IN THE HIGH COURT OF THE REPUBLIC OF SINGAPORE

[2017] SGHC 201

Suit No 55 of 2012/H

Between

1. Creative Technology Ltd
2. QMAX Communications Pte Ltd

… *Plaintiffs*

And

Huawei International Pte Ltd

… *Defendant*

Consolidated with
Suit No 606 of 2012/Z

Between

Huawei International Pte Ltd

… *Plaintiff*

And

ZiiMAX Singapore Pte Ltd

… *Defendant*

JUDGMENT

[Contract] — [Misrepresentation Act]

[Contract] — [Breach] — [Anticipatory breach]

[Contract] — [Contractual terms] — [Implied terms]

[Contract] — [Contractual terms] — [Exclusion clauses]

TABLE OF CONTENTS

INTRODUCTION **1**

BACKGROUND FACTS **2**

EVENTS LEADING UP TO THE CONTRACT 2

THE CONTRACT 6

PARAGRAPH 8 OF ANNEXURE 6 OF THE CONTRACT 7

HUAWEI'S RESPONSIBILITY FOR ITS ASSUMPTIONS AND RADIO PLANNING PARAMETERS 10

NON-CONNECTIVITY PROBLEMS SURFACING 12

TERMINATION OF THE CONTRACT 15

ALLEGED WITHOUT PREJUDICE COMMUNICATIONS **16**

MISREPRESENTATION AND/OR NEGLIGENT MISSTATEMENTS ON THE NUMBER OF RADIO SITES REQUIRED **17**

HUAWEI'S REPRESENTATIONS 17

HUAWEI'S DEFENCE 19

SUFFICIENCY OF 225 RADIO SITES NOT AN OPINION BUT A MATERIAL STATEMENT OF FACT 23

HUAWEI'S REPRESENTATION BEING FACTUALLY UNTRUE OR FALSE 29

MINIMUM RSSI AND CINR VALUES AND OTHER PLANNING ASSUMPTIONS NOT PREMISED ON ANY MUTUALLY AGREED ASSUMPTIONS 35

HUAWEI NEVER INFORMED CREATIVE OF ITS INABILITY TO MEET THE CONTRACT REQUIREMENTS DUE TO CREATIVE'S BUDGET CONSTRAINT OF US$20M 36

ENTIRE AGREEMENT CLAUSE DOES NOT EXCLUDE MISREPRESENTATION 37

SECTION 2(1) OF THE MISREPRESENTATION ACT 40

HUAWEI'S ANTICIPATORY REPUDIATORY BREACH OF CONTRACT 42

HUAWEI'S BREACH OF CONTRACT DUE TO THE INABILITY OF THE WIMAX NETWORK AS DESIGNED TO MEET THE CONTRACT REQUIREMENTS 53

COVERAGE AND DATA RATE REQUIREMENTS NOT SATISFIED WITH ONLY 225 (±10%) RADIO SITES 54

Dr Lee's calculations 56

Pandion's calculations 57

Huawei's calculations in October 2011 60

Empirical data obtained during Dr Lee's 2012 Drive Tests 61

Optimisation alone insufficient to bridge the gross underestimation in the number of radio sites required 65

Connection difficulties 72

HUAWEI'S THREE CRITICAL MISTAKES 74

Wrong morphology classification used 76

Fade margin and interference margin erroneously removed 84

Huawei Propagation Model inappropriate for the Singapore environment 87

RELIABILITY OF DR LEE'S 2012 DRIVE TEST RESULTS 93

Initial analysis of the 2012 Drive Test results 93

Re-analysis of the 2012 Drive Test Results 104

RELIABILITY OF THE SHENZHEN CONNECTIVITY TEST 108

THE MYRIAD PROPAGATION MODEL AND THE CROSSWAVE PROPAGATION MODEL 110

ELECTION TO RESCIND 118

CONCLUSION FOR SUIT NO 55 121

SUIT NO 606 122

ZIIMAX'S SUBMISSIONS 123

HUAWEI'S SUBMISSIONS 128

MY DECISION 129

COMPUTATION OF DAMAGES 133

LIMITATION OF LIABILITY AND DAMAGES UNDER ART 15 OF THE CONTRACT 133

Article 15 of the Contract 133

My decision 134

(a) Rescission of the Contract for misrepresentation 134

(b) Termination of the Contract for anticipatory repudiatory breach 136

(c) Gross negligence 139

AMOUNT THAT CREATIVE CLAIMED IN DAMAGES 151

WHETHER CREATIVE MITIGATED ITS LOSS 153

TOTAL DAMAGES CLAIMABLE BY CREATIVE 167

INDEMNITY COSTS 167

ORDERS OF THE COURT 169

Creative Technology Ltd and another
v
Huawei International Pte Ltd

[2017] SGHC 201

High Court — Suit No 55 of 2012/H consolidated with Suit No 606 of 2012/Z
Chan Seng Onn J
7-10, 14-16, 21-24 July; 30 November; 2-3 December 2015; 11, 18-19 April; 10, 12-13 October 2016; 27 July 2017

16 August 2017 Judgment reserved.

Chan Seng Onn J:

Introduction

1 In Suit No 55 ("Suit No 55"), Creative Technology Ltd ("CTL") and its wholly-owned subsidiary, QMAX Communications Pte Ltd ("QMAX") (collectively referred to as "Creative") claimed against Huawei International Pte Ltd ("Huawei") for loss and damage arising from Huawei's repudiatory breach of a contract in which Huawei was to build, design and operate a WiMAX network for Creative in the 2.3GHz spectrum ("WiMAX Network"). Prior to its acquisition by CTL sometime in February 2009, QMAX was the holder of exclusive spectrum rights for the 2.3GHz frequency band in Singapore.

2 Alternatively, Creative claimed against Huawei under s 2(1) of the Misrepresentation Act (Cap 390, 1994 Rev Ed) and under tort for Huawei's negligent misstatement. Under each of these alternative causes of action,

Creative sought the return of the sum of US$9,295,388.98 paid to Huawei under the contract. Creative also claimed damages of S$19,253,120.01 and US$22,000, being the expenses incurred by Creative for the WiMAX Network.

3 In the same Suit No 55, Huawei counterclaimed against Creative for wrongful rescission and/or termination of the contract and claimed the additional sums of US$9,649,935.86 and S$6,224.19 that Huawei would have received from Creative had the WiMAX Network been completed successfully.

4 In Suit No 606 of 2012/Z ("Suit No 606"), which was consolidated with Suit No 55, Huawei claimed against CTL's wholly-owned subsidiary, ZiiMAX Singapore Pte Ltd ("ZiiMAX") an outstanding payment of US$104,860 for indoor Customer-Premises Equipment ("CPE") purchased by and supplied to ZiiMAX under a purchase order dated 13 May 2011 ("CPE Agreement"). ZiiMAX counterclaimed against Huawei in the same Suit No 606 for the return of US$85,600 paid by ZiiMAX to Huawei for the Universal Serial Bus ("USB") dongles supplied by Huawei to ZiiMAX under a purchase order dated 28 April 2011 ("USB Agreement"). ZiiMAX had intended to use the CPE and USB dongles with the WiMAX Network to be operated by QMAX.

Background facts

Events leading up to the Contract

5 In early 2009, Creative explored the possibility of engaging Huawei to construct a WiMAX Network to provide mobile data services using WiMAX technology after Creative's representatives PW1 Koh Zi Kai ("PW1-Koh") and PW3 Lian Yam Fei ("PW3-Lian") had met up with Huawei's sales representative DW1 Leong Yu Ming ("DW1-Leong") at a WiMAX Forum Congress Asia held in Singapore in April 2009 at which Huawei's

representatives presented a paper titled "Build a Successful WIMAX Network" that would entail a "quick and low cost WiMAX deployment". On 15 May 2009, PW1-Koh followed up with an email requesting Huawei for more information including its presentation materials, an "Information Template" that Huawei would require its customers to provide, a "Sample RFI/RFP [*ie*, Request for Information/Request for Proposal]" and a Network Diagram.

6 It is unclear to me whether Huawei had sent the information that Creative had requested. However, on 17 June 2009, Creative wrote a brief letter inviting its potential vendor, Huawei, to submit a proposal for the "design, build, maintenance and operation of a 2.3 GHz WiMAX" and requested detailed information to be furnished on Huawei's WiMAX proposal including the "Estimated number of sites needed to cover Singapore (Military areas, cemeteries & large bodies of water are to be excluded from the planned coverage)" ("nationwide coverage") with the estimate to be minimally "accurate up to ±10%". By way of an email dated 1 July 2009, PW1-Koh asked Huawei to plan for a target data-rate requirement of 1 Megabits per second ("Mbps") for the Down Link ("DL") and 256 kilobits per second ("kbps") for the Up Link ("UL") at the cell edge. According to PW1-Koh,[1] Creative had also made clear from the outset that it wanted the proposed WiMAX Network to have nationwide coverage with first wall penetration. This was corroborated by DW1-Leong[2] during his cross-examination.

7 Thereafter, Huawei submitted various wireless network planning proposals to Creative with different numbers of radio sites based on different network equipment, antenna configurations and end-user devices. In these

[1] Day 2, Page 64 lines 16 to 19.

