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Case No: HP-2019-000032

IN THE HIGH COURT OF JUSTICE
BUSINESS AND PROPERTY COURTS OF ENGLAND AND WALES
INTELLECTUAL PROPERTY LIST
PATENTS COURT

Royal Courts of Justice, Rolls Building
Fetter Lane, London, EC4A 1NL

Date: 29/07/2021

Before :

HIS HONOUR JUDGE HACON
(Sitting as a High Court Judge)

- -

Between :

(1) INTERDIGITAL TECHNOLOGY CORPORATION **(2) INTERDIGITAL PATENT HOLDINGS, INC.** **(3) INTERDIGITAL, INC.** **(4) INTERDIGITAL HOLDINGS, INC.**	**Claimants**
- and -	
(1) LENOVO GROUP LIMITED **(2) LENOVO (UNITED STATES) INC.** **(3) LENOVO TECHNOLOGY (UNITED KINGDOM) LIMITED** **(4) MOTOROLA MOBILITY LLC** **(5) MOTOROLA MOBILITY UK LIMITED**	**Defendants**

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- -

Douglas Campbell QC, Joe Delaney and **Maxwell Keay** (instructed by **Gowling WLG**) for the **Claimants**
Thomas Hinchliffe QC, Jeremy Heald and **Kyra Nezami** (instructed by **Kirkland & Ellis International LLP**) for the **Defendants**

Hearing dates: 3-5 and 8-12 March 2021

- -

Approved Judgment

Covid-19 Protocol: This judgment was handed down remotely by circulation to the parties' representatives by email and release to BAILII. The date and time for hand-down is deemed to be 10.30 a.m. on Thursday 29 July 2021.

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HIS HONOUR JUDGE HACON

Judge Hacon :

Introduction

1. This is the first in a series of trials concerning five patents. They claim inventions in the field of 3G and 4G telecommunications technology and all are asserted to be standard essential patents. A FRAND trial and further technical trials are due to follow.

2. The present trial concerns European Patent (UK) No. 2 485 558 ("the Patent"). The invention is entitled "Method and apparatus for providing and utilizing a non-contention based channel in a wireless communication system". It has a priority date of 31 January 2006. There is no challenge to priority.

3. The First Claimant is the owner of the Patent. All the claimants are members of the same group of companies and since I need not distinguish them, I will refer to them collectively as "InterDigital".

4. The defendants are all members of the Lenovo group of companies and I will call them "Lenovo".

5. InterDigital and Lenovo have since November 2009 been in discussions regarding the licensing of the Patent, together with other patents in InterDigital's portfolio. Since June 2010 offers of a worldwide licence on what InterDigital claims to have been FRAND terms have been made. An offer has also been made by InterDigital to license the patent on alternative terms, the details of which do not matter here. So far the negotiations have come to nothing.

6. InterDigital alleges that Lenovo is not a willing FRAND licensee or alternatively will not commit to accepting the burden of the FRAND licence offered and that accordingly Lenovo cannot enforce InterDigital's FRAND obligations. InterDigital further claims that Lenovo has imported 4G devices into the United Kingdom and has marketed those devices here, thereby infringing the Patent.

7. Lenovo rejects the proposition that InterDigital's offers of a licence are FRAND. Lenovo admits the importation and marketing of the devices alleged to infringe the Patent but denies that they infringe and counterclaims for a declaration that the Patent is invalid.

8. The Amended Grounds of Invalidity allege that the Patent is invalid for lack of novelty, lack of inventive step and insufficiency. There is a pleaded allegation of added matter but it was not pursued at trial.

9. InterDigital has made an application to amend the Patent, the application being conditional upon a finding that the claims as granted are invalid. Lenovo resists the application on the grounds that the claims as proposed to be amended give rise to objections of lack of clarity, added matter and lack of support.

The witnesses

10. Each side provided an expert witness. InterDigital's witness was Dr Jonathan Moss. Dr Moss is a telecommunications engineer, consultant, and a trainer at the University

of Oxford. He has 22 years of experience in the design and operation of mobile telecommunications networks. From 1998 to 2003 Dr Moss worked at BT Labs and other telecom companies as a 3G network optimisation engineer. During this period he was a member of a working group at 3GPP, the umbrella name for a number of standards organisations which develop protocols for mobile telecommunications. Dr Moss has taught courses in 3G and later 4G technologies. He has earlier experience of appearing in the Patents Court as an expert witness.

11. Lenovo's expert was Professor Matthew Valenti. He is Professor of Computer Science and Electrical Engineering at West Virginia University and Chair of the Department of Computer Science and Electrical Engineering. Prof Valenti has over 25 years' experience in telecommunications, with an emphasis on wireless and cellular networks. He has appeared before as an expert witness in patent disputes before the US courts, the US Patent and Trademark Office and the International Trade Commission in Washington.

12. I found both Dr Moss and Prof Valenti to be exemplary expert witnesses. They were very well informed on the technology, as one would expect, giving clear answers to the questions put to them where they felt able to do so.

13. There was unchallenged written evidence from Neil Wiffen on behalf of InterDigital. Mr Wiffen is a telecommunications consultant who explained details of transmissions from mobile phone base stations in the UK which by the time of the trial were no longer contested.

The skilled person

14. It was agreed between the parties that the skilled person is an engineer in the field of mobile telecommunications with 2-3 years' experience. The engineer would have worked with 3G mobiles and by the priority date in January 2006 would have been aware that 4G, LTE, was in the process of being developed and standardised. LTE is the system implementing the fourth generation of mobile telecommunications technology, discussed more fully below. He or she would have been aware that the relevant standardisation was being carried out by 3GPP. They would have known that one of the key standards to be agreed was that governing the signalling between a base station and mobiles. The experts agreed that the skilled person would have attended at least some of the 3GPP meetings on LTE standardisation and would have known about the four technical reports published by January 2006 and that their contents offered the best guide to the development of LTE up to that time.

15. There was a minor difference between the experts as to the degree of attendance at 3GPP working groups, but I do not believe that it matters. Dr Moss had a concern that attendees at such meetings are typically inventive. Assuming that is right, the skilled person is an artificial construct and so any inventive capacity that might be expected of a real person with experience of 3GPP meetings is excluded from the mental makeup of the skilled person.

Technical background and the common general knowledge

16. There was no dispute about the law on the common general knowledge. There was little disagreement about its contents. In this section of the judgment I set out some

technical background all of which, by common consent, formed part of the common general knowledge at the priority date.

UE

17. User Equipment or **UE** is a term commonly used in the industry to cover all devices which exploit a mobile telecommunications system – mobile phones, tablets, laptops and so on. The Patent uses a term of its own: "wireless transmit/receive unit" or **WTRU** which is defined to be broader still than UE although the greater breadth of devices covered makes no difference to the issues in this case. In this judgment I will use the prior art term since it is the one mostly used in the evidence: UE.

Cells – uplink and downlink

18. UE networks are organised into cells. At the heart of each cell is a base station. Communications passing from the phone to the base station are called the uplink or **UL**, communications from base station to the phone are called the downlink or **DL**. The base station is also in communication with the wider network. The user of a UE is liable to move in proximity from one cell to another, so a UE is capable of transferring its uplink and downlink from one base station to another.

Standardisation of technology

19. Cellular networks for UEs set up in the 1980s, since when there have been continuous improvements to the technology. A feature of these advances has been the establishment of industry standards which allow compatibility between products from different manufacturers and which thereby promote freedom of competition between alternative providers of the products to consumers. The progress of the technology over time can be measured by reference to the successive generations of standards, from 1G of the 1980s to 5G now.

20. These standards must be decided internationally, although this does not always mean global standardisation. For instance, the Universal Mobile Telecommunications System, or **UMTS**, a 3G system, was adopted in Europe and elsewhere, whereas North America used an alternative 3G standard called **cdma2000**.

21. Of particular relevance to this litigation is the successor to UMTS, a 4G system known as "Long Term Evolution" or **LTE**.

Layers

22. A conceptual framework known as the "Open Systems Interconnection Model" or **OSI Model** has been developed to distinguish and describe the functions of a wireless network. According to this model signals between the **nodes** of a system – the component parts which transmit and receive signals, typically a base station and UEs – are divided into seven conceptual layers. I need only discuss the first three.

23. Layer 1 is known as the **physical layer**. The physical layer of a component deals with the transmission and reception of raw data bits.

24. Layer 2 is the data link layer or **DLL**. This packages data into manageable blocks and corrects errors that may have occurred at the physical layer. It is divided into two

sublayers: Medium Access Control, **MAC**, and Radio Link Control, **RLC**. MAC is concerned with managing the rate of data transmission so that a fast sender does not overwhelm a slow receiver. MAC is also concerned with duplexing and multiplexing, to which I will return in a moment. RLC identifies protocols used in the signals and provides error control.

25. Layer 3 is the **network layer**. This part of a component deals with the structuring and managing of a multi-node network. It was also referred to as the radio resource control or **RRC** because it sets up and manages the connection between the UEs and the base station.

Channels

26. Channel is the term used to mean a path through which signals flow, here specifically signals between a base station and a UE. They are divided into physical, logical and transport channels.

27. **Physical channels** are the means by which information is transmitted; they carry user data and control messages. **Logical channels** provide services for the MAC. **Transport channels** take the bits of information from a logical channel and put them into appropriately sized blocks for transmission by a radio link.

Duplexing and multiplexing

28. Transmissions in a cellular network are made within a limited available bandwidth which raises the potential for interference between signals using the same bandwidth. Two processes are employed to deal with this.

29. The first is **duplexing**. Uplink and downlink transmissions are separated, typically either by using different frequencies – known as frequency division duplexing or **FDD** – or by transmitting in short distinct timeslots: time division duplexing or **TDD**.

30. The second is **multiplexing**. Transmissions to or from one base station to multiple UEs can be separated. As with duplexing they may be separated by frequency – frequency division multiple access, **FDMA**. Or they may be separated by time – time division multiple access, **TDMA**. There is a third alternative: multiple transmissions may be sent at the same frequency and time but in each case multiplied by a signature code specific to one UE. This is called code division multiple access, **CDMA**.

31. These three alternatives are not mutually exclusive and may be used in combination.

Scheduling

32. Downlink transmissions from the base station to UEs are initiated and coordinated by the base station. The base station must elect one or more UEs with which it will communicate, decide when to communicate and allocate the necessary resources. The allocation of resources to use is known as the **schedule** and the process of creating those resources is called **scheduling**.

Scheduling requests

33. When a UE has data to transmit over the uplink, it must first notify the base station of the UE's need for transmission resources by sending a **scheduling request**. The base station responds with a **scheduling grant**, identifying the resources the UE can use.

Layer 1 uncoordinated channels

34. Uplink transmissions from a UE to the base station may be coordinated by the base station or may be left uncoordinated. In the latter case two or more UEs may transmit at the same time and frequency, creating a collision. In such a case it is likely that one or none of the colliding transmissions will be successfully received by the base station. The UEs will detect that a collision has occurred and will re-transmit. The probability of a further collision is minimised by each UE waiting for a random period of time before re-transmitting, which minimises the likelihood of a further collision. Nonetheless, collisions give rise to unpredictable transmission delays, known as **latency**.

35. Uncoordinated channels of transmission are sometimes referred to as "random access" channels – **RACH** – or **contention based channels**.

Layer 2 coordinated channels

36. Coordinated channels, using duplexing or multiplexing to avoid collision, may be dedicated or alternatively shared. A **dedicated channel** is one allocated to a single UE for a relatively long period of time. A **shared channel**, despite its name, is not shared by UEs in the manner of an uncoordinated channel; it has rapidly varying allocation to one UE at a time, albeit only for a short period of time.

Control signalling

37. UE networks require a means to control how data is transmitted. They use **control signalling**: signals which take the form of control information. There are different kinds of control signalling, of which three have relevance to this case: (i) scheduling requests, (ii) channel quality measurements and (iii) channel quality feedback known as "HARQ".

Channel quality measurements

38. UEs periodically report to the base station on the quality of signal received. This is a channel quality indicator, **CQI**. If the signal from the base station was poor, the base station may take appropriate steps, often by altering the modulation scheme (see below) or may just wait for improvement in channel quality.

HARQ

39. Hybrid automatic repeat request or **HARQ** is another means of checking signal quality. The UE or base station determines whether a signal has been correctly received. If the signal was correctly received, a positive acknowledgment or **ACK** is transmitted back, and the original transmitter will move on to send the next set of data. Receipt of a negative acknowledgment or **NACK** will cause retransmission of the signal. ACKs and NACKs were sometimes referred to as **HARQ feedback**.

States of activity

40. UEs exist in variable states of activity. A high state means that the UE is capable of its maximum rate of data transmission with minimum chance of latency. But that comes at the cost of high power and bandwidth consumption. Lower states of activity cause less power consumption and allow a greater number of UEs to have the simultaneous possibility of accessing the base station. In UMTS the highest activity state is the **CELL_DCH** state; the lowest is idle mode. There are intermediate states in between.

Modulation

41. Information can be encoded into a radio wave by means of varying the properties of the wave. In this discussion of the technology it can be assumed that the frequency of the wave – the **carrier wave** – is constant, so there are two possible variables: amplitude and the phase of the wave.

42. Using amplitude to transmit information is known as amplitude-shift keying or **ASK**. In its simplest form, the amplitude of the wave is either zero or some level above zero – in other words, the carrier wave is either sent or not sent. This type of ASK is known as on-off keying or **OOK** – transmission of the carrier wave corresponds to a single binary digit 1; no transmission corresponds to 0. By having in a succession of time slots either a signal or no signal, the transmitter sends a sequence of single bits of information in the form of 0s and 1s.

43. More complex forms of ASK involve signals of varying amplitude as well as no signal, and thus information encoded in more than just a simple series of 0 and 1 bits.

44. In phase-shift keying or **PSK** the phase of the carrier wave is shifted to communicate successive bits of information. Binary phase-shift keying or **BPSK** employs two phases separated by 180^0. Since there are only two alternatives, the information is transmitted in single bits, either 0 or 1. Quadrature phase-shift keying or **QPSK** uses four phases of the carrier wave, separated by 90^0, a condition known as **orthogonality**. The four phases can be represented as the four alternative values 00, 01, 10 and 11, each of which thus constitutes two bits of information.

45. It is possible to combine ASK and PSK to increase the complexity of the signal transmitted. Quadrature amplitude modulation or **QAM** is a family of modulation methods in which ASK is used with two carrier waves out of phase by 90^0, i.e. an orthogonal system.

46. Orthogonal frequency-division multiplexing or **OFDM** is a type of frequency-division multiplexing (see above) in which the carrier waves are out of phase by 90^0.

