power ratios.

220. Dr Brydon's answer to this in paragraph 5.4 of his third report was simply to assert that "Section 2.1.2.3.3 has to be read as being subject to [the disputed paragraph]", in other words, that the disputed paragraph created an exception to section 2.1.2.3.3.

221. As Dr Irvine pointed out in paragraph 86(d) of his second report and re-iterated in paragraph 41 of his third report, however, section 2.1.2.3.3 states at page 2-53, immediately after saying that the MS "shall maintain" the power ratios:

> "If the mobile station reduces the data rate or terminates the transmission on a code channel for any reason other than being commanded by the base station or reaching the end of an allowed transmission period, the mobile station shall not change Multiple_Channel_Adjustment_Gain for any code channel."

Thus section 2.1.2.3.3 specifically addresses the actions required by the disputed paragraph, and provides an exception to the mandatory requirement. It does not provide the exception suggested by Dr Brydon. Moreover, the only actions it mentions are reducing the data rate and terminating the transmission, consistently with Dr Irvine's interpretation of the disputed paragraph.

222. Dr Brydon maintained in cross-examination that the disputed paragraph provided an exception to the mandatory requirements of section 2.1.2.3.3, saying that "something has to give" because "the mobile must respond to its closed-loop power control commands". But he had no explanation as to why page 2-53 should provide an exception, but not the one he was suggesting. Moreover, the suggestion that "something has to give" involved Dr Brydon reverting to reading sentence [4] as being mandatory at all times. As discussed above, he accepted that that cannot be right.

223. It is also notable that, as Dr Brydon accepted, there is nothing in the text which specifies a timeframe for the reduction in transmission power that he envisaged. Dr Irvine's opinion was that, if such a reduction had been intended, which involves a response within a different timeframe to that specified in sentence [3], that would have been specified. I find this evidence persuasive.

224. Counsel for the Defendants placed reliance on evidence given by Dr Brydon in cross-examination that the skilled person would perceive benefits in the MS acting immediately. Dr Irvine did not agree with this. In any event, the issue is how the skilled person would understand the disputed paragraph, which forms part of a standard specifying how the MS is to behave in various circumstances. For the reasons discussed above, I consider that the skilled person would not understand that C.S0002 either required or permitted an immediate reduction in transmission power in the manner suggested by the Defendants.

225. Accordingly, I accept Philips' interpretation of the disputed paragraph. Although this is primarily an issue for the court guided by the primary evidence of the expert

witnesses, I am comforted in this conclusion by the secondary evidence referred to in paragraphs 231-235 below.

Obviousness over C.S0002

226. The Defendants put their obviousness case over C.S0002 in three different ways. Case 2 depends on the Defendants' construction of "predetermined time period". Since I have not accepted that construction, that case falls away. That leaves case 1 and case 3.

227. *Case 1*. Case 1 is based on the skilled person implementing C.S0002 in the context of implementing (the power control aspects of) cdma2000 when making a mobile phone in the UK. In that case, the skilled person would have, as part of that exercise, to implement page 2-47, including the disputed paragraph.

228. Counsel for Philips submitted that the skilled person would not implement cdma2000, and specifically not C.S0002, because the skilled person would be focussed on UMTS, because the skilled person would consider power control in cdma2000 to be inferior to that in UMTS and because the skilled person would consider Release 0 of the Physical Layer Standard to be out of date. I do not accept this submission. I have already dealt with the point that the skilled person could be working on designing and building a cdma2000-compliant phone in the UK. As counsel for the Defendants pointed out, the Patent cannot be valid if the claims are old or obvious in the light of any item of prior art, including C.S0002. Thus the Defendants are entitled to test the validity of the Patent by supposing that the skilled person is simply endeavouring to put the teaching of C.S0002 into practice. Moreover, Release 0 was not out of date at the Priority Date in the sense of being technologically obsolescent. Given that it had been widely implemented, building a phone in accordance with Release 0 was, from a technical perspective, a perfectly reasonable option (whether or not it was commercially attractive).