[2] Day 4, Page 247 lines 8 to 16.

proposals, the number of radio sites ranged from 184 to 360 radio sites to cover a total area of 256.93km^2 identified by Huawei to be the area of nationwide coverage required by Creative. Huawei divided the nationwide coverage area into three different clutters: "Dense Urban", "Urban" and "Suburban".

8 The proposal for 184 radio sites was premised on a two-way antenna transmitting and receiving configuration (with two transmitters and two receivers, *ie*, 2T2R) using a mix of USB dongles and CPEs as end-user devices. The proposal for 360 radio sites was for a 2T2R antenna configuration using only USB dongles.

9 In an email dated 28 July 2009, Huawei informed Creative that the cost of equipping a typical radio site would be between US$79,715 to US$89,610. Hence, if the WiMAX Network required more radio sites, the total project cost would accordingly increase. In August 2009, Creative requested for a revised proposal using a four-way antenna transmitting and receiving configuration (with four transmitters and four receivers, *ie*, 4T4R) instead. At a presentation on 18 August 2009, Huawei informed Creative that 256 radio sites would be required for this configuration in order to support 300,000 subscribers using only USB dongles.

10 After PW1-Koh and PW3-Lian notified DW1-Leong and Huawei's Vice-President of Solutions and Sale Support, An Jian, at a meeting on 28 October 2009 that Creative's budget was US$20m, DW1-Leong sent an email dated 30 October 2009 to PW1-Koh stating that Huawei was able to provide the WiMAX Network based on 220 radio sites, which was lower than Creative's budget expectation.

11 Finally, in its WiMAX Network Planning Proposal dated 25 January 2010, Huawei provided a detailed link budget calculation explaining the radio frequency parameters it had chosen for the penetration loss (inclusive of first wall penetration) for its three different clutters under Dense Urban (*ie*, a loss of 20dBm), Urban (*ie*, a loss of 15dBm) and Suburban (*ie*, a loss of 10dBm) including the radio frequency parameters for the USB dongle as the end device ("the Link Budget"). In the proposal, Huawei also explained how it arrived at the coverage planning result that 225 radio sites would be required based on a 4T4R configuration using only USB dongles with 0dBi antenna gain as the end-user device and with the data-rates at the cell edge of 1Mbps for the DL and 256kbps for the UL. The estimated total cost for the equipment, design, engineering and installation of the whole WiMAX Network was US$17.7m (based on US$78,680.92 per radio site multiplied by 225), which would be well within Creative's budget.

12 Clearly, the changes in the number of radio sites from 256 down to 220 and finally to 225 were made *after* Creative had informed Huawei that Creative's budget for the WiMAX Network project was US$20m. There is no evidence before me that Creative was ever cautioned that Creative's budget of US$20m constrained them to a "lower quality network" or to one that would not have met the requirements of Creative. Instead, the evidence of DW1-Leong[3] and Huawei's Account Manager Cao Dan Bo ("DW2-Cao")[4] was that 225 radio sites would suffice to meet Creative's requirements.

13 I note that in the introduction to the WiMAX Network Planning Proposal to Creative, Huawei claimed that it "has already deployed WIMAX, CDMA,

[3] Day 4, Page 209 line 13 to Page 210 line 14, Day 5, Page 163 lines 2 to 9.

[4] Day 6, Page 29 lines 15 to 22, Page 34 lines 12 to 23.

UMTS and GSM commercial networks around the world and accumulated plenty of networks planning experience through theoretic research and project implementation". Huawei stated very impressively that it had "over 2000 engineers and experts specializing in radio network planning and optimization".

14 From January to June 2010, Huawei continued to represent in its various correspondence and documents that 225 radio sites were sufficient to meet Creative's requirements. Amongst the documents were (a) the "WiMAX 16e Wireless Network Planning Proposal For Singpore [*sic*] Creative Project" dated 25 January 2010; (b) the "WiMAX Technical Proposal for QMC Technology WiMAX Project" dated 25 January 2010; (c) the "RNP Solution for Creative" dated 25 January 2010; (d) the revised "High Level Requirement Response" ("HLRR") from Huawei dated 19 March 2010; (e) Huawei's document titled "RNP Solution for Wise Port"; (f) DW1-Leong's email dated 2 April 2010 to PW1-Koh; (g) Huawei's radio planner Zou Yicai ("DW5-Zou")'s email dated 5 April 2010 to PW1-Koh; and (h) all subsequent updated versions of the HLRRs from Huawei leading up to the date of signing of the contract.

The Contract

15 On 28 June 2010, Creative and Huawei executed the "SUPPLY CONTRACT FOR THE WIRELESS BROADBAND NETWORK (WIMAX INFRASTRUCTURE) SOLUTION" (the "Contract"). The total Contract Price (exclusive of GST) was US$19,900,916. The finalised version of the HLRR document was annexed and incorporated as Annexure 6 to the Contract.

Paragraph 8 of Annexure 6 of the Contract

16 Paragraph 8 of Annexure 6 of the Contract is central to this dispute and it states as follows:

8 Radio Access Network:

a. *225 radio sites will be sufficient* to provide Nationwide coverage for Singapore with first wall penetration, based on a *measurement criteria of ≥ -85dBm RSSI* [Received Signal Strength Indicator] Signal Strength and CINR [Carrier to Interference and Noise Ratio] of 3dBm. Military areas, cemeteries & large bodies of in-land water can be excluded from the planned initial coverage.

[Huawei's response]: *Comply.*

Based on Huawei WIMAX radio network planning, the coverage criterion for each scenario is:

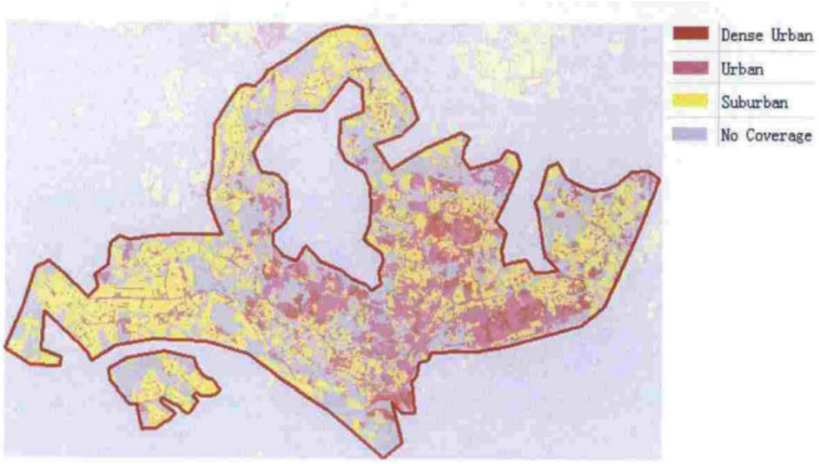

Figure 2 WiMAX Radio Network Coverage

1) *Dense urban: RSSI >=-85.76dBm & CINR >=3dB with 90% area coverage probability*;

2) *Urban: RSSI>-85.76dBm & CINR>=3dB with 90% area coverage probability*;

3) *Suburban: RSSI>=-87.53dBm & CINR>=3dB with 90% area coverage probability*

The radio network planning parameters are shown in the following table:

Coverage Planning	Dense Urban	Urban	SubUrban
Terminal	USB Dongle	USB Dongle	USB Dongle
Target Coverage Area(km^2)	**11.03**	**94.41**	**151.49**
Coverage Radius(km)	0.34	0.58	1.52
Coverage Area per site (km^2)	0.23	0.66	4.50
Site No. for each Scenario	48	143	34
Total Site No.		**225**	

Table 4: Radio Network Planning Parameters

From the above table, we can see the *planning area is* 11.03+94.41+151.49 = *257 km^2, Huawei can achieve 90% street level coverage with first wall penetration for the planned area.*

Drive test will be used to validate RSSI & CINR in coverage zone, the selected test route should be mutually selected and decided. *The test terminal will be placed on the roof of vehicle.* Considering the indoor penetration loss, the drive test pass criterion is:

1) *For dense urban, RSSI>=-67.76dBm* & CINR>=3dB with 90% area coverage probability;

2) *For urban, RSSI>=-70.76dBm* & CINR>=3dB with 90% area coverage probability;

3) For *suburban, RSSI>=-77.53dBm* & CINR>=3dB with 90% area coverage probability.

For wise port, the terminal is outdoor CPE (26dBm transmission power & 6dBi antenna gain), so coverage criterion for wise port is RSSI>=-95dBm & CINR>=3dB with 90% area coverage probability.

b. *Coverage is further defined as a standard USB dongle with 0dBi antenna gain* having QPSK [Quadrature Phase Shift Keying] ½ modulation for both DL [Download or Down Link] and UL [Upload or Up Link].

[Huawei's response]: *Comply*

Huawei RNP simulate based on USB dongle.

c. *Cell-edge committed data-rate is 1Mbps DL and 256 kbps UL.*

[Huawei's response]: *Comply*

[emphasis added]

17 It was not disputed that there would be a ±10% margin in the required number of radio sites notwithstanding the wording of para 8 of Annexure 6 above.