Spreading and despreading

47. I referred above to CDMA, sometimes called **code multiplexing**. It can be applied to a BPSK signal. The original BPSK signal takes the form of a series of zeros and ones or sometimes a series of ones and minus ones. A code, unique to a UE in communication with the relevant base station, takes the form of a repeating series of 8 bits, i.e. a series of 8 zeros and ones. It is known as a **spreading code**. In a process called **spreading**, the BPSK signal is multiplied by the repeating spreading code to create a new composite signal. The receiving node, using the same code, carries out the reverse process, **despreading**, to recreate the original BPSK signal.

HSDPA and HSUPA

48. The development of the European UMTS system began in 1998. The system was first made available to customers in December 2001 and was thereafter modified in successive releases. Two developments of particular significance were high speed download packet access, **HSDPA**, and high speed uplink packet access, **HSUPA**.

49. The introduction of HSDPA allowed higher speeds and reduced latency in the downlink. One key feature was the use of HARQ, the signal quality check discussed above. Another was the use of a new channel known as the high speed physical downlink shared channel, **HS-PDSCH**.

50. The base station of UMTS is called the **Node B**. The Node B makes scheduled transmissions on HS-PDSCH. These contain signals with codes allocated to a particular UE. The UE recognises its own code and in response reports on channel quality; if the quality is high, the Node B uses higher rates of modulation and coding, thus achieving a higher rate of data transmission.

51. A corresponding system was developed for uplink, HSUPA, which uses a channel called the enhanced dedicated physical data channel or **E-DPDCH**. Like HSDPA, it uses HARQ. There was also an uplink control channel, **E-DPCCH**, which accompanies E-DPDCH, sending a control signal when E-DPDCH sends data, but not otherwise.

Scheduling Information and the happy bit

52. UEs are generally within range of more than one Node B. Each Node B transmits a grant. There is an absolute grant which sets the maximum power at which the UE can transmit on the E-DPDCH and a relative grant by which the Node B adjusts the level at which the UE can transmit up and down, within the absolute grant. Subject to the limit of that grant, the UE transmits the maximum data possible on that Node B's E-DPDCH. Subject to any change in the grant, the UE can continue to transmit at that power level.

53. A Node B selects the maximum power grant to be allotted to a UE by taking into account two items of information supplied by the UE. First is the scheduling information transmitted by the UE. This is an 18-bit message which informs the Node B of (a) the priority level of the highest priority data which the UE wishes to transmit, (b) how full the UE's data buffer is – how much data it wishes to transmit – and (c) how close the UE is to its maximum transmit power.

54. Secondly, the UE transmits a simple message known as a **happy bit**. This is a 1-bit signal which either indicates that the UE would benefit from a higher power allowance, i.e. the UE is unhappy, or that it would not: the UE is happy with the power allowance as it is. The happy bit is sent on the E-DPCCH channel as one bit out of a 10 bit control signal decoded at the physical layer.

LTE

55. LTE was in the course of development at the priority date but the fact of its development and some of the characteristics of LTE proposed by the priority date would have been known to the skilled person. By the priority date a technical report entitled

"Requirements for Evolved UTRA (E-UTRA) and Evolved UTRAN (E-UTRAN)" had been published. It is common ground that that the skilled person would have known the requirements and design targets of LTE set out in this document, although much remained to be agreed. At the priority date it would not have been possible to build an LTE UE or an LTE base station in the forms they finally took by December 2008.

56. In LTE the base station is called an evolved Node B, or **eNB**.

57. At the priority date it was contemplated that in LTE the UE would not have any allocation on the uplink channel unless and until such allocation was given by the eNB. This contrasted with UMTS where the UE could always send scheduling information on the uplink channel.

More about on/off keying

58. There was one aspect of the technical background in relation to which there was not common ground between the experts as to the common general knowledge, namely on/off keying – OOK. It was agreed that the skilled person would have known about OOK from their university degree course. The experts did not take the same view as to how widely the skilled person would have perceived its potential application to be. I will come back to that.

59. There was also a disagreement between the experts as to terminology – how broadly OOK could properly be defined.

60. Dr Moss said it was confined to a sinusoidal carrier wave either being sent or not, generating a single bit of information in the form of a one or a zero.

61. Prof Valenti was of the view that OOK encompasses any situation in which information is conveyed simply by sending or not sending of a signal – it need not be a carrier wave. In particular, the spreading code used in CDMA can be sent alone, or not sent, and where the presence or absence of the code conveys information, this qualifies as OOK.

62. There was some independent support for Prof Valenti's view. One of the textbooks in evidence was *HSDPA/HSUPA for UMTS* edited by Harri Holma and Antti Toskala ("Holma & Toskala"). It was published in May 2006 but Dr Moss accepted that it distilled what the skilled person would have known at the priority date. At section 5.3.5 Holma & Toskala discuss a downlink channel called "E-HICH" which is used by the base station to transmit positive and negative acknowledgments, ACK or NACK. The authors say:

> "E-HICH information is BPSK-modulated with on/off keying and the modulation depends on which cell is transmitting the E-HICH."

63. In cross-examination Prof Valenti said that in the system there contemplated by the authors an ACK from the base station would be communicated by transmitting a BPSK-modulated spreading code; a NACK would be communicated by transmitting nothing. He said it was a type of OOK. It was put to him in cross-examination that a table in the same section of the book (Table 5.6) gave the base station three alternative states of transmission: one, minus one and zero. Prof Valenti maintained that the three alternatives applied only in the context of cells in the same radio link set; in the case of

other cells the alternatives were just plus one or zero. It was the latter signalling which Prof Valenti described as OOK, but he said that it was a little complicated and not the best example.

64. Dr Moss said that the relevant passage in Holma & Toskala was not about OOK but this was because to his mind OOK was confined to the circumstance of sending or not sending a sinusoidal modulation signal. On the other hand, Dr Moss accepted that the term OOK had been used in 3GPP discussion documents about the forthcoming LTE outside the transmission or non-transmission of just a sinusoidal signal. There was a proposal by Qualcomm Europe dated 29 August to 2 September 2005. Dr Moss agreed that a suggestion in the document was to use OOK (the authors' term) for an ACK/NACK channel, using the fact of transmission of a spreading code as an ACK and no transmission as a NACK. Another 3GPP discussion document, dated May 2006 and so after the priority date came from Motorola, Inc. As Dr Moss accepted, Motorola suggested an OOK scheme in which a multiplexing code is transmitted to represent a NACK and nothing is transmitted for an ACK.

65. It seems to me that the skilled person in January 2006 would have been aware that some of those in the field used the term OOK narrowly, where the signal transmitted or not transmitted must be a sinusoidal carrier wave, but that others used OOK to mean conveying information by the transmission or non-transmission of any type of signal, including a modulated signal.

66. Taking OOK to have the broader meaning, the more significant issue was the common general knowledge about applications to which OOK could be put.

67. Dr Moss said in his second report that at the priority date the skilled person would have known that OOK had not been used in HSUPA for sending SI messages and there was no suggestion at that time that it should be used in that way in an LTE system. Prof Valenti agreed.

68. Prof Valenti said that at the priority date those skilled in the art would have known that OOK was not appropriate for data modulation but could be used for transmission of control information. He gave the example of a TV remote which he quoted from a textbook. It seems that this was a rare example and in context not close to cellular networks.

69. Prof Valenti asked Lenovo's lawyers to conduct a search to find examples of OOK being used for any purpose in cellular networks before the priority date. They found just one example in a paper which, as Prof Valenti properly conceded, would not have formed part of the common general knowledge. It concerned a cdma2000 network in which OOK was used in a downlink paging channel, not as an uplink scheduling request.

70. There was discussion about the attraction of OOK from the point of view of energy efficiency. Prof Valenti said that if the signal to be transmitted had more ones than zeros, it would make more sense to use BPSK. But if there were more zeros than ones, OOK would be more energy efficient since a zero requires no energy. He went on to agree, however, that it was a little more complicated than this. The complication arose from the distinction between "coherent" and "non-coherent" OOK. Coherent OOK requires the detector of the signal to recognise its frequency and phase. The detector in

a non-coherent OOK system needs only simply to recognise that there is a signal – of any frequency or phase. Coherent OOK is likely to be needed if the signal is liable to be corrupted by noise, but it is more costly to implement. A point made by Dr Moss was that for coherent OOK it was necessary to transmit "pilot bits". These provide a phase reference to the detector of the signal to ensure that it can be coherently demodulated. The transmission of pilot bits requires energy. The experts agreed that coherent OOK therefore offered no energy advantage over BPSK. Prof Valenti thought that the advantage remained in the case of non-coherent OOK where the signal stream contained more zeros than ones.

71. I find that OOK was known to the skilled person at the priority date, a basic technique taught at university. Its utility depended on issues of noise, cost and energy consumption. OOK would have been viewed as having no application as a means of transmitting data and was very seldom used in transmitting control information. The skilled person at the priority date would not have been aware of any use of OOK in a cellular network implemented up to that date.

The Patent

72. In the background section of the specification, the Patent refers to 3G cellular networks and LTE. It identifies the challenge of efficient channel usage given that UEs (as I have indicated, the Patent uses the broader term "WTRUs") need to communicate with the base station for a variety of reasons. The specification points to the disadvantages of using a RACH, namely that such a channel is contention based and its use incurs delays, inefficient use of resources and may negatively impact system capacity. A UE could use an uplink shared channel, but it would require a request to use the channel on a RACH, which would be inefficient and add delay because of the two step procedure.

73. The invention is summarised in this way:

> "[0012] The present invention is directed to the establishment, maintenance, and utilization of a non-contention based (NCB) channel in a wireless communication system comprising at least one Evolved Node-B (eNB) and a plurality of wireless transmit/receive units (WTRUs). Each NCB channel is dedicated and allocated for use by a particular WTRU in the system for utilization in a variety of functions, and the allocation is communicated to the WTRUs in the system by the eNB. The wireless communication system analyses the allocation of each NCB channel as required, and each NCB channel is reallocated as required."

74. In broad terms, the invention concerns a non-contention based (NCB) uplink control channel, how it is set up and how it is used by the UE.

The Claims

75. Claim 1 and dependent claims 2 to 13 are method claims, the method being implemented by a UE to set up and use an NCB uplink channel.

76. Claim 14 and dependent claims 15 to 25 are product claims, the product being a UE with the means to implement the methods of the earlier claims.

77. Claims 26 and dependent claims 27 to 36 are also product claims, the product being an eNB with the means to implement the methods claimed.

78. InterDigital said that claims 1, 9, 10, 13, 14, 19, 22 and 23 are independently valid. It was a little simpler than that because InterDigital accepted that the validity of claim 14 stands or falls with claim 1, claim 23 with claim 10 and claim 22 with claim 13.

79. The following is a table of the significant claims as prepared by InterDigital, divided into integers. Also included are claims 9 and 19 as proposed to be amended, with the proposed amendments underlined.

Claim 1	
1A	A method implemented by a wireless transmit/receive unit, WTRU (120), the metho comprising the steps of
1B	receiving a first allocation from an evolved Node B, eNB (110), wherein the first allocation is an allocation of an non-contention based NCB uplink control channel,
1C	the first allocation comprises a configuration for transmitting scheduling requests ov the NCB uplink control channel, and the configuration indicates a periodicity alloca to the WTRU for transmitting scheduling requests on the NCB uplink control chann and indicates which sub-carrier resource of the NCB uplink control channel are to b used by the WTRU for transmitting the scheduling requests;
1D	transmitting (710) a scheduling request over the NCB uplink control channel in accordance with the first allocation, wherein the transmitted scheduling request comprises a transmission burst, and presence of the transmission burst on NCB upli channel resources assigned to the WTRU by the first allocation is indicative of a request for uplink transmission resources by the WTRU;
1E	monitoring (710) a downlink control channel;
1F	detecting (720) that a transmission on the downlink control channel is intended for t WTRU based on a WTRU identifier indicated in the transmission on the downlink control channel,
1G	wherein the transmission on the downlink control channel comprises a second allocation, the second allocation being an allocation of an uplink shared channel; an transmitting (730) data over the uplink shared channel in accordance with the secon allocation.
Claim 9 (as granted)	
9	The method of claim 1, further comprising: receiving a hybrid automatic repeat request, HARQ, transmission; and transmitting an acknowledgement, ACK, over th NCB uplink control channel.
Claim 9 (as proposed to be amended)	
9	The method of claim 1, further comprising: receiving a hybrid automatic repeat request, HARQ, transmission; and transmitting an acknowledgement, ACK, over th NCB uplink control channel<u>; wherein the ACK is transmitted concurrently with the scheduling request</u>.
Claim 10	
10	The method of claim 1, wherein the first allocation further comprises a second configuration, the second configuration is used by the WTRU for transmitting chann quality measurement information over the NCB uplink control channel.
Claim 13	
13	The method of claim 1, wherein the uplink NCB control channel is multiplexed amo a plurality of WTRUs using a combination of code, frequency, and time multiplexin
Claim 14	
14A	A wireless transmit/receive unit, WTRU (120), comprising: receiving means (126);

	transmitting means (127); processing means (125) in communication with the receiving means and the transmitting means, the processing means being configured to:
14B	receive, from an evolved Node B, eNB (110), a first allocation, wherein the first allocation is an allocation of an non-contention based NCB uplink control channel,
14C	the first allocation comprises a configuration for transmitting scheduling requests ov the NCB uplink control channel, and the configuration indicates a periodicity alloca to the WTRU for transmitting scheduling requests on the NCB uplink control chann and indicates which sub-carrier resource of the NCB uplink control channel are to b used by the WTRU for transmitting the scheduling requests;
14D	and transmit (710) a scheduling request over the NCB uplink control channel in accordance with the first allocation, wherein the transmitted scheduling request comprises a transmission burst, and presence of the transmission burst on NCB upli channel resources assigned to the WTRU by the first allocation is indicative of a request for uplink transmission resources by the WTRU;
14E	means for monitoring (710) a downlink control channel;
14F	means for detecting (720) a transmission on the downlink control channel that is intended for the WTRU based on a WTRU identifier indicated in the transmission o the downlink control channel,
14G	wherein the transmission on the downlink control channel comprises a second allocation, the second allocation being an allocation of an uplink shared channel; an means for transmitting (730) data over the uplink shared channel in accordance with the second allocation.
Claim 19 (as granted)	
19	The WTRU of claim 14, wherein the processing means is further configured to transmit hybrid automatic repeat request, HARQ feedback with the scheduling request.
Claim 19 (as proposed to be amended)	
19	The WTRU of claim 14, wherein the processing means is further configured to transmit hybrid automatic repeat request, HARQ feedback over the NCB uplink control channel concurrently with the scheduling request.
Claim 22	
22	The WTRU of claim 14, wherein the NCB uplink control channel is multiplexed among a plurality of WTRUs using a combination of code, frequency, and time multiplexing.
Claim 23	
23	The WTRU of claim 14, wherein the first allocation further comprises a second configuration, the second configuration is used by the WTRU for transmitting chann quality measurement information over the NCB uplink control channel.