229. Case 1 is based on the Defendants' interpretation of the disputed paragraph. Interpreting the disputed paragraph in that way, the Defendants contend that an obvious way in which to implement it would be to select the option of reducing the transmission power on at least one out of the Reverse Fundamental Channel, the Reverse Supplemental Channels and the Reverse Dedicated Control Channel from the three options given. If Philips is right as to the construction of "data transmit power", as I held, then that would bring the skilled person within claim 3.

230. If the premise were correct, then it seems to me that the Defendants are correct that the postulated conclusion would follow. It is pertinent to note, however, that this way of putting the case is very close to a case of anticipation. That being so, Philips relies on two points of secondary evidence.

231. First, the Defendants have not been able to point to any book, article or technical proposal, whether before or after the Priority Date, in which the disputed paragraph has been interpreted in the manner which the Defendants contend for or in which it has been proposed to implement it in the way which the Defendants suggest was obvious.

232. Secondly, the relevant passage was present in cdma2000 from Release 0 in July 1999 and continued to be present up to and including Release C Version 1.0. Despite this, the Defendants have adduced no evidence that any of the hundreds of millions of cdma2000-compliant phones manufactured since July 1999 operated in this way.

233. Counsel for Philips sought to emphasise this point by putting to Dr Brydon two leaflets demonstrating that the Defendants had themselves made cdma2000-compliant phones since the Priority Date. Counsel for the Defendants objected to this on the ground that the Defendants had not been given advance notice of these leaflets prior to Dr Brydon giving evidence in accordance with the agreed directions for trial. I agree that prior notice should have been given by Philips. Counsel for the Defendants informed me on instructions that, had the Defendants been given prior notice, they would have adduced evidence that they did not know, and were unable easily to find out, how the phones implemented the disputed paragraph. I will assume that that is correct.

234. Even so, it remains a striking feature of the case that there is no evidence that the disputed paragraph has ever been implemented in what the Defendants contend was an obvious way even though hundreds of millions of cdma2000-compliant phones have been made. If it was obvious, one would have thought that the Defendants would have been able to prove anticipation by prior use (subject to any question of making available to the public) by phones made between July 1999 and the Priority Date or at least that it had been done after the Priority Date. Counsel for the Defendants submitted that this would have been difficult for the Defendants to prove, but it seems to me that there are a number of ways in which it could have been done.

235. On the other hand, it must be acknowledged that, even if it was not done, that does not necessarily mean that it was not an obvious option. In theory, there could be other explanations. No such explanations have been identified, however.

236. As noted above, I consider that this secondary evidence supports the conclusion that I have reached in the light of the primary evidence that the disputed paragraph would be interpreted in the manner contended for by Philips. Accordingly, I conclude that the Defendants' first way of putting their obviousness case fails.

237. *Case 3*. Case 3 is purportedly based on Philips' interpretation of the disputed paragraph. That being so, it is notable that counsel for the Defendants eschewed the conventional *Pozzoli* approach to the assessment of obviousness when arguing this case. (He did the same when arguing case 1, but that is understandable given that, as discussed above, case 1 is close to being an anticipation case and turns on the correct interpretation of the disputed paragraph.) I consider that it is both possible and helpful to adopt the conventional approach, however.

238. If, as I have held, the disputed paragraph would be interpreted by the skilled person in the manner contended for by Philips, the difference between C.S0002 and claim 3 is that C.S0002 discloses a system in which the MS responds to power up commands which would require it to exceed the maximum transmission power in one of the ways set out in paragraph 194 above and then resumes normal power control at a frame boundary (except that termination could occur mid-frame), whereas claim 3 (as I have interpreted the claims) claims a system in which the power of a channel is reduced in

response to a first criterion and then increased in response to a second criterion within a predetermined time period i.e. within a frame (or a TTI, in UMTS).