18 It is important to note that the contract requirements found in paras 8(a), 8(b) and 8(c) in Annexure 6 of the Contract (see [16] above) ("Contract Requirements") are *conjunctive* requirements. Huawei did not dispute this. Thus a failure or an inability of the WiMAX Network as designed to meet any one of these three requirements is in itself sufficient to constitute a breach in the performance of the Contract or an inability to deliver under the Contract.

19 In other words, end users within the nationwide coverage area (behind no more than one wall) should have had a 90% probability of enjoying:

(a) RSSI ≥-85.76dBm and CINR ≥3dB, under para 8(a);

(b) Connection to a 0dBi gain USB dongle, under para 8(b); *and*

(c) A data-rate of 1Mbps (DL) and 256kbps (UL), under para 8(c) of the Contract.

20 If there was no connection with a 0dBi gain USB dongle after first wall penetration, then the RSSI and CINR values required at that location would have to be increased beyond the minimum stated in para 8(a) to provide the necessary connection. Even if there was connection but the stipulated minimum data-rate on either the DL or the UL was not achieved, the RSSI and CINR values would have to be increased even further beyond the minimum stated in para 8(a) for that location. Merely achieving the minimum RSSI and CINR values at the location was insufficient if there was no connection or if the requisite data rates were not obtained with a 90% degree of probability after first wall penetration.

Huawei's responsibility for its assumptions and radio planning parameters

21 It would appear that Huawei (especially some of its witnesses) tried to adopt the position that Huawei should be exonerated for any errors made in the various planning parameters and assumptions used in the course of its radio planning because the planning parameters (including, *inter alia*, the RSSI and CINR values of ≥-85dBm and 3dB respectively, the three morphology classifications used and the total area under each morphology classification) and the assumptions adopted by Huawei's radio planners were agreed to by Creative and thereafter incorporated into the Contract.

22 I believe that Huawei abandoned this position in its submissions as it is plainly not tenable. It is clear from the evidence that Huawei was the designer and builder of the turnkey WiMAX Network project for Creative. Therefore Huawei had to be responsible for the correctness of all the planning parameters and assumptions used by its radio planners in designing and building a WiMAX Network that was to meet Creative's requirements. Creative engaged Huawei to provide a turnkey solution precisely because Creative had limited experience and expertise in radio network planning and in designing and setting up a WiMAX Network.

23 Huawei was fully cognisant of Creative's requirement for Huawei to provide a turnkey solution. This is reflected (a) in Huawei's Letter of Intent template sent to Creative on 4 August 2009 where it was stated that "Both Parties hereby agree that the project will be implemented by Huawei as *Turnkey Project*…" [emphasis added]; and (b) in both the 29 December 2009 HLRR and the final signed draft of the HLRR, where one of the stated requirements was that "As this is a *full-turnkey project*, all costs are to be included in the proposal with the exception of site rental, local loop, international backhaul, spectrum

and power." [emphasis added]; and where Huawei's response to this requirement in the final signed draft was "*Comply*. As this is a *full-turn key project*, all costs are to be included in the proposal with the exception of …" [emphasis added].

24 DW1-Leong conceded[5] that the specific details needed to design the WiMAX Network to meet the HLRR were left entirely to the expert network designer from Huawei. The WiMAX Network design plans and calculations were prepared by Huawei's radio planners and presented to Creative more for Creative's information than with any expectation or intention that Creative was to check the correctness of Huawei's design planning parameters, assumptions or its design calculations. DW1-Leong eventually conceded[6] that if Huawei's radio planners made a mistake in any of their planning parameters and assumptions or design calculations, the fault would lie with Huawei and not its customers. This was also conceded by DW5-Zou,[7] who was Huawei's radio network planner during the pre-contract stage. DW5-Zou accepted that radio planning was Huawei's responsibility and not the customer's.

25 Clearly, the common understanding must have been that Huawei was the expert on the design of the WiMAX Network and Creative, as the customer, would rely on and trust Huawei to provide a viable technical design for the turnkey project. Huawei had marketed itself as having vast experience in radio network planning and in deploying similar WiMAX networks in many other countries whereas Creative was a greenfield operator with no radio planning

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[5] Day 4, Page 117 lines 15 to 22, Page 214 line 3 to Page 215 line 13, Page 215 line 23 to Page 216 line 3, Page 223 line 19 to Page 224 line 9, Page 225 line 11 to Page 226 line 14, Page 231 line 20 to Page 233 line 17 and Page 234 lines 10 to 17.

[6] Day 4, Page 205 lines 15 to 25.

[7] Day 11, Page 125 lines 23 to 25.

tools or experience in this area. Relying on Huawei's vast experience, Creative simply accepted the correctness of the following information furnished by Huawei: (a) the types of morphology to be used and the coverage area for each type of morphology; (b) the number of radio sites to fulfil Creative's requirement for nationwide coverage with first wall penetration at 90% probability; and (c) the minimal RSSI and CINR values for a 0dBi antenna gain USB dongle to achieve a connection after first wall penetration with at least a data-rate of 1Mbps on the DL and 256kbps on the UL. Creative was in no position (both before and at the time of the Contract) to assert that any of the technical information provided by Huawei (that was later incorporated into the Contract) was or could be wrong.

Non-connectivity problems surfacing

26 About a year into the execution of the contract, a serious lack of connectivity was observed between the Huawei-supplied USB dongles and the WiMAX Network that was being set up by Huawei. About 123 radio sites had been installed as of mid-August 2011. Creative conducted its own static tests and found that the USB dongles were not able to consistently connect with the WiMAX Network even at areas where the radio signals met the criteria stipulated in the Contract for RSSI of -85dBm (for Urban areas) and -87dBm (for Suburban areas), and CINR greater than 3dBm. On 22 August 2011, Creative's representative, Foo Tuan Gee ("PW2-Foo"), surfaced these connectivity issues to Huawei. At a meeting on 12 September 2011, Huawei informed Creative that it would "identify 20 locations to test out the connection of the dongle at the RSSI -85 and CINR >3".

27 At the meeting on 16 September 2011, Huawei's radio optimiser Muhammed Adel ("Adel") presented test results only for 11 test locations to

Creative despite agreeing to do connection tests for 20 locations. I infer that Huawei did not find it necessary to carry tests for a further nine locations because it was satisfied that the results from the 11 test locations would already be sufficient for them to form a reasonable conclusion. Adel's test results[8] showed that the USB dongle failed to access the webpage at six of the 11 locations, which was substantially below the Contract Requirement of 90% probability. Given these results, Huawei confirmed that "based on the test performed, for RSSI at 85db and CINR at 3db, it [could not] get connection and access." In cross-examination, DW1-Leong confirmed this position:[9]

> MR YIM: …*Do you agree, since you were at the meeting on 16 September, that Adel, your optimiser, had confirmed that at the RSSI contract values and CINR contract values, they couldn't get connection and access?*
>
> A: *Yes.*
>
> COURT: *So both sides agree on that? Basically you confirmed QMAX's position.*
>
> MR YIM: *Yes.*
>
> COURT: On a technical matter you confirmed QMAX's position, this is on a technical matter, at 85 and 3 dB – never mind about the morphology, it just simply cannot connect?
>
> A: Yes, and the – I was proposing the team to do further investigation. That is my next plan – so I would say, yes, I aware of these things, the –
>
> [emphasis added]

28 Based on the results obtained, Creative told Huawei at this meeting that its classification of "Urban, suburban and dense region" was "questionable" and that it should perform a review of its morphology classification. Huawei eventually agreed to Creative's request to review both the RSSI values as well

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[8] PCB 304.

[9] XXN of DW1-Leong Yu Ming, Day 5 Page 44 line 21 to Page 45 line 11.

as Huawei's morphology classification. Towards the end of the meeting, Huawei's technical director Sheng Lei reassured Creative that a new radio planner Zhang Zhixin ("DW4-Zhang") would be heading the WiMAX Network project team, and DW4-Zhang would review "all the sites deployment and coverage issues" to which Creative responded that the new radio planner should return with "an urgent and concrete plan to advise QMAX on for [*sic*] the whole network optimization, and to advise QMAX on how many additional sites is needed to enhance the coverage".[10]

29 Given the context of that meeting, I conclude that it was not a request from Creative to Huawei to change Creative's original requirements for the WiMAX Network as per the Contract to a different 3G network or to another better network with an increased or enhanced area or probability of coverage. Creative simply wanted to know how many additional sites were needed to secure connectivity to the network according to the Contract Requirements. They were not asking for any "new requirement" as contended by Huawei. This was confirmed in cross-examination by Francis Ng Chee Wei ("DW7-Ng"), Huawei's senior project manager in charge of the WiMAX project from April 2011 until its termination in December 2011.[11] This was similarly made clear by DW1-Leong.[12]

30 Despite the ample time and opportunity given and even after several meetings, Huawei could not demonstrate to Creative that the USB dongle could consistently connect to the WiMAX Network at the RSSI value of -85.76dBm

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[10] PCB 314.

[11] XXN of DW7-Ng Chee Wei, Day 13 Page 66 lines 6 to 25.

[12] XXN of W1-Leong Yu Ming, Day 5, Page 57 lines 4 to 24; Day 5, Page 59 line 22 to Page 60 line 8.

for Dense Urban and Urban areas, and -87.53dBm for Suburban areas as per the Contract Requirements and that there was no need to increase the number of radio sites over and above that stipulated in the Contract Requirements.