Construction

The general law

80. Since *Actavis UK Ltd v Eli Lilly and Co* [2017] UKSC 48 there have been two steps to ascertaining the scope of a patent claim. The first is to decide what the claim means in accordance with the general rules of construction of a document, see *Actavis* at [58] and *Trump International Golf Club Scotland Ltd v Scottish Ministers* [2015] UKSC 74, at [33]. This has sometimes been referred to as the "normal construction" of a claim. It is a purposive construction, the inventor's purpose being ascertained from the description and the drawings as they would be understood by a person skilled in the art with the common general knowledge in mind, see *Icescape Ltd v Ice-World International BV* [2018] EWCA Civ 2219, at [60].

81. If a product or process does not infringe the claim as a matter of normal construction, the analysis moves to the second question which is whether the product or process nonetheless falls within the scope of the claim because it varies from the invention according to the normal construction in a way or ways which is or are immaterial. No issues arose under this second question in the present case.

The date as of which a patent specification is to be construed

82. A significant feature of claim 1 is an eNB. Between the priority date of the Patent in January 2006 and the finalisation of LTE in December 2008 when Release 8 was published, the skilled person's notion of what an eNB is will have evolved along with the published information about LTE.

83. This raises a question as to the correct date as of which "eNB" is to be construed and more generally the law on the date as of which a patent specification should be construed. InterDigital submitted that it was the date of filing the application, Lenovo argued for the priority date.

84. Lenovo referred to the discussion in *Terrell on the Law of Patents*, 19th ed. in which the authors point out that in *Willemijn Houdstermaatschappij BV v Madge Networks Ltd* [1992] RPC 386, Stuart-Smith LJ, delivering the judgment of the Court of Appeal, stated at p.388:

> "A patent specification must be construed as at the date of its publication …"

85. It should be added that this was obiter. The authors of *Terrell* go on to say at 9-14:

> "The correct date for construction of the claims therefore still merits further specific review. The leading contender is the date of publication of the granted patent. It is submitted that this is further supported by the consideration that the specification and claims may be amended up until grant, and this would also be consistent with the express provision in s.27(3) that if a patent is subsequently amended, different dates may be relevant for obviousness (priority), for sufficiency (filing), and for construction (publication) may be inconvenient but it is submitted that it is not so anomalous as to be rejected: it merely reflects the different underlying policies."

86. Lenovo relied on *Teva UK Ltd v Merck Sharp & Dohme Corp.* [2017] EWHC 539 (Pat). Arnold J was unpersuaded by the reasoning in *Terrell* (which also appeared in the 18th edition before the court). He addressed the question of the relevant date at [109], beginning with what the Court of Appeal had said in *Willemijn*:

> "As counsel for the Claimants pointed out, however, that statement was obiter since there does not appear to have been any issue as to the correct date in that case. Furthermore, counsel for MSD referred me to the discussion in *Terrell on the Law of Patents* at 9-27 to 9-33, in which the editors note that it was held in *Dyson Appliances Ltd v Hoover Ltd* [2001] RPC 26 at [48(k)] (Michael Fysh QC, as he then was) that the relevant date was the application date and recognise that the law is not settled, although they argue in favour of the publication date. As at present advised, I have to say that I do not find the editors' arguments convincing. I would add that it can be seen from reading decisions of this Court

> and the Court of Appeal over at least the past decade or two that the general practice is to construe patent claims as at the priority date (or the application date if priority is lost)."

87. Arnold J took the correct date to be the priority date, or application date if there is no valid priority date, but on the ground that it was not open to the defendant to contend for any other date given how the proceedings had been conducted.

88. It seems to me that contrary to what is implied in *Terrell*, the correct date for the assessment of sufficiency is the priority date, unless priority is lost in which case it will be the date of filing the application. As will appear, this matters with regard to the date for the construction of a patent specification.

89. In *Biogen Inc v Medeva plc* [1997] RPC 1, Lord Hoffmann ruled *obiter* at pp.53-54 that sufficiency is to be assessed as of the date of filing the patent application, agreeing with the Court of Appeal. He said (at p.54):

> "Section 72(l)(c) can only give effect to this principle if the relevant date for compliance is the date of application. It would be illogical if a patent which ought to have been rejected under section 14(3) is rendered immune from revocation under section 72(1)(c) by advances in the art between the date of application and the publication of the specification. The provisions for amendment, so far from detracting from this view, seem to me to support it. Section 76(2) says that the amended application shall not disclose matter which extends beyond that previously disclosed. In other words, the application may not add new matter to make an insufficient application sufficient. It seems to me in accordance with this scheme that an insufficient application should also not become sufficient because of general developments in the state of the art after the filing date. I therefore agree on this point with the Court of Appeal."

90. This, however, must be read in the light of the Supreme Court's judgment in *Regeneron*. Several times Lord Briggs (with whom Lord Reed, Lord Hodge and Lord Sales agreed, Lady Black dissenting) stated the proposition, albeit unchallenged before their Lordships, that sufficiency is to be assessed at the time of the priority date. One example is paragraph 2 of Lord Briggs' judgment quoted above. Lord Briggs addressed *Biogen* directly at [48]:

> "… Both the Court of Appeal and the House of Lords held that the claim failed, inter alia for insufficiency, but for different reasons. Apart from holding that sufficiency is to be tested as at the priority date (a rule which is not in dispute in this appeal) the case is of importance [to the issues in *Regeneron* for reasons which Lord Briggs went on to explain]."

91. There is no room for doubt that the Supreme Court interpreted Lord Hoffmann to have meant in *Biogen* that sufficiency is to be assessed as of the priority date if valid, or if not, the filing date.

92. InterDigital submitted that I am bound by the ruling of the Court of Appeal in *Nokia Corporation v IPCom GmbH & Co KG* [2012] EWCA Civ 567, in which the Court considered an argument on insufficiency not unlike the one advanced in the present case. Kitchin LJ, which whom Etherton and Laws LJJ agreed, said (at [171]):

> "The patent must be construed as of its filing date (see *Biogen Inc v Medeva plc* [1997] RPC 1, at 53-54)."

93. I am bound by that ruling but I must be clear what it is. I cannot be certain whether the Court took the date referred to by Lord Hoffmann to be invariably the filing date or the priority date unless, as was the case in *Biogen*, there was no valid priority date, in which case the filing date. On the other hand, I can be sure that the Court of Appeal ruled in *Nokia* that a patent specification should be construed as of the date referred to by Lord Hoffmann. I think that on a strict view the latter is the ruling by which I am bound. As I have explained, on a correct view that means the priority date or, if none, the filing date.

94. For the foregoing reasons, I take the view that the Patent must be interpreted as of its priority date: 31 January 2006.

Construction of the relevant integers of claim 1

Evolved Node B - eNB

95. The method of claim 1 requires a first allocation of an NCB uplink control channel from an evolved Node B or eNB. Evolved Node B is a term which was used at the priority date for a base station of the type that would operate within an LTE system when such a system was implemented. It was not a term used in the context of earlier systems.

96. Paragraph [0064] of the specification states:

> "[0064] The present invention may be implemented in any type of wireless communication system, as desired."

97. The paragraph goes on to give examples of such systems, of which LTE is just one. However, that cannot override the skilled person's understanding of an eNB. If and to the extent that the skilled person would have believed that an eNB together with the other features of claim 1 could be implemented in a system other than LTE, the claim covers such implementation, but not otherwise.

98. Dr Moss's evidence was that in January 2006 the skilled person could have made what he called a "demonstrator eNB". The gaps in the technical reports published by then could have been filled to create something which would have given the user experience of what LTE would be like when the standard was complete. Prof Valenti said nothing to the contrary. I will use the term "Demonstrator eNB" to mean an eNB as conceived by the skilled person at the priority date in the manner indicated by Dr Moss and "Finalised eNB" to mean an eNB as explained in Release 8 of LTE.

The configuration indicates which sub-carrier resource are to be used

99. There was an issue of construction as to the meaning of "indicates" in the context of the configuration of integer 1C that indicates which sub-carrier resource of the NCB uplink control channel is to be used by the UE. The point was raised in the context of essentiality and I will discuss it below within that topic.

Presence of a transmission burst is indicative of a request for uplink channel resources

100. InterDigital submitted that the transmission burst of claim 1 must be interpreted as a scheduling request; it is not enough if the eNB *could* interpret the presence of the burst in that way. I agree. Further information may be contained within the burst, such as the amount of data to be sent and the priority requirement, but that is optional.

101. The Patent says nothing about the nature of the transmission burst. Dr Moss was cross-examined about this and said that the skilled person would be able to work that out for themselves using their common general knowledge. He thought that the skilled person would probably use a bipolar code – i.e. a spreading code. That may be right, but in principle any signal would do.

102. Claim 1 does not exclude the possibility that the transmission burst may contain information to be decoded by the eNB as well as the burst of itself being indicative of a scheduling request.

Claims 9 and 19

103. Claim 9 introduces into the method of claim 1 the requirement that the NCB uplink control channel is further used for HARQ feedback. The UE receives HARQs and transmits a positive or negative acknowledgment (ACK or NACK) to the eNB using that channel. Claim 19 is concerned with the processing means of the UE; the HARQ feedback need not be sent over the NCB uplink control channel.

104. There was a dispute about the word "with" in claim 19. InterDigital submitted that it means concurrently with, i.e. it is sent at the same time as the scheduling request. Lenovo's position was that concurrency is not inherent in the word "with" and that claim 19 (like claim 9) neither requires nor excludes ACK/NACK signals being transmitted at the same time as a scheduling request; "with" merely requires both to be sent over the same channel.

105. Neither side suggested that in this context "with" is a term of art. I find it hard to see what it could mean if it does not mean concurrently with. I think that "on the same channel as" would be an idiosyncratic meaning to ascribe to the word. Lenovo pointed to nothing in the specification which would lead the skilled person towards such a meaning. I find that claim 19 requires the HARQ signals to be sent at the same time as the scheduling request.

106. Claim 9 as granted has no such limitation. It includes, but does not require, the HARQ signals being sent at the same time as the scheduling request.

Novelty – the law

107. It is well established that in order to anticipate an invention, an item of prior art must disclose the invention unambiguously: "the prior publication must contain clear and unmistakeable directions to do what the patentee claims to have invented", see *General Tire and Rubber Co Firestone Tyre and Rubber Co Ltd* [1972] RPC 457, at 485-486. In *Synthon BV v Smithkline Beecham plc* [2005] UKHL 59 Lord Hoffmann drew together what the House of Lords had said in that passage and from *Hill v Evans* (1862) 31 LJ (NS) 457, at 463:

> "[22] If I may summarise the effect of these two well-known statements, the matter relied upon as prior art must disclose subject-matter which, if performed, would necessarily result in an infringement of the patent. That may be because the prior art discloses the same invention. In that case there will be no question that performance of the earlier invention would infringe and usually it will be apparent to someone who is aware of both the prior art and the patent that it will do so. But patent infringement does not require that one should be aware that one is infringing: "whether or not a person is working [an] … invention is an objective fact independent of what he knows or thinks about what he is doing": *Merrell Dow Pharmaceuticals Inc v H N Norton & Co Ltd* [1996] RPC 76, 90. It follows that, whether or not it would be apparent to anyone at the time, whenever subject-matter described in the prior disclosure is capable of being performed and is such that, if performed, it must result in the patent being infringed, the disclosure condition is satisfied. The flag has been planted, even though the author or maker of the prior art was not aware that he was doing so."

Inventive step – the law

108. There was no dispute about the law but there was a difference in emphasis. Jacob LJ set out a structured approach in *Pozzoli SpA v BDMO SA* [2007] EWCA Civ 588, at [23]:

> "(1) (a) Identify the notional 'person skilled in the art';
>
> (b) Identify the relevant common general knowledge of that person;
>
> (2) Identify the inventive concept of the claim in question or, if that cannot readily be done, construe it;
>
> (3) Identify what, if any, differences exist between the matter cited as forming part of the 'state of the art' and the inventive concept of the claim or the claim as construed;
>
> (4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?"

109. As is usual, discussion in the present case will focus on step (4). This was done in argument by reference to the claim, not a suggested inventive concept.

110. In *Conor Medsystems Inc v Angiotech Pharmaceuticals Inc* [2008] UKHL 49, Lord Hoffmann (at [42]) approved the statement by Kitchin J in *Generics (UK) Ltd v H. Lundbeck A/S* [2007] EWHC 1040 (Pat) that the assessment of obviousness is multifactorial in nature (at [72]):

> "The question of obviousness must be considered on the facts of each case. The court must consider the weight to be attached to any particular factor in the light of all the relevant circumstances. These may include such matters as the motive to find a solution to the problem the patent addresses, the number and extent of

the possible avenues of research, the effort involved in pursuing them and the expectation of success."

111. Lenovo had a particular point about being wary of "lions in the path" of an invention to which a patentee may point. They referred to Jacob LJ's comments in *Pozzoli*:

> "[27] Patentability is justified because the prior idea which was thought not to work must, as a piece of prior art, be taken as it would be understood by the person skilled in the art. He will read it with the prejudice of such a person. So that which forms part of the state of the art really consists of two things in combination, the idea and the prejudice that it would not work or be impractical. A patentee who contributes something new by showing that, contrary to the mistaken prejudice, the idea will work or is practical has shown something new. He has shown that an apparent 'lion in the path' is merely a paper tiger. Then his contribution is novel and non-obvious and he deserves his patent.
>
> [28] Where, however, the patentee merely patents an old idea thought not to work or to be practical and does not explain how or why, contrary to the prejudice, that it does work or is practical, things are different. Then his patent contributes nothing to human knowledge. The lion remains at least apparent (it may even be real) and the patent cannot be justified.
>
> [29] This analysis does not require a different way of looking at the inventive concept depending on whether or not the patentee has shown the prejudice is unjustified as the judge thought at [67]. It is simply that in the former case the patentee has disclosed something novel and non-obvious, and in the latter not. The inventive concept, as I have said, is the essence of what is in the claim and not dependent on any question about a prejudice being overcome."

112. Jacob LJ had in mind an instance in which it is established that the skilled person would have had known of the product or process of the patent in suit at the priority date or would have regarded it as obvious, but would have been dissuaded from implementing the invention because of a technical prejudice. There can be an inventive step in informing the world that a prevailing prejudice is wrong. The patentee must establish on the evidence (a) that the prejudice existed at the priority date in the mind of those in the art and (b) that it was false. It must have been the prejudice which held back the implementation of the invention, not a technical difficulty which the patentee has done nothing to resolve, although that may be implicit in the proof of (a) and (b). In *Koninklijke Philips NV v Asustek Computer Corporation* [2019] EWCA Civ 2230, Floyd LJ, with whom Patten and Henderson LJJ agreed, summarised (at [73]) the principle to be drawn from the passage in *Pozzoli* I have just quoted:

> "The principle is that you cannot have a patent for doing something which the skilled person would regard as old or obvious but difficult or impossible to do, if it remains equally difficult or impossible to do when you have read the patent. To put it another way, the perceived problem must be solved by the patent."