239. Case 3 is based on a skilled person working on the development of the power control aspects of UMTS Release 5 who is given C.S0002 at the Priority Date and reads it with interest. Philips contends that, without the benefit of hindsight, the skilled person would not be motivated to use an old Release of the cdma2000 Physical Layer Standard as the basis for further development of UMTS, and certainly would not pick out an unclearly-drafted 11-line passage on page 113 of 409 as teaching him how to improve UMTS power control.

240. I agree with this. Simply reading and understanding the power control aspects of C.S0002 would require considerable effort. The skilled person is deemed to take the trouble to read and understand the document, but he is not deemed to assume that the document contains anything which will be of assistance to him. That is particularly so given that he would appreciate that C.S0002 was an old Release. For the reasons discussed above, the skilled person would regard the power control scheme in UMTS Release 5 to be superior to that in C.S0002, which he would regard as complex and unwieldly by comparison. Dr Brydon fairly accepted that it was unlikely that the skilled person would work through the power control sections of C.S0002 rigorously enough to pick out the disputed paragraph as being useful to him in his work on UMTS. Even if the skilled person homed in on the question of what the MS does when it hits the maximum power limit, he would find that the disputed paragraph was unclear. It would take further effort to extract the meaning set out in paragraph 194 above. Even if he got that far, why would that point him in the direction of claim 3?

241. Counsel for the Defendants relied upon a passage in his cross-examination of Dr Irvine as establishing that the skilled person would arrive at the invention without invention on this hypothesis. I am not persuaded of this. Although skilfully executed, the cross-examination was a classic step-by-step exercise based on hindsight. In any event, I do not accept that it did establish that the skilled person would arrive at the claimed invention.

242. The steps were as follows:

i) the skilled person would notice the similarities and differences between UMTS power control and cdma2000 power control;

ii) the skilled person would notice that the disputed paragraph dealt with the situation where the MS received a power-up command which would take it above the maximum transmit power;

iii) the skilled person, having interpreted the disputed paragraph in the manner that Dr Irvine did, would see that it involved sacrificing a lower priority channel so that the lead channel could transmit at the commanded output power level;

iv) the skilled person would see, without exercising invention, that that was a good idea which could be stolen and used in a future release of UMTS;

v) that would involve replacing the words about applying scaling to the total transmit power in section 5.1.2.6 of TS 25.214 in UMTS Release 5 with words about reducing the transmission power on another code channel; and

vi) the obvious way in which to do that would be "on a slot by slot basis".

243. In my judgment there are several flaws in this approach. First, step (iii) involves interpreting sentence [4] of the disputed paragraph as mandatory at all times, but as discussed above that is an incorrect reading of it. Secondly, step (iii) also involves ignoring Dr Irvine's caveats discussed in paragraph 218 above. Thirdly, although Dr Irvine accepted step (iv), I consider that it is relevant that no reason was put as to why the skilled person would see this. Fourthly, step (v) ignores Dr Irvine's response to the question, which was that the skilled person "would have to go away and design a procedure to allow for that reduction, which is my criticism of the cdma2000 specification because it just says 'reduce the transmission power'". Thus the skilled person would be faced with having to work out *how* and *when* to reduce the power in the UMTS context. Fifthly, as counsel for Philips pointed out, the cross-examiner did not define what he meant by doing it "on a slot by slot basis" in step (vi). It is therefore unclear what Dr Irvine was agreeing to. Sixthly, the cross-examination does not establish that the result would be a system in which the power of a channel is reduced in response to a first criterion and then increased in response to a second criterion within a predetermined time period i.e. within the TTI.

244. Accordingly, I conclude that case 3 is not made out.

245. *The Dutch decision*. The Defendants rely on a decision dated 22 March 2017 of the District Court of The Hague holding that the Patent was obvious over C.S0002. The Dutch court's decision is entitled to respect; but it was not considering the amended claim which is before me, and the evidence and arguments were somewhat different. Accordingly, I have to make my decision based on the evidence and arguments before me.

Conclusion

246. For the reasons given above, I conclude that the Patent is valid and has been infringed by the Defendants.