31 Huawei then came out with revised and higher minimum threshold values of RSSI ≥-80dBm and CINR ≥8dBm for 90% coverage for Creative's consideration, on the purported basis that Creative had requested for a WiMAX Network with "new requirements". According to Huawei, these changes would necessitate an additional 619 radio sites, which brought the total number of radio sites to around 855. This meant that the original budget of US$20m that Creative had allocated for the WiMAX Network project based on the Contract, which stipulated a requirement of only 225 (±10%) radio sites, would be far exceeded. Creative found the proposal unacceptable if that was to be the technical solution to the connectivity issue, as it would have resulted in significantly increased capital and operating costs for Creative, leaving aside a longer implementation time. Other proposals from Huawei to address the connectivity issue all required additional radio sites far in excess of that stipulated in the Contract, with similar adverse financial and commercial consequences for Creative.

Termination of the Contract

32 Creative decided to terminate the Contract on 29 December 2011 pursuant to Art 13.1 of the Contract for material breaches by Huawei, and alternatively, pursuant to Art 13.2 of the Contract for Huawei's failure to meet the Contract Requirements (see also [16]). On 20 January 2012, Creative gave further written notice that, in the alternative, Creative was rescinding the Contract on account of Huawei's misrepresentations. At this stage, Huawei had completed building 175 "base stations" (to be used interchangeably with "radio sites").

Alleged without prejudice communications

33 Huawei submitted that whether the four meetings on 13 October, 9 November, 9 December and 14 December 2011 (the "four meetings") were "without prejudice" meetings was a "live issue" at the trial.

34 On 10 July 2013, Huawei filed an application (see Summons No 3536 of 2013) to strike out certain paragraphs of the statement of claim on the basis that the four meetings were held on a "without prejudice" basis. The Senior Assistant Registrar examined holistically the relevant facts and circumstances in some detail and then specifically found that none of the four meetings were covered by "without prejudice" privilege. The Senior Assistant Registrar found that Creative's representatives attended the four meetings in order to find operational or technical solutions to the connectivity problems with the WiMAX Network. They did not attend these four meetings with the mind-set to resolve a dispute and enter into without prejudice negotiations. Accordingly, the Senior Assistant Registrar dismissed Huawei's application. Huawei appealed but decided to withdraw its appeal at the hearing of the appeal before me on 25 October 2013. I granted Huawei leave to withdraw the appeal. In my view, there was no such "live issue" before me at the trial. Huawei is estopped from raising this same issue again.

35 In any event, I agree with the finding of the Senior Assistant Registrar that the four meetings were essentially to explore technical solutions to the connectivity problems raised by Creative to Huawei in an on-going project and were not "without prejudice" negotiations to reach a settlement on a dispute between the parties.

36 The minutes of these four meetings were admitted as evidence before the court and Creative was entitled to rely on them.

Misrepresentation and/or negligent misstatements on the number of radio sites required

Huawei's representations

37 There is ample documentary evidence to show that in the months leading to the signing of the Contract in June 2010, Huawei had consistently represented to Creative that 225 (±10%) base stations would be capable of meeting Creative's requirement for a nationwide WiMAX Network (excluding military areas, cemeteries and in-land bodies of water) with first wall penetration, 90% area coverage probability, connection with a USB dongle with 0dBi gain and QPSK ½ modulation, and a data rate of 1Mbps on the DL and 256kbps on the UL, all of which eventually became part of the Contract Requirements as can be seen at [16] above. I find that these representations of fact were made and had induced Creative to sign the Contract on 28 June 2010. Huawei had computed the total coverage area to be 256.93km^2. Huawei adopted "Penetration Loss" of 20dBm for Dense Urban, 15dBm for Urban and 10dBm for Suburban areas, which would have taken into account the loss of signal strength for first wall penetration in its network planning modelling and calculations.

38 In an email dated 27 January 2010, DW1-Leong sent to Creative a copy of a revised HLRR which clearly stated that 225 base stations would be required for Singapore nationwide coverage with first wall penetration, with data speeds of 1Mbps for the DL and 256kbps for the UL, and with military areas, cemeteries and large bodies of in-land water excluded. I reproduce para 8 of the 27 January 2010 HLRR below:

> 8. Radio Access Network:
>
> a. 222 radio sites, with 666 sectors (±10%) will be sufficient to provide Nationwide coverage for Singapore with first wall penetration.
>
> *[Huawei's response]: Comply*
>
> *For Singapore Nationwide coverage require 225 Base station exclude military areas, cemeteries and large bodies of in-land water.* The RNP [Radio Network Planning] also include the Wiseport project and detailed proposed site location, Huawei analysis on the port coverage solution and recommendations as detailed in the Annex "RNP Solution for QMC Wiseport" also refer to "RNP proposal" for entire wireless radio network planning and solution for QMC.
>
> …
>
> c. Cell-edge committed data-rate is 1Mbps DL and 256kbps UL.
>
> *[Huawei's response]: Comply*
>
> …
>
> g. Military areas, cemeteries & large bodies of in-land water can be excluded from the planned coverage.
>
> *[Huawei's response]: Comply*
>
> *Huawei Proposed Radio network planning for Singapore nationwide deployment excluded Military areas, cemeteries & large bodies of in-land water.* Please refer to "RNP Proposal" for more detail information.
>
> [emphasis added]

39 In Creative's HLRR dated 30 March 2010, Huawei responded that it would "Comply" with each of the following requirements:

> (a) "225 radio sites will be sufficient to provide Nationwide coverage for Singapore with first wall penetration, based on a measurement criteria of ≥-85dBm RSSI Signal Strength and CINR of 3dBm. Military areas, cemeteries & large bodies of in-land water can be excluded from the planned initial coverage".

(b) "Cell-edge committed data-rate is 1 Mbps DL and 256 kbps UL".

40 In subsequent versions of the HLRR leading up to the signing of the Contract, the above requirements remained unchanged, and Huawei continued to maintain that it would and therefore could "Comply". If Huawei could not possibly comply because it was technically impossible to do so, then Huawei should not have responded with the word "Comply". It should have clearly stated otherwise and then indicated the actual number of radio sites that would enable Huawei to meet the connectivity and data-rate requirements stipulated in the HLRR.

41 DW1-Leong and DW2-Cao, who were Huawei's representatives for Creative's WiMAX Network project, admitted during their cross-examination that they had understood that Creative's Contract Requirements were consistently for a WiMAX Network with nationwide coverage, excluding military areas, cemeteries and large bodies of in-land water and a cell edge committed data rate of 1Mbps for the DL and 256kbps for the UL.

Huawei's defence

42 Huawei did not dispute that the representations were made that 225 sites would be sufficient to provide nationwide coverage as per the HLRR, but said that they did not amount to a statement of fact (whether past or present). Instead, these statements were promises of what Huawei would or intended to do in the future. They were therefore not actionable as a misrepresentation, citing *The Law of Contract in Singapore* (Andrew Phang gen ed) (Academy Publishing, 2012) ("*The Law of Contract in Singapore*") at paras 11.026 and 11.029; *Treitel, The Law of Contract* (Edwin Peel gen ed) (Sweet & Maxwell, 13th Ed, 2011)

at paras 9-001 and 9-009; and the Court of Appeal decision in *Tan Chin Seng v Raffles Town Club Pte Ltd* [2003] 3 SLR(R) 307 ("*RTC*") at [20]-[21].

43 I accept Huawei's submission that Creative cannot seek to convert a contractual promise into a misrepresentation of present fact. But the main question is whether the misrepresentation that Creative alleges that is actionable is a statement of fact: that Huawei's technical analysis of the Contract Requirements demonstrates that 225 radio sites are technically sufficient to provide for nationwide coverage at the data DL and UL rates required by Creative. If Huawei had failed to correctly perform the technical radio planning modelling and calculations and is subsequently shown to have made a gross error in the computation of the number of radio sites required, due perhaps to certain wrong technical assumptions and input parameters being used as part of the complex calculations in the modelling exercise performed by Huawei, resulting in a wrong and grossly underestimated figure represented to Creative for the actual number of radio sites being technically required for the nationwide coverage at the stipulated data DL and UL rates, is that a misrepresentation of an existing fact? The existing fact is broadly a technical fact that is to be established through existing and available scientific wave propagation analysis and modelling: either the technical fact is that 225 stations will be *sufficient* to provide the necessary coverage, or the technical fact is that 225 stations will be *insufficient* to provide the necessary coverage.

44 A simple analogy may help. Suppose a representation is made by Huawei that 2 x 3 will be 5 (perhaps due to its mathematical incompetence or negligence). But the true and existing mathematical fact we all know is that 2 x 3 will be 6. I would think that the representation of Huawei that 2 x 3 will be 5 is not a failed contractual promise but a misrepresentation of an everlasting mathematical fact that 2 x 3 will be 6. This misrepresentation that 2 x 3 will be

5 has nothing to do with any statement of intention of Huawei as to its future performance or otherwise. It is simply Huawei's misstatement of a true and pre-existing mathematical (or technical) fact.