113. In closing Lenovo made a great deal about the absence from the Patent specification of any stated advantage of the inventive concept advanced by InterDigital at trial.

114. There is no statutory requirement that the invention claimed in a patent provides an advantage over the prior art (see s.1 of the Patents Act 1977 ("the Act")). If it does not, generally the invention may well not be used by third parties in which case the patent will probably not trouble the courts, but that is by the way.

115. A patent specification may set out a problem with the prior art technology, identify a solution and explain why the invention embodying that solution is an improvement over the prior art. But sometimes nothing may be said about any advantage in using the inventive concept as advanced at trial. One possible inference to be drawn is that between the drafting of the specification and the trial the patentee's idea of what the inventive concept is has moved on.

116. There is an exception. Where the alleged inventive step resides in the identification of a sub-range of a feature within a known larger range, the patentee must identify the advantage conferred by the sub-range. Neuberger LJ called the circumstance in which a patentee fails to do this "parametritis", see *LG Philips LCD Co. Ltd v Tatung (UK) Ltd* [2006] EWCA Civ 1774, at [39]. A patent for such an invention lacks inventive step because identifying an arbitrary sub-range within a known larger range will invariably be obvious. What may not be obvious is identifying a sub-range which will confer an improvement over the prior art, but the patentee must establish the improvement. The better view may be that this is required to avoid what would otherwise be an inevitable finding of obviousness on the facts, not because the statute has been supplemented by a special rule of law.

117. A similar principle applies where the claimed invention involves nothing more than the combination of arbitrary features which offer no technical advantage. Such an invention will be obvious: see *Nokia Corp v IPCom GmbH & Co KG* [2012] EWCA Civ 567, at [125]-[127], citing *Abbott Laboratories Ltd v Evysio Medical Devices ULC* [2008] RPC 23 and *Actavis UK Ltd v Novartis AG* [2010] EWCA Civ 82.

118. Lenovo did not advance any argument by reference to parametritis cases or the principle in *Nokia* just mentioned. InterDigital objected that Lenovo's point on a lack of stated advantage had only been raised in closing. Many inventions take the form of a combination of features and I take the view that if a point on the *Nokia* principle had been raised, it would have been necessary to do so in Lenovo's pleading so that InterDigital would have been afforded the opportunity to lead evidence on their characterisation of any technical advantage.

119. As it is, either implementing the invention of claim 1 of the Patent was obvious at the priority date or it was not. If not, there was an inventive step.

120. Turning to InterDigital's submissions on the law, they wished to emphasise the unreliability of secondary evidence in a case such as this one. *Koninklijke Philips NV v Asustek Computer Inc* [2018] EWHC 1224 (Pat) was concerned with technology similar to that in the present case. The party seeking to revoke the patent in suit produced technical documents (in fact T-docs, see the discussion of the Samsung prior art below) published immediately after the priority date. These were said to show that the alleged invention was being made almost simultaneously by many other than the patentee. Arnold J stated (in a judgment affirmed by the Court of Appeal, [2019] EWCA Civ 2230):

> "[201] The Defendants rely on post-Priority Date contributions from LG and Lucent to WG1 meeting 23 in Espoo on 8-11 January 2002 as confirming that differential ACK/NACK powers was obvious. But that pre-supposes that LG and Lucent came up with the invention independently from Philips (and each other). The Defendants did not adduce any evidence from either LG or Lucent to establish this, however. Counsel for the Defendants simply relied upon the absence of any reference to Philips' contributions R2-24(01)2366 and R2-24(01)2368 to the WG2 meeting in New York on 22-26 October 2001 which disclosed the invention to 3GPP as showing this (or at least as being sufficient to shift the onus of proving the contrary onto Philips, which had not led any evidence of fact on the question). I do not accept this, since it is possible that LG and Lucent were aware of Philips' contributions despite the absence of such reference. For example, Dr Farooq Khan of Lucent attended both the October 2001 WG2 meeting and presented the Lucent paper at Espoo. In any event, I agree with counsel for Philips that the mere fact, if fact it be, that LG and Lucent came up with the same invention shortly after the Priority Date is insufficient to establish that it was obvious at the Priority Date."

121. I would observe that Arnold J was not setting out any principle of law. His point, as I understand it, was that publication of the invention of the patent in suit shortly after the priority date by competitors of the patentee may or may not be significant depending on whether it is likely that the competitors had become aware of the work done by the patentee.

The cited prior art

122. Lenovo cited two items of prior art:

(1) PCT Application No. PCT/US2003/024889, publication number WO 2004/016007 ("Laroia"); and

(2) T-doc no. R2-052409, submitted by one of the Samsung companies at a meeting of the 3GPP TSG RAN Working Group 2 held at Cannes on 10-14 October 2005 and published before the meeting ("Samsung").

123. Lenovo pleaded that Laroia deprived the Patent of both novelty and inventive step; Samsung was only relied on for inventive step.

Samsung

124. Samsung is a "T-doc", the term used for a technical document submitted for discussion at 3GPP working group meetings during the development of LTE. It is entitled "LTE State & State transitions". The document begins with the statement that at an earlier meeting in London three UE states had been agreed. Samsung outlines proposed technical characteristics for those three states and what would happen during transition from one state to another.

125. The first suggested state is "LTE_DETACHED": the UE is not registered to the system and the system is not aware of its location. The second is "LTE_IDLE": the system

knows the location of the UE up to "tracking area level" which consists of a group of cells; the UE is allocated a temporary ID and an IP address. The third is "LTE-_ACTIVE": the system knows the location of the UE up to the level of specific cell; the UE is allocated an ID which uniquely identifies the UE.

126. Section 3 of the document discusses transitions by the UE from one state to another and in section 3.2, transitions made within a single state, namely the LTE_ACTIVE state: ("DRX" means discontinuous reception; "NC-SI" is defined in section 3.1 to mean a non-contention resource for sending scheduling information):

> "3.2 LTE_ACTIVE <-> LTE_ACTIVE
>
> It is our assumption that in the LTE_ACTIVE state, the UE can have a large variety of activity both in UL and in DL. Thus power saving mechanisms should be in place to not waste power in case a UE has low activity but is still in LTE_ACTIVE state. In ref [1] this 'power-reduced-state' was named 'dormant substate'.
>
> For the DL, we assume that using different DRX cycles while in active state can cope with a variety of DL activity levels.
>
> For the UL, the situation is a bit different, since the initiator of the traffic and the scheduler are not 'on the same side of the radio interface'. The main issue for UL transport thus becomes how quickly a UE can ask for UL resources. We see in principle 2 mechanisms for asking for additional UL traffic capacity:
>
> a) Sending an 'E-DCH SI-like' msg added to other traffic for which an UL resource allocation has been received.
>
> b) Sending an 'E-DCH SI-like' msg on a non-contention resource which is provided periodically (i.e. use a 'NC-SI' channel).
>
> We assume that every UE in LTE_ACTIVE will be able to use the NC-SI."

127. Samsung here contemplates two possible mechanisms by which the UE could ask for additional uplink resources. The first under sub-paragraph (a) is where the UE has already received resource allocation; it sends an "E-DCH SI-like" message using that resource. The alternative mechanism under (b) sends a similar form of message on a non-contention based channel.

128. It is option (b) that matters. The issue of inventive step over Samsung was whether it was obvious to implement this option so that the presence of the message on the NCB channel was of itself indicative of a request for uplink transmission resources. The experts were agreed that all the other integers of claims 1 and 14 were either disclosed by Samsung or were obvious variations on what was disclosed.

Samsung and inventive step – the arguments

Claims 1 and 14

129. The message sent in Samsung is an "E-DCH SI-like" message. This is not a term of art. In his first report Dr Moss said:

> "[233] The Skilled Person would have recognised that an 'E-DCH' was an uplink transport channel (the 'Enhanced Dedicated Transport Channel') in HSUPA. They would also understand that 'SI' stood for Scheduling Information. They would therefore probably assume that the authors of Samsung had in mind that an 'E-DCH SI' message was a Scheduling Information message sent on a transport channel that was specified in an HSUPA standard, although there is no actual cross-reference to any standards within Samsung."

130. Prof Valenti's view was similar. An E-DCH message in the context of HSUPA was an 18-bit message sent at the MAC layer. The happy bit sent on the E-DPCCH was a means of sending a scheduling request. Prof Valenti accepted in cross-examination that the E-DCH message was not conveyed by detecting the presence of the signal, but by decoding the contents of the signal.

131. Lenovo's primary case was that it was obvious to implement option (b) by making the "E-DCH-like" message a 1-bit transmission burst the presence of which communicated a scheduling request, rather than an 18-bit message encoding the scheduling request.

132. Their secondary case was that if the E-DCH-like message would have been taken to be an 18-bit message familiar from HSUPA, the skilled person would have understood that it could serve as scheduling request solely by the fact of its being sent as well as providing within the 18-bits further information about the request which would be decoded by the UE, e.g. priority or buffer status.

133. InterDigital submitted that the secondary case was an afterthought by Prof Valenti. He had said nothing about it in his first report. Lenovo's response to this was that its secondary argument arose from Prof Valenti's view on what Dr Moss had said in his first report.

Additional Resources

134. Before turning to Lenovo's two arguments, there is a preliminary matter. Samsung's proposed two mechanisms in its section 3.2 involve a UE asking for *additional* UL traffic capacity. Dr Moss understood that additional meant in addition to existing UL capacity. That would mean that neither option is contemplating a UE with no uplink resources. But he confirmed that option (b) would be the only one available if the UE has no uplink resource allocation.

135. In cross-examination Prof Valenti conceded that he found the word "additional" a little troublesome, but pointed to the sentence in Samsung immediately before the one containing "additional":

> "The main issue for UL transport thus becomes how quickly a UE can ask for UL resources."

136. Prof Valenti said that this earlier sentence makes it clear that the UE may have no resources to begin with. He also suggested that section 3.1 of Samsung implied that the UE may start with no resources. He speculated that the authors used "additional" to include "additional to zero".

137. This document cannot bear the weight of a close textual analysis. It was presumably either written by authors whose native language is not English or was translated from Korean. It is not a finalised 3GPP standard, only a discussion document, one of many that the attendees of the relevant meeting would have ploughed through during their 5 days in Cannes.

138. Section 3.1 concerns the transition from LTE_IDLE to LTE_ACTIVE and suggests that in this transition the UE will "optionally" be allocated UL resources. It implies at the end that a UE will pass into the LTE_ACTIVE state when it has received a CID (cell-specific identification) – there is no mention of any additional requirement of an allocation of UL resources.

139. I am not sure why Prof Valenti placed reliance on the sentence in section 3.2 preceding the sentence containing "additional". To my mind, on an ordinary reading the UL resources referred to could be additional to existing resources just as much as new resources. It is neutral.

140. Section 3.2 is ambiguous, but I think that it would likely occur to the skilled person that "additional" in section 3.2 could be a slight misuse of the word. I also think that he or she would decide that given what is said in section 3.1, it probably is: UL traffic capacity may optionally be sought by a UE with no existing UL resources.

Lenovo's Primary Case – the Expert Evidence

141. Dr Moss was cross-examined at some length as to why it would have been obvious to the skilled person to substitute a transmission burst for the E-DCH SI-like message under Samsung's option (b) in section 3.2. He agreed with the following. If the UE had no UL resource allocated to it, the UE would use option (b). The downside of using the non-contention based channel of option (b) was that potential resources would go to waste in the periods during which the channel was provided to a UE but not used. That downside increases if the amount of bandwidth provided in the relevant periods increases. Therefore providing the UE with enough resource to send a one bit message in the form of a transmission burst would waste less resources than allocating a resource that would allow the UE to send many more bits. Also, the consequence of allocating a higher resource would be that fewer UEs could have access to the channel.

142. Prof Valenti made similar points in his second witness statement. In cross-examination, however, his argument that there was a clear overall incentive to send just a 1-bit message became significantly more muted. He said that the skilled person would be careful how a control channel would be used, there were trade-offs between allocating enough resource to the non-contention channel and avoiding wastage and he could see the skilled person picking either an 18-bit or 1-bit message.

143. Dr Moss considered whether the skilled person would have regarded the potential twin problems of wasted resources and a limited number of UEs having access to the channel as real issues, or just theoretical difficulties which would have been seen as having no significance in practice. He said that if there was a risk of latency because of a larger resource allocation to each UE for the same bandwidth, the bandwidth could be increased. That would take resource away from the uplink data channel but resource allocated to the non-contention based channel was a relatively small overhead compared to the size of the data channel. Also, in 3G there was always a dedicated

channel running continuously which allowed the UE to send measurement reports and which could be used for much of the information that a UE wished to send. In Dr Moss's view the skilled person starting off in LTE would primarily want to budget enough capacity in the non-contention channel to do all the things he thought may be necessary.

144. In a later passage of his cross-examination Dr Moss accepted that there was a trade-off between allocating enough resource to the non-contention channel and avoiding wastage. How this would be struck would depend on several variable factors that would have to be taken into account. Dr Moss did not believe that the skilled person would perceive any practical difficulty in having a request for UL resources by the UE in the form of an 18-bit message. Despite being pressed several times, he maintained his opinion that only with hindsight would the skilled person have considered substituting a 1-bit message.

145. Lenovo had several subsidiary arguments which were said to support their argument that using a 1-bit message in the form of transmission burst would have been obvious. They did not add much of substance to the main argument but I will discuss them.

146. The first was to characterise InterDigital's case – that it was not obvious to substitute a 1-bit transmission burst – lacked merit for the reason outlined in *Pozzoli* in the discussion about a lion in the path and a paper tiger. In truth, Lenovo contended, the Patent merely claims an old idea thought not to work without explaining why, contrary to the prevailing belief, it works.

147. I do not think that this case is analogous to *Pozzoli* in that way. I did not understand InterDigital's argument to be based on removing a technical prejudice against a known or obvious idea. InterDigital's case was that the invention of the Patent was new at the priority date; the invention was neither present nor obvious in the mind of the skilled person. There was debate about reasons why the skilled person would have been driven towards or away from the invention. The cogency or otherwise of those reasons, in both directions, must be considered carefully. But that applies to any assessment of obviousness in a patent case.

148. *Pozzoli* was also used by Lenovo as a springboard for an argument that InterDigital had to establish an advantage in using the presence of a transmission burst on the NCB uplink channel as indicative of a scheduling request. For the reasons stated above I do not accept that there was any such obligation.