45 Therefore, the point is *not* that Huawei had promised to build 225 radio sites as a contractual term and *not* that it did not fulfil its contractual obligation to build all the 225 radio sites, which is then only a breach of a contractual promise of future performance to build these 225 radio sites; which promise, if unfulfilled, does not amount to an actionable misrepresentation. Huawei was alleged to have miscalculated the number of radio sites that would be technically sufficient to provide nationwide coverage for Singapore based on the correct existing scientific principles governing wave propagation and loss across different existing physical morphology types after first wall penetration in Singapore, and therefore Huawei had misrepresented a present fact that 225 radio sites would be technically sufficient to provide nationwide coverage for Singapore that would satisfy the Contract Requirements.

46 The English High Court in *Esso Petroleum Co Ltd v Mardon* [1975] 2 WLR 147 held that Esso Petroleum was liable in negligence for its pre-contractual statement made to and relied on by Mardon, a prospective tenant for a petrol station, that the *potential* throughput by the third year of operation based on Esso's expertise and calculations was 200,000 gallons of petrol (which Esso had forgotten to revise downwards to account for the local council's refusal to allow the pumps to front the busy main street and therefore the station had to be built back to front) was a statement of an existing fact (per Lawson J at 150) and not a mere expression of opinion (per Lawson J at 151):

> I further find that the 1963 forecast expressly or by implication contained a statement of fact, namely as to the then potential of the site, and that that was not a mere expression of opinion as to what throughput the site might in fact achieve in the

> future. I further find that that statement of fact was incorrect. Put another way, in 1963 I find that the Eastbank Street site had not a potential throughput of 200,000 gallons in the third year or foreseeably in any year after the third year of tenancy. The incorrectness of that statement was attributable to the physical conditions of the site, its layout and siting, which were such as to fail in substance to attract the attention of passing as opposed to local traffic, and it was plain that, without a substantial contribution from passing traffic, the forecast throughput was unattainable.
>
> …
>
> [T]he relevant statement was not a mere expression of opinion.

47 In the appeal to the English Court of Appeal in *Esso Petroleum Co Ltd v Mardon* [1976] 1 QB 801 (at 824), Ormrod LJ agreed with Lawson J that Esso's assessment of the site's potential amounted to a statement of fact. Shaw LJ (at 831-832) opined that Esso had both the available information and a wealth of experience as compared to Mardon from which Esso was expected to be able to provide a sound, trustworthy and authoritative estimate of the potential capacity of a given petrol station, which persons minded to enter into a business relationship with Esso could place reliance on.

48 An expression of an opinion based on facts known to one party but not the other may imply or involve a statement of a material fact. In *Smith v Land and House Property Corporation* (1884) 28 Ch.D. 7, the seller of a property represented to a potential buyer at an auction sale that the existing tenant was "a very desirable tenant", when in fact the tenant had not been paying his rent regularly and owed rent to the seller. The buyer sought to avoid specific performance of the contract brought by the seller on the basis of a false representation. The seller argued that his representation was merely an expression of opinion. However, Baggallay LJ (at 13) upheld on appeal the conclusion of Mr Justice Denman that there was a material misrepresentation because the seller ought to have known perfectly well that the tenant did not pay

his rent properly, and was not justified to describe the tenant as very desirable. Bowen LJ in addressing the question whether there was a misrepresentation of a specific fact (at 15) observed that:

> …it is often fallaciously assumed that a statement of opinion cannot involve the statement of fact. In a case where the facts are equally well known to both parties, what one of them says to the other is frequently nothing but an expression of opinion. The statement of such opinion is in a sense a statement of a fact about the condition of the man's own mind, but only of an irrelevant fact, for it is of no consequence what the opinion is. *But if the facts are not equally known to both sides, then a statement of opinion by the one who knows the facts best involves very often a statement of a material fact, for he impliedly states that he knows facts which justify his opinion.*
>
> …
>
> The vendors state that the property is let to a most desirable tenant, what does that mean? I agree that it is not a guarantee that the tenant will go on paying his rent, but it is to my mind a guarantee of a different sort, and amounts at least to an assertion that nothing has occurred in the relations between the landlords and the tenant which can be considered to make the tenant an unsatisfactory one. That is an assertion of a specific fact.
>
> [emphasis added]

Sufficiency of 225 radio sites not an opinion but a material statement of fact

49 On the facts of this case, Huawei's contention that its representation that 225 radio sites would be sufficient was merely an expression of opinion is untenable. I find that the correspondence between the parties shows that Huawei intended its representation to be a statement of fact. It had used the definitive word "Comply" not to express any opinion, but to assert a fact based on its expert knowledge on WiMAX Network design in answer to the technical requirement under para 8(a) of Huawei's final HLRR dated 28 June 2010 (Annexure 6 to the Contract) that "225 radio sites will be sufficient to provide Nationwide coverage". Clearly, Huawei knew that Creative was relying on Huawei, given its specialised expertise and knowledge on WiMAX networks

and radio wave propagation under different physical morphological conditions, to perform with reasonable skill and care its theoretical wave propagation calculations and modelling with appropriate input parameters and technical correction factors in order to furnish a fairly accurate and reliable factual answer to that technical question – essentially on whether it was technically achievable to have WiMAX nationwide coverage (with certain areas excepted) for the kind of morphological conditions in Singapore with 225 radio sites under the conditions stated in the HLRR and with the kind of equipment that Huawei was going to use. In contrast, Creative had no experience in designing and building wireless networks, except for a coastal project with only six radio sites, and was thus completely reliant on Huawei to deliver a "turnkey project". Creative's lack of experience is demonstrated by the fact that it even had to seek Huawei's advice on how to prepare a "Request for Proposal" document to enable Creative to seek product and technical specifications on WiMAX networks from potential WiMAX vendors.

50 As to whether the statement of fact was material, it cannot be seriously disputed that given the budgetary constraint for the project which Creative had set at US$20m, the total number of radio sites was a crucial consideration for the financial and commercial viability of the WiMAX Network as the project cost would escalate if the number of radio sites were to increase significantly for nationwide coverage to be technically achieved at the specified data rates.

51 I agree with Creative's submission that Huawei's representation that the sufficiency of 225 radio sites would obviously and vitally affect the WiMAX Network that Huawei was designing for Creative. It cannot be seriously disputed that Huawei, as a telecommunications vendor of "standing and repute", had skills, knowledge and experience far superior to that of Creative (who was merely a purchaser of the WiMAX Network) in the field WiMAX technology

and network planning, and that Creative would therefore have substantial and reasonable grounds to rely on Huawei to provide an estimate, with a fair degree of accuracy, on the number of radio sites required for the WiMAX Network desired by Creative based on the network planning technical modelling tools at Huawei's disposal and the skills, knowledge and experience that Huawei had.

52 It is clear to me that there was *no factual basis* for classifying HDB estates as "Suburban" given the general density and typical heights of the blocks of flats in HDB estates in Singapore and this seriously distorted the input morphology parameters for the radio planning and modelling tool used by Huawei. With erroneous inputs, obviously the output from the modelling tool would be wrong. The familiar phrase "garbage in, garbage out" naturally applies as the accuracy of the output from the computational tool depends on what information is fed into the tool. The output essentially arises from a complex computation using a radio planning computerised tool which needs to be fed with certain factual input parameters and certain other numerical parameters based on the knowledge and skills of an experienced radio planner. The erroneous input morphology parameters for HDB estates in my view explains in part the gross underestimation of the total number of radio sites required. I do not believe that the mistake in the input parameters was intentionally made. It is more likely than not due either to carelessness or the lack of experience of Huawei's radio planners with the actual physical morphology of Singapore when the various radio planning exercises were done by Huawei during the period leading up to the finalisation of the technical design specifications and eventual signing of the Contract.

53 On the totality of the evidence, I find that Huawei's estimate of 225 radio sites amounts to a material statement of fact that 225 radio sites is a fairly accurate estimate of the number of radio sites that can be relied upon to meet

the required coverage, connectivity and data rates stipulated in the Contract. This is because Huawei, being in essence the specialist in this field, is obviously in a trusted position to provide reliable and fairly accurate estimates in its radio planning for its clients. I further find that Huawei's representation of 225 radio sites being technically sufficient had played a real and substantial part in inducing Creative to enter into the Contract to its detriment.