149. Lenovo's second point was that the experts were agreed that the method of claim 1 would work and that any type of scheduling could be used once the scheduling request is granted. That is true, but it does not follow that having the scheduling request in form of a 1-bit transmission burst was obvious.

150. The third argument was made by reference to Prof Valenti's evidence in his second report in which he said that the skilled person would not have confined themselves to simply thinking about whether the scheduling request should be 18-bit or 1-bit. They would also have considered sending scheduling information, such as buffer status, on the channel of Samsung's option (a), i.e. along with other data once UL resources had been allocated. In that case the request for UL resources would have been kept simple

– a 1-bit message, i.e. OOK to indicate a resource request. Prof Valenti maintained his view about this in cross-examination.

151. It seems to me that this is a variation on Lenovo's main argument: the skilled person would have wanted to minimise the resource allocated to the non-contention channel of option (b) and here was another route to that preferred result.

152. Fourthly, even if the sending of an 18-bit message with buffer status information on the NCB channel was one obvious option open to the skilled person implementing Samsung, that does not mean that sending a 1-bit burst request, was not also obvious.

153. That is correct. The question remains, though, whether the latter was obvious.

154. Fifthly, Dr Moss accepted in cross-examination that the means of requesting UL resource discussed in each of paragraphs [0004] and [0005] were common general knowledge at the priority date. Lenovo argued that this concession and his agreement that they were a means of saving resources cannot be reconciled with his view that it would not have been obvious to substitute the 18-bit message of Samsung's option (b) for a 1-bit burst. Both means of requesting resources in paragraphs [0004] and [0005] used contention based channels, but Dr Moss had also conceded in cross-examination that the principle of wasted resources is the same for an NCB channel as for a contention based channel.

155. As I understood Dr Moss's evidence, he was saying that, at least in the context of a method discussed in a post-priority document from Ericsson, there was a trade-off between having enough resource for the scheduling request and wasting resources when UEs do not take up the allocation and that this was true where the resource was on a contention based channel. But the fact that the skilled person would have been aware of the trade-off is not conclusive of whether he or she would have thought it obvious to substitute a 1-bit transmission burst in place of the 18-bit E-DCH SI-like message of Samsung's option (b).

156. Sixthly and finally, Lenovo emphasised that the request for UL resource in Samsung's option (b) was "E-DCH SI-*like*". This would imply to the skilled person that the message would be not be exactly the same as the one in HSUPA, albeit with similarities to it. Dr Moss had agreed. In HSUPA a larger message was sent on a transport channel and a 1-bit message on the physical control channel, the happy bit. The happy bit was modulated using BSPK, not sent as a transmission burst, but this was a consequence of how it worked. At every interval during which the UE could contact the base station – every two or ten milliseconds – the UE had to signal whether it was happy or unhappy. In contrast, it was common ground that in LTE as proposed in Samsung's T-doc, the UE would transmit a resource request only when needed. This explains why the happy bit was not sent as a transmission burst.

157. I set this argument out as advanced in Lenovo's closing written submissions. I find it convoluted and I am not sure where it goes. The written submissions do not record the argument as either having been raised by Prof Valenti or put to Dr Moss in cross-examination.

158. I agree with Dr Moss's observation in cross-examination that the skilled person would most probably have understood Samsung to have meant an E-DCH SI-*like* message to

be a signal similar to an E-DCH SI signal familiar from HSUPA but to be used in an LTE network. I would not give "like" any more developed meaning than that.

Lenovo's primary case – the secondary evidence

159. Lenovo relied on four T-docs. Two of the four were published before the priority date. All four disclosed the use of a 1-bit message from the UE to request UL resources followed by more information as to resources required sent on the uplink shared channel. In two instances, the initial request is on a RACH channel, not a non-contention based channel and in one instance it is not clear.

160. Prof Valenti said nothing about these documents in his reports but he was asked about them in cross-examination. He said that he had looked at hundreds if not thousands of T-docs, but the four in question were found by Lenovo's lawyers following a discussion with Prof Valenti. Prof Valenti knew nothing about the search strategy used. He accepted that in the course of the 3GPP meetings in around the first eight months of 2006 a total of about 6,500 T-docs were submitted.

161. The four T-docs were put to Dr Moss in cross-examination. It was submitted by Lenovo that Dr Moss had expressed the view that there seemed to be a consensus forming about sending a small amount of data, receiving an allocation and then sending more information on the uplink shared channel.

162. I do not think that is what he meant. This was the part of the cross-examination on which Lenovo relied:

> "Q. Just focusing on the point about sending on the control channel a short 1-bit message with a subsequent allocation of resources to send the uplink scheduling information, we have seen all these companies proposing as one option that signalling arrangement, have we not?
>
> A. Well, they seem to be running to a consensus of sending small amounts on a RACH channel and then receiving an allocation and then sending more information about what they want, what the UE wants."

163. I think that Dr Moss was talking about a limited consensus between the authors of the four papers – not, as Lenovo implied, a consensus within the industry. Although Dr Moss was then pressed to alter his evidence about the skilled person's reaction to Samsung, he did not:

> "Q. And one of the proposals we see from all of them is the suggestion I have put to you that because of the potential for the waste of resources on a non-contention resource, one obvious thing to do is to send a very small message on the non-contention resource, receive an allocation and then subsequently send in-band on the shared channel the fuller scheduling information?
>
> A. Yes, well, the starting point is the Samsung document. Samsung presents something quite clear, clearly something that is going to work, and I do not think the skilled person, the uninventive skilled person would have come up with all of these, would have brainstormed it with

> colleagues to come up with all of these alternatives and weighed them all up. The fact that there were several companies coming up with many alternatives, many of which were based on the RACH does not necessarily mean that any of them are necessarily obvious to the skilled person."

164. I find these four T-docs to be of no assistance. First, they are four out of a large number of contemporary T-docs. If all were investigated it may be that the industry consensus was the opposite of that proposed by Lenovo. Secondly, to the extent that there was a consensus between the four, as Dr Moss said it was for the use of 1-bit message on a RACH channel.

Lenovo's primary case – discussion

165. To recap, Lenovo's primary case was that it would have been obvious to reduce the size of the 18-bit message proposed by Samsung to a 1-bit message which solely by its presence indicated a scheduling request – OOK. The motivation was to minimise resource allocation and to maximise the number of UEs that a cell could service.

166. Assuming that the skilled person would have considered OOK in this context, I do not accept that there would have been any motivation of that kind. That was not Prof Valenti's evidence. He was of the view that the skilled person would have had an open mind on the topic, which does not imply a motivation one way or the other.

167. I think the starting point for a skilled person considering the E-DCH SI-like message of option (b) in section 3.2 of Samsung would have been to think of the familiar E-DCH SI message of HSUPA. That was an 18-bit message containing scheduling information and without a bit identifying the message as a scheduling request. That function was provided by the happy bit sent on the E-DPCCH. Option (b) indicates that its proposed message is not the same, in that sending the message serves as a mechanism for asking for UL resources, although that could be done by a signal within the message.

168. I was persuaded by Dr Moss that the principal further thought of the skilled person reading Samsung would have been that it was important to allocate enough resources to the NCB channel to avoid latency and yet to allow sufficient UEs to have access to the channel. Samsung was recommending an overall structure for alternative states of the UE with many interlocking features in which, under option (b), the scheduling request would be like the E-DCH SI message of HSUPA but in an LTE network. The skilled person would not have blindly accepted Samsung's recommendations but he or she would have known that implementing them would involve the use of an eNB which would bring with it uncertainties. The skilled person would have believed that in navigating those uncertainties Samsung, a leader in the field, probably knew what they were doing.

169. I am not persuaded that the skilled person would in those circumstances have focussed on the scheduling request in option (b) of section 3.2 and considered replacing the 18-bit message proposed by Samsung with a 1-bit transmission burst, i.e. considered the use of OOK for the scheduling request.

170. To my mind this is a case in which there is a very real danger of applying hindsight. OOK was a basic technique taught at university. But the skilled person would not have

been aware of any use of OOK in any of the cellular networks developed by that date. Nor would he or she have known of any suggestion that it should be used in LTE. OOK would have been far from the forefront of the skilled person's mind as an option for an uplink channel in LTE. The skilled person reading Samsung could in principle have directed their attention to the scheduling request of option (b) and OOK could have come to the mind as an alternative mechanism for a scheduling request by a UE with no uplink resources. With hindsight there were no significant barriers to that line of thinking. If pursued, the skilled person would probably then have run through the relevant trade-offs between OOK and the mechanism of option (b), which may have suggested that OOK was an obvious alternative.

171. But for the reasons I have given, I think the skilled person's mind would have stayed with what Samsung was recommending and that it would not have occurred to them to think further.

Lenovo's secondary case – discussion

172. In his second report, Prof Valenti said that if the E-DCH SI-like message of option (b) in paragraph 3.2 of Samsung would have been taken to mean an 18-bit message containing the type of information as contained in the SI defined in HSUPA, nonetheless the presence of such a message could of itself be an implicit request for uplink capacity. The contents of the message would just provide extra information about the request. Prof Valenti pointed to paragraph [0037] of the Patent which contemplates that the transmission burst on the non-contention uplink channel includes information related to the resource allocation request. He suggested that this is what Samsung discloses.

173. The first point to make is that the skilled person would not have seen paragraph [0037] of the Patent. More than that, in cross-examination Prof Valenti accepted that in an HSUPA system the base station understood that there was a request for uplink resource allocation not from the presence of the signal but from the contents of the signal:

> "A. … Of course it would be a combination of elements from HSUPA, but it would also be elements of LTE. Yes, it would be different. That part I do agree with. This is a system that would be different than an HSUPA system."

174. As I have said, in HSUPA, the E-DCH 18-bit message contains scheduling information, but not a bit identifying the message as a scheduling request. That function was provided by the happy bit sent on the E-DPCCH. Lenovo's secondary argument required the skilled person to have believed that the E-DCH SI-like message in option (b) of section 3.2 of Samsung should be changed from the E-DCH SI message with which he or she would have been familiar. The request for uplink resources should be communicated by the fact that there is an 18-bit message, not by the contents of the message.

175. This secondary argument still requires the skilled person to have focussed on the uplink message of option (b) in section 3.2 and to have considered OOK as a substitute. For the reasons I have given, I doubt that would have been the case.

Conclusion on the validity of the claims

176. It follows from what I have found that all the claims have inventive step over Samsung.

177. I will nonetheless consider the further arguments advanced in respect of the subsidiary claims in issue.

Claims 9 and 19 as granted

178. HARQ is not mentioned in Samsung, but it was agreed between the experts that it was known to be desirable and well known to use HARQ at the priority date. The argument advanced by InterDigital was that it would not have been obvious to send HARQ and ACKs over the NCB uplink channel of Samsung – in the terms of Samsung, the NC-SI channel made optionally available according to option (b) of paragraph 3.2. InterDigital relied on the name given to that channel by Samsung: NC-SI stands for non-contention – scheduling information. HARQ feedback is not scheduling information.

179. Prof Valenti took the view that the skilled person would have appreciated the value of HARQ, would have seen that there is a non-contention channel available and would have used it for HARQ feedback. He was unimpressed by the name given to the channel as an obstacle to its use:

> "A. The channel is called NC-SI, but that is just a short term that is used for the definition, which is that it is a non-contention-based access channel and that it is used for users who do not have to compete and have unique resources in the frequency or code domain. So I would interpret NC-SI channel as just being a kind of a shorthand for that kind of a non-contention-based channel."

180. Dr Moss accepted in cross-examination that it was routine to combine different types of signalling data on the same physical channel. He also said that the skilled person would consider the option of using Samsung's NC-SI channel for HARQ feedback because if the existing channel was not used it would be necessary to create more channels. He went on to qualify that by saying that it would be a very big decision because of the potential commercial consequences.

181. I can leave aside commercial consequences as irrelevant to whether, as a technical matter, the skilled person would have though it obvious to use the NC-SI channel for HARQ feedback. In the end both experts thought it was and I accept that evidence.

182. Claims 9 and 19 are not independently valid over claims 1 and 14.

Other subsidiary claims

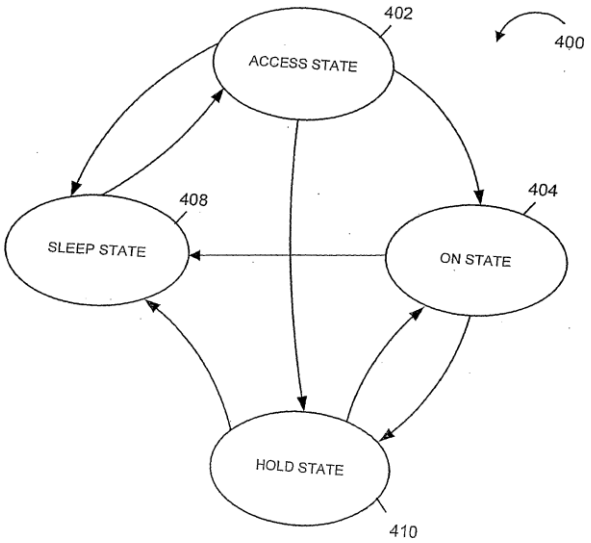
183. In closing InterDigital advanced no separate arguments for the independent validity over Samsung of claims 10 and 23, or claims 13 and 22.

Laroia

184. The section on the background to the invention in Laroia describes known means to make efficient use of limited communications resources. Resources may be made available either in the form of time slots or "tones" (Laroia's word for specific frequencies). These resources may be "shared" or "dedicated". It was common ground

between the experts that Laroia does not use these terms in the usual sense. "Shared" refers to a system in which nodes may use the same resource at the same time, giving rise to the possibility of collisions. "Dedicated" means resources are allocated to a particular device or group of devices, at least for a period of time, thereby avoiding or reducing the possibility of collisions. The background section ends by stating that there was a need for improved methods of allocating resources to mobile nodes (which I will continue to call UEs) to permit a relatively large number of UEs to be supported by a single base station.

185. In summary, the invention claimed in Laroia is having UEs support four different states of operation: the sleep, hold, access and on states. Figure 4 provides a diagrammatic representation of those four states with arrows showing how the UE may move between them:



186. In the on state the UE is fully operational, requiring the highest level of resources. It is allocated bandwidth on an as-needed basis for transmitting and receiving traffic data, including what Laroia calls "payload information", i.e. information such as a text or a video. The UE is allocated a dedicated uplink control signalling channel which is used among other things for communicating resource requests.

187. In the hold state the UE is denied bandwidth for transmitting data. It can be allocated bandwidth for receiving data, although the bandwidth may be shared with other UEs. As in the on state, the UE has a dedicated uplink communication resource which it can use to request transition to other states.

188. In the sleep state the UE has no data transmission resources and no dedicated uplink communication resource. A shared communication channel is used to contact the base station to request resources necessary to initiate transition from the sleep state to another state.

189. The access state is a transitional state, through which the UE passes from the sleep state to either the hold or on state. The UE may also fall back from the access to the sleep state. The UE remains in the access state while timing control signalling is established and, optionally, while full or partial transmission power control signalling is established.

190. Lenovo argued that claims 1 and 14 of the Patent lack novelty or alternatively inventive step over Laroia. The remaining claims in dispute, 9 and 19, both as granted and as proposed to be amended, 10 and 23, and 13 and 22 were said to lack inventive step.

Laroia – novelty of claims 1 and 14

191. InterDigital argued that several features of claims 1 and 14 are missing from Laroia. I will take them in sequence.

Integer 1B – evolved Node B

192. Laroia was filed before the inception of LTE. It was not in dispute that the base station of Laroia was a base station of an earlier system and therefore not an eNB.

193. The skilled person reading Laroia would have known that LTE was in the course of development. By the priority date there had been workshops. Dr Moss agreed that the skilled person would have known something about the proposed eNB.

194. The eNB of claim 1 is a Demonstrator eNB. In the argument on inventive step the parties assumed that it would have been obvious for the skilled person to implement Laroia at the priority date using a Demonstrator eNB. I do not accept, however, that Laroia provides clear and unmistakable directions to the making of a Demonstrator eNB.

Integer 1C – a scheduling request over the NCB channel

195. When a Laroia UE is in the hold state, it may make a request to the base station to transition to another state. Laroia says on page 7:

> "During the hold state … the mobile node is also allocated a dedicated control uplink communication resource, e.g., dedicated uplink control communications channel, which it can use to request changes to other states."

196. Thus, the UE in the hold state is allocated an NCB uplink control channel by which it requests a move to another state, in particular to the on state. Lenovo submitted that the only reason disclosed in Laroia for making a request to move to the on state was that the UE has data to transmit. Therefore the state transition request is simultaneously a request for uplink resources and thereby a scheduling request.

197. InterDigital's argument was that a request from the UE in Laroia to transition from the hold state to the on state is exactly that and nothing more. It is not a request for uplink resources.

198. Laroia says this at page 8:

> "… when the mobile transitions from the hold state to the on state it can transmit data without much delay, e.g. as soon as the requested uplink resource is granted, ..."

199. It was put to Prof Valenti in cross-examination that this implies a request for an uplink resource which may be later than and is therefore distinct from the request to transition to the on state. He accepted that this was one possible reading of Laroia.

200. That reading was the one understood by Dr Moss in his first report. He was cross-examined about it and maintained his view. He said that it would have been within the common general knowledge of the skilled person reading Laroia that there may be reasons for a request to transition to the on state other than a need to transmit data. As appeared from the evidence of both experts and indeed from what counsel said in the cross-examination of Dr Moss, this was common ground.

201. Dr Moss agreed that one of the matters considered by the base station when deciding whether to accept a request from a UE to move to the on state is whether the base station has spare capacity to grant to the mobile, since there would be no point in allowing the UE to go to the on state if it could not do anything. However, it was not clear from the cross-examination that Dr Moss had in mind the base station's spare capacity to grant resources for data transmission or for control signalling. It was not in dispute and expressly stated in Laroia that the bandwidth allocated to a UE for control signalling is greater in the on state than in the hold state.

202. Even if Dr Moss had in mind the base station's capacity to allocate resources for data transmission, I am not sure this would support Lenovo's case. There is no doubt that one of the reasons for a UE to move to the on state is to obtain an allocation of resources to transmit data. It would make sense for the base station to consider its capacity to make such an allocation as one matter, among others, to be considered. It does not follow that the UE will inevitably and immediately require such an allocation.

203. In closing Lenovo emphasised that Laroia itself does not identify a reason for the UE requesting a transition to the on state other than for the purpose of transmitting data. That may be so. InterDigital did not point me to a passage in the document which suggests otherwise. But this is not conclusive of anything. Laroia must be understood through the eyes of the skilled person. He or she would contemplate the possibility of other reasons. A request for a state transition in that document is therefore not *ipso facto* a request for an allocation of uplink resources. The former may very often lead to the latter, but they are distinct. Prof Valenti's evidence did not support the idea that Laroia contains a clear and unambiguous direction that the two are to be run together. Dr Moss's evidence, which I find more persuasive, suggests that the skilled person would take the positive view that they are not to be.

204. There are also passages in Laroia which point the same way, including this on page 6:

> "Of the four states, the on state requires the highest amount of control signaling resources, e.g., bandwidth used for control signaling purposes. In this state, the mobile node is allocated bandwidth on as needed basis for transmitting and receiving traffic data, e.g., payload information such as text or video. Thus, at any given time in the on state a mobile node may be allocated a dedicated channel for transmitting payload information."

205. This indicates that a UE which has transitioned to the on state may not immediately require resources for transmitting and receiving data. It implies that a request for such resources would be distinct from the request to move to the on state.

206. I find that the request for state transition in Laroia is not a scheduling request within the meaning of claim 1.

Integer 1C – sub-carrier resource

207. InterDigital argued that the NCB uplink control channel allocated to the Laroia UE in its hold state, for requesting a state change, is not configured to indicate which sub-carrier resource of the channel is to be used by the UE for transmitting requests.

208. Both parties addressed this argument by reference to a squeeze between it and Lenovo's argument essentiality, in the context of the latter. I will do likewise.

Integer 1D – a transmission burst, the presence of which is indicative of a request for resources

209. On page 9 Laroia says:

> "In another embodiment, the mobile node uses an on/off signaling in its dedicated uplink communication channel, where the mobile node sends a fixed signal (on) when it intends to migrate to another state and does not send any signal (off) when it does not intend to migrate to any other state. In this case, the transmission of the fixed signal can be interpreted as a migration request to the on state if the transmission occurs at certain time instances, and as a migration request to the sleep state if the transmission occurs at some other time instances."

210. I have found that the state transition request here described is not a scheduling request. InterDigital contended that there was a further point: there is no clear and unambiguous disclosure in Laroia of a transmission burst within the meaning of claim 1, i.e. the use of OOK.

211. Lenovo submitted that this passage from Laroia means what it says: a signal is sent to indicate a state transition request and nothing is sent if there is no such request; the presence of the signal is of itself therefore indicative of the request. This is how I would understand the passage unaided by expert evidence. The presence of the fixed signal of itself communicates a request to migrate to the on state if made during certain time slots and communicates a request to migrate to the sleep state if made during alternative time slots. The absence of signal is interpreted as no request to migrate. But I must pay due attention to the evidence.

212. InterDigital pointed to this part of Prof Valenti's cross-examination:

> "Q. Just focusing on Laroia's use of the phrase "on-off signalling", that is not the same as on-off keying, is it?
>
> A. No, this would probably be more general. I mean, on-off keying is an example of on-off signalling: you either transmit the signal or you do not. Here he is calling it on-off signalling. I think maybe the difference would be this is a little broader; basically, you could send pretty much

> any signal you want, it could be a BPSK-modulated PN-code or something like that. I mean, some people would even consider that type of a transmission to be on-off keying, but, yes, there is a -- I mean, it is very similar."

213. InterDigital submitted that since Laroia used a broad meaning of on/off signalling, it need not be OOK. I am not sure that is what Prof Valenti was saying and I find that broader perception of "on/off signalling" hard to reconcile with the way the term is explained in the passage of Laroia I have quoted.

214. Dr Moss said in his first report that the "fixed signal" referred to by Laroia in the passage just quoted could take alternative forms, of which one was an unmodulated tone of fixed frequency. In cross-examination he explained that alternatively it could be an unmodulated BPSK code, which would reduce concerns about reliability and security. These could be a transmission burst in which it is the transmission of the signal, not its contents, that communicates the request. He also agreed that the second sentence in that passage concerned an embodiment of the Laroia invention in which the burst will constitute a request to migrate to the on state if made in certain time slots and a request to move to the sleep state if made in alternative time slots.

215. InterDigital submitted that according to this evidence from Dr Moss a transmission burst was only one alternative disclosed by Laroia and therefore it was not clearly and unambiguously disclosed. InterDigital relied further on Prof Valenti's ready agreement that the fixed signal of Laroia could take any one of three forms:

> "Q. … I am sure you remember Dr. Moss gave evidence that there were three possibilities for the fixed signal, which were the coded predefined message, the signal whose presence could be detected by the base station without decoding and an unmodulated tone of fixed frequency. Do you remember Dr. Moss saying these were the three possibilities?
>
> A. Yes, I do.
>
> Q. And they are all possible, are they not?
>
> A. Certainly, yes. Each one of those could be a possibility. He was talking about a coded message and that could be a case where a signal is sent and after its presence is detected it could be decoded, or it could just be a fixed signal conveying a single bit of information that is either detected or not."

216. As I understood Prof Valenti, he was saying that while the fixed signal might be a coded message which would convey more detailed information about the state transition request, the request itself would be communicated solely by the presence of the signal. That seems to me to make sense of the relevant passage from Laroia. Despite a prolonged cross-examination of Dr Moss on this topic which was not always easy to follow, I think that he was saying the same thing:

> "Q. … What I want to suggest to you is looking at the disclosure of Laroia, when it talks about the fixed signal, first, it does not refer to it being a coded message, does it?

A. It does not say what it is, no. I read it many times and I could not work out what the fixed signal meant.

Q. The last sentence makes it clear that it is the transmission of the fixed signal that indicates the request, not the contents of the signal?

A. That is right."

217. My understanding of the experts' evidence is that although the "fixed signal" in the relevant passage of Laroia could take alternative forms, the state transition request is communicated solely by the presence of the signal, whatever it is. It seems to me that this is signalling by OOK. I accept Lenovo's argument that state transition request in Laroia is made by a transmission burst the presence of which is indicative of a request for resources.

Integer 1G – allocation of an uplink shared channel

218. It will be recalled that a "shared" channel according to the usual usage of that term and, as agreed, according to the meaning ascribed to it in the Patent, is a channel which has rapidly varying allocation to one UE at a time.

219. It was not clear from InterDigital's closing that they maintained their earlier contention that this aspect of integer 1G was not disclosed. If they did, page 3 of Laroia discloses an uplink shared channel (shared in the sense used in the Patent). Dr Moss expressed the initial view that it was only for use as a control channel, not for the transmission of data as required by integer 1G. But in cross-examination he accepted that the use of a shared channel for the transmission of data was well known and that there is nothing in the relevant passage of Laroia which limits the channel to control signalling.

220. Another passage of Laroia on page 24 indicates that the shared channel there described is for data, not signalling:

> "Transmission in the assignment channel occurs, in the Fig. 6 embodiment, on a continuous basis. For each time slot, there is a corresponding traffic channel segment or segments. Traffic channel segments are allocated by the base station 12 to mobile nodes 14, 16 by transmitting a mobile node identifier or mobile node group identifier in a time slot to indicate that the corresponding traffic segment or segments have been assigned for use <u>to</u> the mobile node(s) corresponding to the transmitted identifier."

221. Dr Moss suggested that the assignment channel was only for downlink traffic, relying on the word "to" which I have underlined, although he acknowledged in cross-examination that it could in principle be used for uplink traffic. It seems to me that Dr Moss's reading of the word "to" was over strained. I take the third sentence to mean that identifiers are used indicate that the relevant time slots have been assigned to a UE or group of UEs for data transfer in relation to that UE or those UEs. It seems to me on an ordinary reading of this part of Laroia, the data traffic in the allotted time slots could be downlink or uplink. Integer 1G is disclosed.

Claims 10 and 23 – a second configuration for transmitting channel quality measurement information

222. Claim 10 further requires that the first allocation from the eNB of an NCB uplink control channel is supplemented by a second configuration which is used by the UE for transmitting channel quality measurement information to the eNB over the NCB channel. This channel quality measurement will be in respect of signals received by the UE from the eNB in the downlink.

223. In closing, argument turned on whether Laroia disclosed the channel quality measurement of claim 10 by the UE when in the hold state.

224. There is no doubt that Laroia refers to channel quality measurement being sent by the UE. Prof Valenti pointed out that (a) it may be sent in addition to power control signalling between the UE and a base station in a feedback loop and (b) that power control signalling may be maintained in the hold state. He inferred from this that channel quality measurements would also be maintained in the hold state although, in my view rightly, he said that the inference was not as clear as might be liked.

225. Dr Moss's evidence was that the UE in the hold state is on low power, that consequently there is minimal signalling and that sending channel quality reports would not be a functionality that the skilled person would expect to have been built into the hold state.

226. I have found that claim 1 does not lack novelty over Laroia; nor, therefore, does claim 10. But I also take the view, based on the foregoing evidence, that there is no clear and unambiguous disclosure in Laroia of the transmission of channel quality measurement information as required by claim 10.

Laroia and inventive step

Claims 1 and 14 – arguments

227. The jointly held starting point for the debate on inventive step in relation to claims 1 and 14 was that it turned on integer 1D and the assumption that the request discussed in Laroia to migrate from the hold state to the on state is not also a scheduling request, as I have now found. In other words, there is a two-step approach in which the scheduling request is left until the UE is in the on state.

228. Lenovo had alternative arguments. One was simply that it would have been obvious to the skilled person to double up the state transition request of Laroia so that it was also a scheduling request.

229. Dr Moss had four reasons why this would not have been obvious. The first was that behind Laroia's system was the central idea that when the UE is in the hold state its signalling should be kept to a minimum so that the base station can accommodate more UEs than would be the case if there was a higher level of signalling in that state. Keeping scheduling requests to UEs in the on state was consistent with this idea. UEs may wish to move to the on state for reasons other than a need for uplink payload resources, so adding a scheduling request to the state transition request would be an unnecessary increase in signalling.

230. Prof Valenti accepted in cross-examination that it would complicate the system if the UE both requested a transition to the on state and also indicated the reason for the transition. But he added that it would be consistent with the teaching of Laroia to

allocate different time slots for the two signals to the base station – the transition request and a scheduling request. This was not an arrangement referred to in any prior art drawn to the court's attention or put to Dr Moss. Laroia already distinguishes the alternative requests to move to the on state or to move to the sleep state by using different time slots in which the fixed signal is sent. I infer that Prof Valenti was imagining a third time slot but how this would work was not explored.

231. Dr Moss's second reason was that the skilled person would not have perceived any problem with the two-step approach of Laroia and so would not have thought to change it. It was put to Dr Moss that the skilled person would see the two-step approach as introducing delay. His evidence was that it would not have been associated with any significant delay. Prof Valenti agreed.

232. Thirdly, Dr Moss drew attention to Laroia's principle that transmission power control signalling may be discontinued in the hold state or performed less frequently than in the on state. Sending an uplink data transmission with the wrong transmission power setting could result in delay or interference to other users. This was more likely to happen if a data resource request was sent at the same time as the request to transition to the on state. He maintained his view in cross-examination.