54 Huawei's defence to the misrepresentation claim that the sufficiency of 225 radio sites is merely an opinion therefore fails. There is nothing in the computation of the estimate of the number of sites technically to meet a stipulated data rate and connectivity requirement that is close to an expression of an intent or a promise to do something in the future (*eg*, an obligation to construct 225 sites). A statement that 225 radio sites can technically meet the stipulated data rate and connectivity requirement is a material statement of fact, though it may be an estimate worked out based on certain engineering and wave propagation principles. It is not a forecast of something which may or may not happen, *ie*, the certainty of which is unknown. An analogous situation would be an engineering question posed to a civil engineer as to what the load bearing capacity of a certain beam is. To answer this question, the civil engineer needs to know the material properties of the beam as the material properties affect the strength of the beam. The civil engineer needs to know the length and cross-section dimensions and shape of the beam as these parameters also affect the eventual load bearing capacity of the beam. If the civil engineer is given all the correct factual information, then he will be able to compute using the computational tools available to him, the load bearing capacity of that beam of that size, cross-section and of that material. In a sense, the civil engineer is "predicting" that the beam once constructed with the same material and same dimensions will have that load bearing capacity. But that "prediction" amounts

almost to a certainty because the answer of the civil engineer is based on tested engineering principles and the answer provided will be the same each time for the same beam of the same dimensions and material. His answer can be relied upon more as a "fact" that the beam will and must have that load bearing capacity because it is based on tested engineering principles. Hence, the load bearing capacity worked out by the civil engineer is more akin to a statement of fact of the load bearing capacity for that beam rather than a prediction or a forecast of its load bearing capacity. However, if the civil engineer makes a mistake and uses the wrong formula or inputs the wrong dimensions, albeit into a correct formula, his "prediction" will be wrong because he has gotten his computational methods wrong or his facts wrong (or both wrong) to begin with. In my view, he has not "predicted" wrongly. His results are wrong because he has been incompetent or careless and has made a mistake in his calculations.

55 Accordingly, working out the number of radio sites required is not much different. The correct parameters (including the correct morphology parameters) must be fed into the appropriate radio planning tool for it to compute the correct estimated number of sites to provide the coverage at the required connectivity and data rates. A statement of 225 radio sites as being sufficient is as much a statement of fact: that given the existing morphology in Singapore, 225 radio sites would be the correct number of radio sites needed to be built to meet the Contract Requirements. After all, the morphology of Singapore including the total area, height and distribution of HDB flats throughout Singapore is a given fact, which will not change very much in the period of time that the WiMAX Network is expected to be built. If Huawei had inputted the wrong morphology parameters into its radio planning tool, resulting in the wrong result being obtained, then it would have misrepresented a material fact to Creative as to what would be the sufficient number of radio sites to meet

its Contract Requirements because the representation that the WiMAX Network would be technically capable of functioning with 225 sites in accordance with the Contract Requirements is simply no longer true (or is simply false) as a technical fact.

56 I therefore agree with Creative's submissions that:

(a) Huawei's representation that "225 stations would be sufficient" was a statement of fact about Huawei's existing WiMAX Network, the manner in which radio waves propagate, and the physical landscape of Singapore. There was no element of puff or intention, or of randomness.

(b) Huawei's representation was not a mere expression of opinion for several reasons. Huawei was certainly better equipped than Creative to know the number of sites required, and had held itself out as an expert on WiMAX technology, having designed and installed numerous WiMAX networks all over the world. Between June 2009 and January 2010, Huawei had also asserted to Creative, through a series of technical Radio Network Planning documents that Huawei had done detailed calculations to arrive at the minimum number of base stations needed to achieve nationwide coverage, based on Huawei's existing equipment and a study of the island of Singapore. Huawei, as the maker of the statement, knew and intended that Creative would rely on Huawei's estimate of 225 base stations in entering into the Contract as this greatly impacted Creative's budget.

(c) Finally, but for Huawei's statement that 225 radio sites would be sufficient to provide nationwide coverage (and thus the project would meet Creative's US$20m budget), Creative would not have entered into the Contract to build the WiMAX Network.

Huawei's representation being factually untrue or false

57 I further find that the representation of fact that the WiMAX Network would work with only 225 (±10%) base stations is incorrect and untrue as shown by (a) the revised estimates of Huawei requiring an additional 619 radio sites; and (b) the commercial offers to Creative that Huawei would bear a part of the additional costs of the additional radio sites. Huawei's planners had used incorrect parameters and assumptions in calculating the number of base stations required to meet the Contract Requirements and therefore, miscalculated and severely underestimated the number of base stations required for the WiMAX Network. On this technical issue, I accept the expert evidence of Dr Lee Yee Hui[13] ("Dr Lee") and Jacky Pandion[14] ("Pandion") and prefer their evidence over that of Dr Dimitris Dernikas[15] ("Dr Dernikas").

58 Dr Lee conducted a drive test ("2012 Drive Test") before the WiMAX Network was dismantled. The 2012 Drive Test was conducted for approximately eight hours each day over 14 days, on 5 April and from 13 April to 25 April 2012, covering most areas within the targeted nationwide coverage area in order to collect empirical data of sufficient sample size from the WiMAX Network. Data was collected once every second with the vehicle driven at approximately 35km/h, giving approximately one data point every 10m. At that

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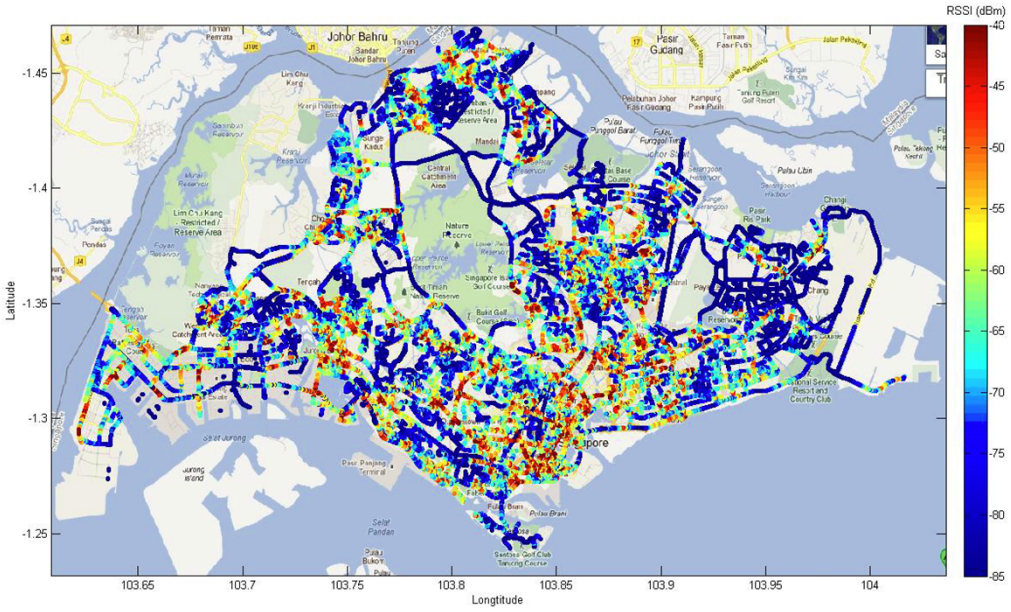
[13] Dr Lee is an Associate Professor with the School of Electrical and Electronic Engineering, Nanyang Technological University specialising in "channel characterisation". She has more than eight years' experience in this area of radio waves propagation between transmitters and receivers in different environments.

[14] Pandion was formerly a manager with CyberCom Group AB, a telecommunications consultancy agency with more than 19 years of experience working as a radio network planning and optimisation engineer.

[15] Dr Dernikas is the Global Head of Services in AIRCOM International Limited. He has more than 20 years' experience in different areas of the telecommunications industry, including research and development, network planning and network optimisation.

time, 162 radio sites were on-air. Of these 162 radio sites, 46 radio sites had been optimised by Huawei. I reproduce below Figure 7 in Dr Lee's 1st Report which shows pictorially the drive test routes taken and the RSSI values recorded by the USB dongle during the drive test:



59 Dr Lee used only the empirical data collected from the 46 optimised sites to determine the "effective coverage radius" (*ie*, distance from the radio site) at which 90% area coverage probability would still be achieved at the stipulated RSSI values for each morphology type in accordance with the Contract,[16] which had assumed the correctness of (a) the path loss formula used by Huawei in its own modified Cost-231 Hata Propagation Model; and (b) the RSSI values adopted by Huawei for each type of morphology. In this regard, I note at [62] below the standard Cost-231 Hata Propagation Model formula used for

[16] Dr Lee's 1st Report Pages 59 to 60 at paras 157 to 159.

predicting path loss, which Huawei deviated from as it used its own parameters and correction factors instead.

60 Table 8 of Dr Lee's 1st Report summarises the "effective coverage radius" of a radio site to achieve 90% area coverage probability for each type of morphology:

Morphology Scenario	Dense Urban	Urban	Suburban
Coverage radius (km) stated in HLRR (Table 2)	0.340	0.580	1.520
Coverage radius (km) using COST-231 Hata Model (Table 2)	0.231	0.390	0.687
Coverage radius (km) derived from empirical data – optimised sites only	0.200	0.280	0.620

Table 8. Comparison of Coverage Radius of Radio Sites

61 As an observation, it would appear that the "effective coverage radius" obtained from the empirical data obtained in the Singapore environment (see the figures in row 4) better validates the "effective coverage radius" for the three different morphologies using the standard Cost-231 Hata Propagation Model (see the figures in row 3) than the one using Huawei's own modified Huawei Propagation Model, which was used to determine the values for the HLRR as in the Contract (see the figures in row 2). These results further suggest that even the standard Cost-231 Hata Propagation Model has underestimated the actual path loss experienced in the Singapore environment. Huawei Propagation Model's underestimation of the actual path loss experienced in the Singapore environment is far greater as shown by the results in the table above.