233. Dr Moss's fourth point, set out in paragraph 205 of his first report was that the "fixed" signal would not be compatible with changing Laroia's system to a one-step approach. He was not challenged on this.

234. Lenovo's alternative argument was that assuming the skilled person would have read Laroia as disclosing only a two-step approach, an obvious way of implementing the scheduling request in the on state was by OOK. In his reports Prof Valenti said that if scheduling requests are transmitted infrequently, as would be expected, the skilled person would have appreciated that there would be a power saving by adopting OOK. In addition Laroia disclosed OOK for a state transition request from the on to the hold state. This would push OOK to the front of the skilled person's mind when considering obvious options for making the scheduling request.

235. It was pointed out by Lenovo in closing that the paragraph in which Prof Valenti put forward this evidence in chief, paragraph 76 of his second report, was not expressly contradicted by either the third or fourth reports from Dr Moss filed afterwards. That cannot be taken as a necessary concession by Dr Moss since his third and fourth reports contain the usual qualification that a failure to comment on a statement made by Prof Valenti should not be taken as an agreement. Assuming it is correct to say that using OOK for the scheduling request would have offered a power saving, Prof Valenti did not indicate how significant this would have been in the mind of the skilled person. Dr Moss was not asked about it.

236. Prof Valenti was cross-examined on this alternative argument. He conceded that all examples of scheduling requests identified in the evidence which were published before the priority date of the Patent were signals which had to be decoded, none used OOK. There followed quite a prolonged section of the cross-examination in which Prof Valenti was asked to make various assumptions, during which he and counsel may sometimes have lost track of each other. I did not draw anything from it.

Claims 1 and 14 – Discussion

237. I discussed whether the state transition request of Laroia was also a scheduling request in the context of novelty. I came to the view that Prof Valenti's evidence was not conclusive on this matter and that Dr Moss's evidence, which I found more persuasive, suggests that the skilled person would take the positive view that the state transition request in Laroia is not a scheduling request. I also indicated passages of Laroia which point away from such a conclusion. There is nothing in Laroia which suggests that there should be a scheduling request effected by OOK.

238. I found Dr Moss's first three reasons why it would not have been obvious to the skilled person to combine Laroia's state transition request with a scheduling request convincing for the reasons he gave and he was not challenged on the fourth. Prof Valenti did not provide any persuasive reason to doubt the first and third and he agreed with the second. I do not believe that it would have been obvious to adopt a one-step approach.

239. Turning to Lenovo's second argument, as I found in relation to Samsung, the skilled person would not have been aware of any use of OOK in any of the cellular networks developed by that date. It is true that OOK is used for the transition request in Laroia but it does not follow that the skilled person would have thought of using the same, rarely used, mechanism for the scheduling request in the on state. As in respect of Samsung, there is a risk of hindsight. It is a necessary part of Lenovo's case that the skilled person would have been thinking about Laroia in the sense of adapting it for use in a network using an eNB. I think it unlikely that the skilled person would have contemplated a first in the context of any mobile network, i.e. OOK for a scheduling request.

Claims 9 and 19 as granted

240. I have found in the context of Samsung that at the priority date the skilled person would have been familiar with HARQ and would have known that it was desirable for UEs to send HARQ feedback. The issue in relation to claims 9 and 19 as granted was whether the Laroia UE in the hold state would use its NCB uplink channel, the channel available to make a state transition request, for HARQ signalling. Laroia states that while in the hold state the UE can be allocated bandwidth for receiving payload data. Lenovo argued that the skilled person would understand that payload data could include a HARQ transmission from the base station and that it would be obvious to have the UE use the NCB uplink channel to respond with ACK/NACK signalling.

241. Dr Moss expressed the view that transmission of HARQ feedback would have been confined to the on state using the uplink channel provided to the UE in the on state. It would run counter to the central idea of the hold state, to limit the amount to control signalling sent in the hold state, to send HARQ feedback. He expanded on this in cross-examination by saying that there are several types of acknowledgment that need to be sent, of which HARQ is one. He agreed that the UE in the hold state does send acknowledgments on the uplink control channel, not just transition requests, but said that these would be RLC network acknowledgments, not acknowledgments to the IP server. He also agreed that the skilled person who is trying to implement Laroia would have to make decisions about the type of data he or she wanted the mobile to receive in the hold state.

242. Prof Valenti took the view that one obvious option that would have been considered by the skilled person was to have HARQs received by the UE in the hold state and using the uplink control channel available to the UE in that state to send feedback ACKs. He said that a HARQ signal is just one bit, so it would not add much to the control signalling. It would be inefficient to create a separate control channel just for sending ACKs and so the skilled person would use the available uplink control channel, which is already available for a variety of purposes. It was put to Prof Valenti that the type of data the UE would be expected to receive in the hold state would not require HARQ feedback. He disagreed, identifying instances in which it would be desirable.

243. I find Prof Valenti's evidence the more convincing on this issue. HARQ was known to be desirable, the NCB uplink control channel available to the UE in the hold state was known to be suitable for HARQ feedback, Laroia expressly states that the channel can be used for at least some types of feedback, using the channel for HARQ feedback was not a significant signalling overhead and the skilled person would by common consent be making design choices about such matters. In my view one of the obvious design choices would have been to use the channel for HARQ feedback. Claims 9 and 19 as granted are not valid over Laroia independently of claims 1 and 14.

Claims 9 and 19 as proposed to be amended

244. The additional feature of the claims as proposed to be amended is that the ACK is transmitted concurrently with the scheduling request. It was not suggested by InterDigital that the addition of this feature made any difference to inventive step.

Claims 13 and 22

245. The only other claim for which independent validity was proposed by InterDigital in closing was claim 13 (and, I infer, claim 22). This requires the NCB uplink control channel to be multiplexed among two or more UEs using a combination of code, frequency and time multiplexing (CDMA, FDMA and TDMA). Laroia discloses that the channel can multiplexed among UEs using combination of frequency and time multiplexing. The issue was whether it was obvious to combine these with code multiplexing. Prof Valenti thought that it would be obvious, Dr Moss not.

246. In cross-examination Prof Valenti maintained his view. Dr Moss said that there would have been no technical difficulty in adding code multiplexing into the combination and the skilled person would expect it to work if motivated to try it, but he did not believe that it would have occurred to the skilled person. He then accepted that the skilled person may have thought that there would be some benefit from using code multiplexing and that they may have experimented.

247. Given that evidence, in my view the skilled person would have seen a possible advantage in adding code multiplexing, would have tried it and would have succeeded. Claims 13 and 22 are not independently valid over Laroia.

Insufficiency

The law

248. Section 72(1)(c) of the Act provides that the court may revoke a patent on the ground that the specification does not disclose the invention clearly enough and completely enough for it to be performed by a person skilled in the art. Lenovo referred to the well-known passage of the judgment of Aldous J in *Mentor Corp v Hollister Inc* [1990] FSR 577, at 562, approved on appeal [1993] RPC 7, at 14:

> "[Section 72(1)(c)] requires the skilled man to be able to perform the invention, but does not lay down the limits as to the time and energy that the skilled man must spend seeking to perform the invention before it is insufficient. Clearly there must be a limit. The sub-section, by using the words, clearly enough and completely enough, contemplates that patent specifications need not set out every detail necessary for performance, but can leave the skilled man to use his skill to perform the invention. In so doing he must seek success. He should not be required to carry out any prolonged research, enquiry or experiment. He may need to carry out the ordinary methods of trial and error, which involve no inventive step and generally are necessary in applying the particular discovery to produce a practical result. In each case, it is a question of fact, depending on the nature of the invention, as to whether the steps needed to perform the invention are ordinary steps of trial and error which a skilled man would realise would be necessary and normal to produce a practical result."

249. I would add an introductory paragraph of the judgment of the Supreme Court in *Regeneron Pharmaceuticals Inc v Kymab Ltd* [2020] UKSC 7:

> "[2] It is a general requirement of patent law both in this country and under the European Patent Convention ("EPC") that, in order to patent an inventive product, the patentee must be able to demonstrate (if challenged) that a skilled person can make the product by the use of the teaching disclosed in the patent coupled with the common general knowledge which is already available at the time of the priority date, without having to undertake an undue experimental burden or apply any inventiveness of their own. This requirement is labelled sufficiency. It is said that the invention must be enabled by the teaching in the patent."

Discussion

250. Lenovo had two arguments on insufficiency. The first was that it was not possible to build an eNB at the priority date. I have found that an eNB of claim 1 is properly construed is a Demonstrator eNB and that it was possible for the skilled person to make such a thing at the priority date.

251. Lenovo's second argument was that the specification did not at the filing date enable the skilled person to use a transmission burst, the presence of which is indicative of a scheduling request, for the concurrent purpose of signalling an ACK/NACK. This argument applies only to claim 9 having regard to the construction of claim 19 as I have found it to be.

252. Some technical background is required before explaining the argument more fully. The experts were agreed that the need to send a scheduling request will not necessarily arise at the same time as the need to send HARQ feedback. Prof Valenti made the point that if an ACK/NACK when there was no need for a scheduling request, it would still be

interpreted as a scheduling request, resulting in the UE being erroneously allocated resources to transmit data on the uplink even though it has no data to transmit. The specification does not enable the two types of signal to be distinguished and is therefore insufficient.

253. However, Prof Valenti suggested a solution in his first report: the eNB could signal, as part of the first allocation, a second configuration which indicates a sub-carrier resource of the NCB uplink channel for HARQ feedback, distinct from that used for a scheduling request. Although he does not expressly say so, I assume that Prof Valenti meant that this would have been a solution which would have occurred to the person skilled in the art, otherwise explaining such a solution would have been irrelevant.

254. Dr Moss agreed with Prof Valenti's proposed solution and said that it was something within the common general knowledge of the person skilled in the art. Dr Moss identified an alternative solution which would also have been within the common general knowledge of the skilled person that I need not go into.

255. Lenovo's second argument was that where HARQ feedback was sent when there was no need for uplink resource, the transmission burst on the NCB uplink channel would not, contrary to claim 1 (on which claim 9 is dependent), be indicative of a request for uplink transmission resources by the UE. The solutions proposed by the experts are not explained in the Patent specification. Therefore claim 9 as proposed to be amended is insufficient.

256. I disagree. As the Supreme Court stated in *Regeneron*, it is enough if the skilled person can perform the invention by using the teaching disclosed in the patent coupled with the common general knowledge available at the time of the priority. As Aldous J said in *Mentor*, in so doing he or she must seek success. The experts agreed this could be done. Lenovo's second argument on insufficiency fails.

The Conditional Amendments

257. InterDigital's application to amend the Patent does not go forward since I have found that the Patent as granted is valid. Lenovo declared themselves baffled as to why the court's time was taken up with the application and so am I. But it was argued and I will deal with it.

258. Claim 9 as granted does not require HARQ feedback to be transmitted by the UE at the same time as a scheduling request. As proposed to be amended it would. The claim does require the feedback to be sent over the NCB uplink control channel.

259. Claim 19 as granted does not requires the HARQ feedback to be sent over the NCB uplink control channel. As proposed to be amended it would. The claim does require feedback to be transmitted at the same time as a scheduling request.

260. The proposed amendments are intended to bring claims 9 and 19 into line. Lenovo objected to the amendments on the grounds of lack of clarity, added matter and lack of support. Argument was directed to proposed amended claim 9 but applied equally to proposed amended claim 19.

Clarity

261. Lenovo submitted that claim 9 lacks clarity for the same reason that the invention claimed by it lacks sufficiency: a HARQ acknowledgment sent when there is no need for a scheduling request would result in a transmission burst which, contrary to claim 1 (on which claim 9 is dependent), is not indicative of a request for uplink transmission resources by the UE; this internal inconsistency amounts to a lack of clarity.

262. InterDigital's response was that the skilled person would know, using common general knowledge, that using different sub-carrier resources respectively for the scheduling request and HARQ feedback, i.e. frequency multiplexing, would allow a transmission burst which is HARQ feedback but not a scheduling request.

263. Lenovo's riposte in its closing submissions was "The clarity of the claim cannot be improved by reference to something that the claim does not require." I infer Lenovo's intended argument from the authorities they cited.

264. An attack on the clarity of a claim generally turns on whether the skilled person would have difficulty in understanding the meaning of the claim, or at least more so than is permitted by s.14(5)(b) of the Act. In *LG Philips LCD Co. Ltd v Tatung (UK) Ltd* [2006] EWCA Civ 1774, Neuberger LJ said:

> "[20] The mere fact that a word, phrase or other provision in a patent claim is not wholly clear will not, by any means, automatically lead to the conclusion that the claim is objectionable. That would involve setting a far too high and unrealistic standard for drafting in any field; it would be particularly inappropriate to adopt such an approach to the drafting of patents, a notoriously difficult exercise in many cases. A claim needs to be as clear as the subject matter reasonably admits of."

265. Sales J referred to *LG Philips* in *Teva UK Ltd v AstraZeneca AB* [2014] EWHC 2873 (Pat) and cautioned (at [109]):

> "On the other hand, a patent defines an intellectual property right and the scope of the patentee's legally protected monopoly, and potential competitors are entitled to fair warning and a reasonable indication from the face of the patent what its scope is."

266. I have no doubt that claim 9 satisfies Neuberger LJ's requirement and Lenovo did not suggest otherwise. The skilled person would have had no difficulty in understanding what claim 9 means: the HARQ feedback is transmitted at the same time as the scheduling request. Lenovo's point, I as understand it, was that notwithstanding the clear meaning of the words, the skilled person would believe that the invention as claimed could only be implemented across a limited sub-set of its apparent scope. The skilled person would be left in doubt as whether the claim is therefore limited to that sub-set.

267. Proposed amended claim 9 covers circumstances in which the needs for HARQ feedback and a scheduling request coincide and circumstances in which they do not. Where they do not coincide, the skilled person could still implement the invention using their common general knowledge. There is no sub-set or any reason to suppose that the claim is more limited in scope than its clear words would suggest.

268. The objection of lack of clarity fails.

Added Matter

The law

269. Section 76(3)(a) of the Act prohibits any amendment which results in the specification disclosing additional matter. Aldous J set out the basic principles of the law on added matter in *Bonzel v Intervention Ltd* [1991] RPC 553, at 574:

> "The decision as to whether there was an extension of disclosure must be made on a comparison of the two documents read through the eyes of a skilled addressee. The task of the Court is threefold:
>
> (1) To ascertain through the eyes of the skilled addressee what is disclosed, both explicitly and implicitly in the application.
>
> (2) To do the same in respect of the patent as granted.
>
> (3) To compare the two disclosures and decide whether any subject matter relevant to the invention has been added whether by deletion or addition. The comparison is strict in the sense that subject matter will be added unless such matter is clearly and unambiguously disclosed in the application either explicitly or implicitly."

270. *Bonzel* was not concerned with proposed amendments. In the present case Aldous J's task (2) would read: "To do the same in respect of the patent as proposed to be amended". Kitchin J elaborated on *Bonzel* in *European Central Bank v Document Security Systems* [2007] EWHC 600 (Pat), an analysis cited with approval by Jacob LJ in *Vector v Glatt Air Techniques* [2007] EWCA Civ 805, at [7]:

> "[97] A number of points emerge from this [the *Bonzel*] formulation which have a particular bearing on the present case and merit a little elaboration. First, it requires the court to construe both the original application and specification to determine what they disclose. For this purpose the claims form part of the disclosure (s.130(3) of the Act), though clearly not everything which falls within the scope of the claims is necessarily disclosed.
>
> [98] Second, it is the court which must carry out the exercise and it must do so through the eyes of the skilled addressee. Such a person will approach the documents with the benefit of the common general knowledge.
>
> [99] Third, the two disclosures must be compared to see whether any subject matter relevant to the invention has been added. This comparison is a strict one. Subject matter will be added unless it is clearly and unambiguously disclosed in the application as filed.
>
> [100] Fourth, it is appropriate to consider what has been disclosed both expressly and implicitly. Thus the addition of a reference to that which the skilled person would take for granted does not matter: *DSM NV's Patent* [2001] RPC 25 at [195]-[202]. On the other hand, it is to be

emphasised that this is not an obviousness test. A patentee is not permitted to add matter by amendment which would have been obvious to the skilled person from the application.

[101] Fifth, the issue is whether subject matter relevant to the invention has been added. In case G1/93, *Advanced Semiconductor Products*, the Enlarged Board of Appeal of the EPO stated (at paragraph [9] of its reasons) that the idea underlying Art. 123(2) is that that an applicant should not be allowed to improve his position by adding subject matter not disclosed in the application as filed, which would give him an unwarranted advantage and could be damaging to the legal security of third parties relying on the content of the original application. At paragraph [16] it explained that whether an added feature which limits the scope of protection is contrary to Art. 123(2) must be determined from all the circumstances. If it provides a technical contribution to the subject matter of the claimed invention then it would give an unwarranted advantage to the patentee. If, on the other hand, the feature merely excludes protection for part of the subject matter of the claimed invention as covered by the application as filed, the adding of such a feature cannot reasonably be considered to give any unwarranted advantage to the applicant. Nor does it adversely affect the interests of third parties.

[102] Sixth, it is important to avoid hindsight. Care must be taken to consider the disclosure of the application through the eyes of a skilled person who has not seen the amended specification and consequently does not know what he is looking for. This is particularly important where the subject matter is said to be implicitly disclosed in the original specification."

271. Lenovo objected to the proposed amendments to claims 9 and 19 on the ground that they would constitute intermediate generalisations. Kitchin LJ (with whom Laws and Etherton LJJ agreed) explained the concept in *Nokia Corporation v IPCom GmbH & Co KG* [2012] EWCA Civ 567; [2013] R.P.C. 5:

"[56] Turning to intermediate generalisation, this occurs when a feature is taken from a specific embodiment, stripped of its context and then introduced into the claim in circumstances where it would not be apparent to the skilled person that it has any general applicability to the invention.

[57] Particular care must be taken when a claim is restricted to some but not all of the features of a preferred embodiment, as the TBA explained in decision T 0025/03 at point 3.3:

> "According to the established case law of the boards of appeal, if a claim is restricted to a preferred embodiment, it is normally not admissible under Art.123(2) EPC to extract isolated features from a set of features which have originally been disclosed in combination for that embodiment. Such kind of amendment would only be justified in the absence of any clearly recognisable

functional or structural relationship among said features (see e.g. T 1067/97, point 2.1.3)."

[58] So also, in decision T 0284/94, *Neopost/Thermal Printing Mechanism* [2000] E.P.O.R. 24, the TBA explained at points 2.1.3-2.1.5 that a careful examination is necessary to establish whether the incorporation into a claim of isolated technical features, having a literal basis of disclosure but in a specific technical context, results in a combination of technical features which is clearly derivable from the application as filed, and the technical function of which contributes to the solution of a recognisable problem. Moreover, it must be clear beyond doubt that the subject matter of the amended claim provides a complete solution to a technical problem unambiguously recognisable from the application.

[59] It follows that it is not permissible to introduce into a claim a feature taken from a specific embodiment unless the skilled person would understand that the other features of the embodiment are not necessary to carry out the claimed invention. Put another way, it must be apparent to the skilled person that the selected feature is generally applicable to the claimed invention absent the other features of that embodiment.

[60] Ultimately the key question is once again whether the amendment presents the skilled person with new information about the invention which is not directly and unambiguously apparent from the original disclosure. If it does then the amendment is not permissible."

Discussion

272. The Patent is derived from PCT Application PCT/US2007/002571 published as WO 2007/089797A2 ("WO 797"). Lenovo submitted that the application for the Patent does not disclose two matters which would be disclosed by the Patent as proposed to be amended:

(1) A method in which the transmission burst is itself indicative of a scheduling request and the burst includes other unrelated information such as a HARQ acknowledgment.

(2) A method comprising a transmission burst which is itself indicative of a scheduling request on one sub-carrier resource and which is a concurrent HARQ acknowledgment on a different sub-carrier resource, in the absence of signalling from the eNB indicating the sub-carrier resource to be used for the acknowledgment.

273. On the construction of the proposed amended claims as I have found them to be above, matter (2) does not arise.

274. With regard to matter (1), InterDigital relied on paragraph [0036] of WO 797:

"Furthermore, the NCB channel may be configured to support a combination of functions. For example, a particular WTRU 120 performing a scheduling request may also be concurrently providing measurement reporting or

> concurrently providing a synchronization burst to perform timing advance. Accordingly, any combination of these functions may be performed in a common signalling procedure. Therefore, any number of functions may be performed concurrently on a configured NCB channel."

275. This provides a general disclosure that the NCB unlink channel may be configured for a combination of uses to be performed concurrently. In an introductory passage at paragraph [0006] the reader of WO 797 is told that UEs must perform a variety of functions such as requesting uplink physical resource allocation and HARQ feedback.

276. I take the view that the skilled person would interpret the general disclosure of paragraph [0036] to include a method in which the signal comprising the scheduling request on the NCB may concurrently serve to provide the alternative function of a HARQ acknowledgment. But paragraph [0036] does not disclose that the presence of the signal is indicative of a scheduling request.

277. The latter is introduced in paragraph [0050] (the number 7 in the first line is in square brackets because paragraph [0050] says "Figure 4"; as was common ground, this should be "Figure 7"):

> "[0050] Referring back again to Figure [7], the transmitted request in step 710 of Figure 7 [the scheduling request] may be a burst transmitted by one of the WTRUs 120 on its respective NCB channel (430, 440, or 450) requesting an allocation of UL physical resources whereby the presence of the burst itself is indicative of the resource allocation request for that particular WTRU 120. Alternatively, the burst may be an indication which, for example, may only include one bit of information, such as a 'zero (0)' or a 'one (1)' that indicates whether or not a resource allocation is needed. The burst may also include information related to the resource allocation request, such as the amount of UL data the particular WTRU 120 will need to transmit, the priority of the data, the QoS, latency requirement, BLER requirement and the like."

278. The final sentence of that paragraph discloses the possibility that the transmission burst may include information related to the resource allocation request but not unrelated information, such as HARQ feedback.

279. In my opinion proposed amended claims 9 and 19 constitute intermediate generalisations. My attention was not directed to any embodiment or general teaching of the invention of WO 797 in which the combination of (a) a transmission burst which is itself indicative of a scheduling request and (b) the burst including other unrelated information such as a HARQ acknowledgment is disclosed. Feature (a) is taken from a specific embodiment disclosed in paragraph [0050] and introduced into the proposed amended claims in circumstances where it would not be apparent to the skilled person that it has any general applicability to the invention. The proposed amended claims thus present the skilled person with new information about the invention which is not directly and unambiguously apparent from the original disclosure.

280. The proposed amended claims do not satisfy s.76(3)(a) of the Act.

Lack of Support

281. It was not suggested that there is any material difference between the disclosure in WO 797 and the specification of the Patent. That being so, both sides agreed in closing that the allegation of lack of support does not arise as an independent ground of objection for the court to consider.

Essentiality

282. Lenovo submits that the invention of the Patent is not essential to Release 8 of LTE. This turns on whether LTE requires the implementation of integer 1C, which I reproduce here for convenience with the key words italicised:

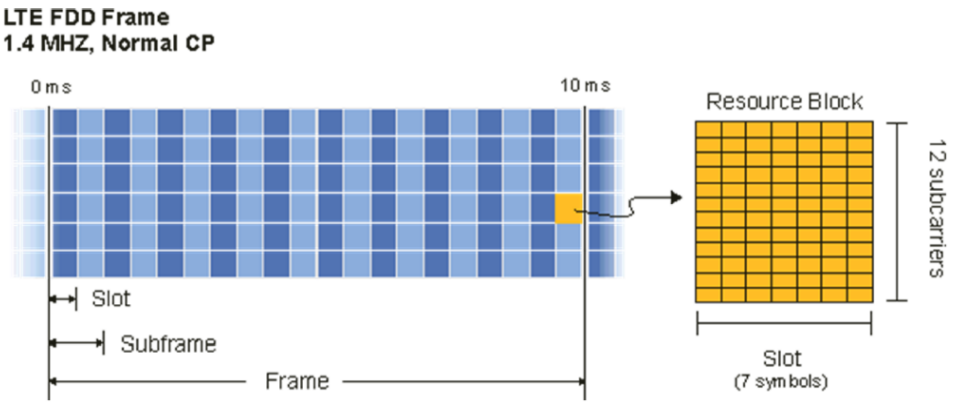
> "The first allocation comprises a configuration for transmitting scheduling requests over the NCB uplink control channel, and *the configuration* indicates a periodicity allocated to the WTRU for transmitting scheduling requests on the NCB uplink control channel and *indicates which sub-carrier resource of the NCB uplink control channel are to be used by the WTRU for transmitting the scheduling requests*;"

283. The short point is whether in an LTE network the configuration allocated by the eNB *indicates* which sub-carrier resource of the NCB uplink control channel is to be used by the UE for transmitting the scheduling requests.

How the relevant part of LTE works

284. The experts were agreed on the relevant detail of an LTE system. If a UE has data to send and does not have a current uplink data channel allocated to it, the UE transmits a scheduling request to the eNB on a channel called PUCCH (physical uplink control channel). This corresponds to the NCB uplink control channel of the Patent. The eNB allocates a unique resource to the UE on the PUCCH.

285. Dr Moss provided a helpful diagram to illustrate how this happens:



286. The allocation is by done by means of "resource blocks". The rectangle shown on the left divides available resources by time along the x-axis and by frequency along the y-axis. In the time dimension, transmissions are organised into 10ms "frames". Each frame is subdivided into 10 "sub-frames". Each sub-frame consists of 2 slots of 0.5ms. Each slot consists of 7 "symbols". In the frequency dimension, transmissions are

organised into 15 kHz sub-carriers. A diagrammatic slot is shown by the square on the right, divided into 84 resource elements (1 symbol x 1 sub-carrier).

287. Resources are allocated in units of "resource block pairs": as the name implies, two resource blocks. A resource block pair is 1ms in the time dimension and spans 180 kHz in the frequency dimension.

288. Each UE is allocated a resource block pair for sending scheduling requests on the PUCCH. More than one UE can share the same resource block pair at the same time, yet each UE requires a unique resource on the PUCCH. This is achieved by each UE using two items of information, namely a "cyclic shift" and an "orthogonal sequence index" to create a "code matrix" distinguishable from other code matrices used by other UEs sharing the same resource block pair. The UE converts its code matrix into a signal which Dr Moss called the UE's "code sequence".

289. The UE must have the means to determine its cyclic shift and orthogonal sequence index. The eNB sends to each UE a parameter called a "sr-PUCCH-ResourceIndex". It has an integer value in the range 0 to 2047 and is unique to a UE within the cell. This parameter is in fact used by the UE for two purposes: first, to determine the cyclic shift and orthogonal sequence index for creating the UE's code matrix and then code sequence and secondly, to determine the resource block pair to be used for transmitting scheduling requests.

290. The UE determines which resource blocks it will use by means of a series of mathematical formulae to calculate a value which represents to the position of the resource blocks. This value depends on (a) the sr-PUCCH-ResourceIndex and (b) five parameters sent to all UEs in the cell.

The arguments

291. It was common ground that the resource blocks to be used in LTE for sending scheduling requests correspond to the sub-carrier resource of the NCB uplink control channel of integer 1C of the Patent.

292. InterDigital argued that because the sr-PUCCH-ResourceIndex is used to calculate the value which represents the position of the resource blocks to be used in LTE, the sr-PUCCH-ResourceIndex indicates which sub-carrier resource of the NCB uplink control channel is to be used. Lenovo's position was that since the sr-PUCCH-ResourceIndex is used for this purpose only in combination with five other parameters, it does not indicate within the meaning of claim 1.

293. Neither expert said that "indicate" in this context is a term of art. The body of the Patent specification does not use either indicate or indicates in relation to the NCB uplink control channel configuration. I did not find any passages of the specification helpful as a guide to the meaning of indicates in claim 1.

294. Dr Moss supported InterDigital's interpretation in his written evidence. He had no doubt that the sr-PUCCH-ResourceIndex is "an indication" of which sub-carrier resource is to be used in LTE and took this to be the same as the sr-PUCCH-ResourceIndex indicating which is to be used. He was not challenged on this in cross-examination.

295. Prof Valenti was cross-examined. He said that sometimes the sr-PUCCH-ResourceIndex *could* indicate a subcarrier resource and was otherwise tentative in his answers regarding the correct interpretation of indicates in claim 1 and its application to LTE. More than once, instead of responding to a question directly, he said it was a matter for the court.

296. I have no doubt that Dr Moss was correct to say that the sr-PUCCH-ResourceIndex is an indication of which sub-carrier resource is to be used by the UE. I take the view that the sr-PUCCH-ResourceIndex therefore indicates which resource is to be used. It is not a unique indicator. InterDigital could have used a word such as "governs" or "determines" but chose not to. In my view the method of the LTE system falls within claim 1 of the Patent and in consequence the Patent is essential to LTE.

Infringement

297. No separate issue arose in respect of infringement. Lenovo uses LTE and therefore infringes the Patent.

Conclusion

298. The Patent is valid, essential to Release 8 of LTE and is infringed. InterDigital's conditional application to amend the Patent falls away.