62 The calculation of the path loss using the standard Cost-231 Hata Propagation Model is represented by the mathematical formula:

$$\boldsymbol{L} = 46.3 + 33.9 \log \boldsymbol{f} - 13.82 \log \boldsymbol{h_{Base}} - \boldsymbol{a(h_{Mobile})} + (44.9 - 6.55 \log \boldsymbol{h_{Base}}) \log \boldsymbol{d} + \boldsymbol{Cm}$$

Where:

L is the Path Loss, (in decibels);

f is the frequency (in MHz) of the radio signals;

$\boldsymbol{h_{Base}}$ is the height (in m) of the radio site antenna;

$\boldsymbol{h_{Mobile}}$ is the height (in m) of the end-user device;

$\boldsymbol{a(h_{Mobile})}$ is the antenna height correction factor which depends on the frequency;

d is the distance (in km) between the radio site and the end user; and

Cm represents a variable correction factor (the "correction factor").

63 Based on the "effective coverage radius" obtained from the empirical data (see the figures in row 4 in the table above), Dr Lee then calculated the "effective coverage area" of each type of clutter (Dense Urban, Urban and Suburban)[17] and thereafter estimated the number of radio sites that would be required for the WiMAX Network to achieve nationwide coverage with 90%

[17] This was done using the formula which was stated in Huawei's RNP (PCB 205): Coverage Area per Site = $1.949 \times \text{Radius}^2$.

area coverage probability assuming that the target coverage areas of Dense Urban, Urban and Suburban had been correctly classified by Huawei as being 11.03km^2, 94.41km^2 and 151.49km^2 respectively (which, as can be seen later, were also wrong).

64 The results of Dr Lee's analysis are set out at Table 11 of Dr Lee's 1st Report, which enables a quick comparison to be made of the estimated number of radio sites when different methodologies are applied:

Morphology Scenario	Dense Urban	Urban	Suburban	Total
No. of sites required stated in HLRR (Table 2)	48	143	34	225
No. of sites required using COST-231 Hata Model (Table 2)	106	318	164	588
Estimated No. of sites required	141	617	202	960

Table 11. Comparison of Number of Sites Required by WiMAX Network

65 She concluded after analysing the results that 225 (±10%) base stations were grossly insufficient to meet the Contract Requirements because of multiple errors acting cumulatively to aggravate the underestimation, namely, (a) the overly optimistic correction values used by Huawei in its Huawei Propagation Model were unsuitable for the Singapore environment; (b) critical errors were made in the classification of the HDB estates as "Suburban" instead of "Dense Urban" or "Urban"; and (c) wrong parameters apparently adopted for the sensitivity of the USB dongle which meant that the value set by Huawei in the

HLRR for minimum connectivity with the USB dongle at RSSI value of -85.76dBm for 90% area coverage probability was too low. I have no good reason not to accept Dr Lee's conclusions based on her analysis of the empirical data, which I find it difficult to fault.

66 According to Dr Dernikas, his simulations using the vector-based propagation model (*ie*, the Myriad Model/Crosswave Model) establish that 225 base stations would be sufficient. Pandion's evidence was that even a vector-based simulation would show that 225 base stations remain grossly insufficient to meet the Contract Requirements. I find Pandion to be more credible and impartial than Dr Dernikas on this issue and I accept Pandion's evidence. I will explain in more detail later in this judgment why I have accepted Pandion's expert opinion and conclusions and rejected those of Dr Dernikas.

67 Pandion's conclusions based on his analysis of the simulation results derived from the Crosswave vector-based propagation model support the conclusions drawn by Dr Lee from the empirical data obtained from 46 optimised sites during Dr Lee's 2012 Drive Test that the 225 base stations were grossly insufficient to meet the Contract Requirements.

68 After a careful assessment of all the evidence (which I shall elaborate later in this judgment in greater detail), I find on a balance of probabilities that 225 (±10%) base stations is in fact grossly insufficient to meet the Contract Requirements. I must emphasise that I do not need to determine (even on a balance of probabilities) for the purposes of this judgment the *actual and true* minimum number of radio sites that is *in fact* needed to fulfil the Contract Requirements. I just need to find on balance that it is more likely than not that 225 radio sites is a substantial underestimate based on all the evidence available to me, to arrive at a legal result that Creative has succeeded in proving a

"misrepresentation of fact" in that Huawei's representation that 225 radio sites is capable of providing nationwide coverage with 90% coverage probability is *in fact untrue*, or *false* in other words.

Minimum RSSI and CINR values and other planning assumptions not premised on any mutually agreed assumptions

69 There is no merit in Huawei's argument that its representation to Creative was premised on a set of planning assumptions allegedly agreed between Creative and Huawei, and reproduced in Annexure 6 of the Contract (*eg*, RSSI values and morphology classification), such that if those planning assumptions were wrong, Huawei would not be responsible to Creative because they had been mutually agreed assumptions.

70 Huawei asserted that PW1-Koh had decided to include the minimum RSSI ≥-85dBm and CINR 3dBm values as part of the HLRR after studying the technical information obtained from various other vendors in particular Samsung. PW1-Koh denied this during his cross-examination and I believe him. After reviewing Samsung's documents furnished to Creative, I am satisfied that PW1-Koh would not have been able to discern the minimum RSSI value for connectivity from them. I also accept PW1-Koh's evidence that the comparison of the radio planning designs from different vendors would be difficult because of the different proprietary equipment to be used for the different proposed WiMAX networks. DW1-Leong had admitted under cross-examination that the RSSI and CINR values were not determined by Creative but were derived by Huawei's own radio planners as part of Huawei's design of the WiMAX Network. It is therefore difficult to adopt RSSI and CINR values for connectivity used in the design by one vendor and simply apply them to the design of another vendor because different vendors use different proprietary equipment.

71 Accordingly, I reject Huawei's contention that the minimum RSSI values and CINR values originated from Creative. I do not believe that Creative would have the comparable expertise of Huawei in the field of radio planning to be able to derive the appropriate minimum RSSI and CINR values for connectivity purposes. On balance, Creative is far more likely to have depended on Huawei to provide the figures and to have relied on Huawei for the correctness of those figures. On the totality of the evidence, I find that Huawei (and not Creative) furnished the minimum RSSI and CINR values to be used for the design of the WiMAX Network.

Huawei never informed Creative of its inability to meet the Contract Requirements due to Creative's budget constraint of US$20m

72 I do not believe Huawei's assertion that it had informed Creative prior to signing the Contract that it was unable to comply with the Contract Requirements if Creative's expressed budget was US$20m. It is strange that the specifications in the Contract would have stipulated those requirements if both parties had come to an understanding *prior* to signing the Contract that Creative's requirements for the WiMAX Network could not and would not be fulfilled. If so, then what was the purpose of having a contract that would inevitably be breached? The contemporaneous documentary evidence does not bear out Huawei's assertion in this regard. Furthermore, I do not consider it unusual if Creative had used budgetary constraints as a negotiating tactic to get the best price for the project. Huawei ingeniously capitalised on that to suggest that Creative had accepted a performance for the WiMAX Network that was lower than that stipulated in the Contract Requirements because Huawei had reduced the pricing for the WiMAX Network project to bring it within Creative's budget.

Entire agreement clause does not exclude misrepresentation

73 I shall now turn to the next issue on Huawei's reliance on the entire agreement clause in Art 23.3 of the Contract to defeat Creative's claim in misrepresentation.

74 Huawei submitted that the following entire agreement clause, Art 23.3, in the Contract would negate Creative's misrepresentation claim:

> 23.3 This Contract and its annexures contain the entire understanding and agreement between the Parties respecting the subject matter hereof and all prior negotiations, understandings, representations and agreements of the parties, except for the NDA, whether oral or written, with respect to the subject of this Contract are superseded in their entirety.

75 Huawei relied on *IBM Singapore Pte Ltd v UNIG Pte Ltd* [2003] SGHC 71, where Tay Yong Kwang J (as he then was) held (at [39]) that an entire agreement clause "erased any legal consequences that could have arisen from the Response to [the Request for Proposal] or the discussions and negotiations that had taken place. The contractual relationship between the parties was now circumscribed by the signed agreements and by those alone". Huawei also referred to *Chuan Hup Marine Ltd v Sembawang Engineering Pte Ltd* [1995] 1 SLR(R) 162 ("*Chuan Hup*") where GP Selvam J determined that an entire agreement clause precluded the defendants from relying on any implied term, collateral warranty or misrepresentation.

76 In *Chuan Hup*, the alleged misrepresentation was that "the vessel was capable of making 11 knots and would make 9.5 to 10.5 knots". In fact the vessel maintained a speed of only 6.5 to 8.5 knots. Clause 25 in the contract stipulated that the duration of the voyage between Singapore and Bombay was not to exceed 10½ days except for certain contingencies. Selvam J found that the minimum speed was a matter of calculation as the distance and the maximum

duration of the voyage was fixed. Hence the contractual promise regarding speed was not absolute. The court reasoned that plaintiffs were thus precluded from raising the misrepresentation and other matters which were at variance or in conflict with cl 25. Selvam J concluded that any implied term, collateral warranty and misrepresentation was overridden by cl 25.

77 In the present case, the facts misrepresented prior to the conclusion of the Contract were incorporated into the Contract. Accordingly, there is nothing in the Contract which is at variance with or contradicts the representations made prior to the Contract. In my view, the entire agreement clause cannot possibly oust Huawei's misrepresentation when it is the very basis for the number of radio sites stipulated in the Contract. Where the facts misrepresented have formed part of the Contract and its annexures, which were according to the entire agreement clause to contain the entire understanding and agreement between the parties, it cannot reasonably and logically be said that these same facts (albeit untrue or false) also embedded within the Contract have been thereby excluded. The purpose and intent of the entire agreement clause read as a whole appears to me to exclude any understandings, representations and agreements made *prior* to the conclusion of the Contract that *contradict* or *do not conform to* the entire understanding and agreement between the parties as encapsulated by the wording of the Contract and its annexures as drafted.

78 On the facts of this case, the material facts stated in the Contract do not differ from nor do they contradict the material facts represented by Huawei before the conclusion of the Contract. In fact, they are the same. Unfortunately, these material facts are false and incorrect in fact. For the reasons I have stated, I cannot see the direct applicability of the entire agreement clause to contractually oust the liability of Huawei for the false or incorrect material facts represented to Creative prior to the conclusion of the Contract that have also

been subsequently incorporated within the Contract, even if "representations" in the entire agreement clause can be construed liberally to include "misrepresentations".

79 More significantly, if the intention of the parties was to exclude all misrepresentations by way of contract, then the clause effecting such an intention would have to be very clearly expressed. Misrepresentations have been held not to be excluded by the mere inclusion of the word "representation" in an entire agreement clause: see *AXA Sun Life Services plc v Campbell Martin Ltd* [2012] 1 All ER (Comm) 268 ("*AXA Sun*") at [94]; *RBC Properties Pte Ltd v Defu Furniture Pte Ltd* [2015] 1 SLR 997 at [113] ("*RBC Properties*"); *BskyB Ltd v HP Enterprises Services UK Ltd* [2010] EWHC 86 at [382]. I agree with Creative's submission that in Art 23.3, the word "representation" was placed alongside some words expressive of contractual obligations: "...understandings, representations and agreements of the parties". Read as a whole, the purpose of Art 23.3 appears to suggest that it was intended to denude any pre-contract statements or representations of contractual effect, but not to exclude liability for misrepresentation.

80 In *AXA Sun*, the English Court of Appeal held that a clause could exclude liability for misrepresentation in three ways: (i) the parties agreeing that no representations were made; (ii) the parties agreeing that there was no reliance on any representation; and (iii) expressly excluding liability for misrepresentation. None of these are present in Art 23.3.

81 Huawei however submitted that the additional reference to "all prior negotiations" in Art 23.3 (see [74]) distinguishes it from the entire agreement clauses referred to in the three cases mentioned above at [79].

82 I do not agree that liability for either negligent or fraudulent misrepresentations made in the course of "prior negotiations" can be said to have been clearly, expressly and specifically excluded by Art 23.3. There is nothing in Art 23.3 to indicate to me that it was intended to take away the rights of one party to the Contract to bring an action against the other party for any negligent or fraudulent misrepresentations made by the latter party. The words "prior negotiations" take Huawei's construction of Art 23.3 no further than the word "representations". In *Inntrepreneur Pub Co v East Crown Ltd* [2000] All ER (D) 1100, the English High Court held at [8] that:

> An entire agreement provision does not preclude a claim in misrepresentation, *for the denial of contractual force to a statement cannot affect the status of the statement as a misrepresentation.* The same clause in an agreement may contain both an entire agreement provision and a further provision designed to exclude liability e.g. for misrepresentation or breach of duty.
>
> [emphasis added]

83 In conclusion, I find that Art 23.3 does not clearly exclude liability for misrepresentation and Huawei cannot avail itself of it.

Section 2(1) of the Misrepresentation Act

84 Section 2(1) of the Misrepresentation Act provides as follows:

> Where a person has entered into a contract after a misrepresentation has been made to him by another party thereto and as a result thereof he has suffered loss, then, if the person making the misrepresentation would be liable to damages in respect thereof had the misrepresentation been made fraudulently, that person shall be so liable notwithstanding that the misrepresentation was not made fraudulently, *unless he proves that he had reasonable ground to believe and did believe up to the time the contract was made that the facts represented were true.*
>
> [emphasis added]

85 I agree with Creative's contention that the burden is on Huawei under s 2(1) of the Misrepresentation Act. The primary difference between a common law claim for negligent misstatement and a claim under s 2(1) of the Misrepresentation Act is that under the former, it is for Creative to prove that Huawei was negligent, while under the latter Huawei shoulders the burden of showing that it was not negligent. Specifically, following the test set out by the Court of Appeal in *RBC Properties*, which was cited to me by both parties, the inquiry proceeds in the following two steps (at [69]-[70]):

(a) Based on an objective assessment of the facts, did Huawei subjectively believe that the facts represented were true?

(b) If Huawei did hold that subjective belief, did Huawei have reasonable grounds to do so?

86 I accept, and Creative does not contest, that Huawei subjectively believed that the facts represented were true. The dispute relates to the second step. And here, the inquiry is not whether a reasonable person in Huawei's shoes could have believed the facts to be true, but whether *Huawei* had reasonable grounds for its belief at the time that the contract was made (*RBC Properties* at [70]). But even so, I find that Huawei has not discharged this burden.

87 I will elaborate on the reasons in detail later in the judgment but suffice to say at this point that Huawei is an experienced telecommunications company with vast experience in WiMAX technology and wave propagation theories. Looked at objectively, Huawei had *no* reasonable ground to believe that 225 sites would be sufficient. Neither has Huawei provided any satisfactory explanation on how the three significant mistakes came about. To date, Huawei does not believe it had made any mistakes in the design of the WiMAX Network (with the exception of only one mistake in the morphology classification of

HDB estates as "Suburban"). Given the evidence before me, I believe that Huawei did not realise at that time the Contract was entered into that it had made the three critical mistakes due to the gross negligence of, principally, DW5-Zou. I believe Huawei only realised and recognised its mistake much later into the Contract after connectivity problems arose but Huawei tried to find a way out to resolve the issue and then they had no other choice but to propose to Creative revised criteria and parameters for radio planning under the guise of meeting a "new requirement" from Creative, which resulted in a WiMAX Network of 855 radio sites.

88 Accordingly, Huawei is liable to Creative for damages under s 2(1) of the Misrepresentation Act.

Huawei's anticipatory repudiatory breach of contract

89 I find that Huawei is in anticipatory repudiatory breach of the Contract. The following words and conduct (including silence) of Huawei had led Creative reasonably to conclude that Huawei was no longer capable of fulfilling the Contract Requirements with only 225 base stations:

(a) After Creative complained over the course of several project meetings with Huawei in August and September 2011 about the poor connectivity of the WiMAX Network at the coverage planning design threshold for the desired coverage probabilities and data rates at a minimum RSSI value of -85dBm and questioned the correctness of Huawei's planning parameters, Huawei informed Creative at the meeting on 11 October 2011 that the planning parameters were revised (*ie*, planning values for RSSI were revised from ≥-85dBm to ≥-80dBm, and the classification for HDB estates was revised from "Suburban" to "Dense

Urban") and 619 additional base stations were required based on these revised planning parameters.

(b) At a meeting on 19 October 2011, Huawei proposed new acceptance criteria for the network including a stationary test instead of a drive test for the cell edge throughput acceptance test and further recommended a RSSI of -80dBm and a CINR of 8dB as the acceptance standard. However, Creative did not agree and insisted that Huawei comply with the key performance indicators as per the Contract Requirements for acceptance. Creative reiterated that the acceptance for the cell edge throughput was to remain as 1Mbps DL and 256kbps UL on a drive test without additional sites in compliance with the Contract.[18] DW1-Leong confirmed that was what happened during the meeting.[19] Huawei's response was that it would do an internal review and get back to Creative. After various postponements, Huawei finally arranged a meeting on 9 November 2011, to present its proposed solution to Creative.

(c) At Huawei's presentation to Creative on 9 November 2011, one of the slides stated that the network:[20]

> …cannot achieve consecutive coverage even with 226 sites due to scatter site location acquisition and low height resulting weak coverage and connectivity. Additional 619 sites to have 90% nationwide will lead to high CAPEX & OPEX expenditure.

In another slide titled "Revise Site distributions base[d] on actual condition", it was highlighted in red for emphasis that:[21]

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[18] PCB 375.

[19] XXN of DW1-Leong, Day 5, Page 111 line 24 to Page 112 line 20.

[20] PCB 388.

[21] PCB 389.

> The main challenge: 236 sites not able to meet 90% is due changes on the cluster morphology where most of the HDB defined as sub urban in previous planning. In practical scenario, HDB will be likely categorize as Dense urban in Singapore. As a result, additional 619 sites require to fulfil RSSI =-80 dbm; CINR =8dB @ 90% coverage nationwide.

The same slide indicated that with 236 sites, coverage was only 65.7%. Huawei made an offer to defray a substantial part of the costs of the additional base stations.

(d) At the two meetings on 9 and 14 December 2011, Creative asserted that Huawei failed to deliver on the Contract, to which there was no denial by Huawei. For instance, the minutes of meeting on 9 December 2011[22] recorded Creative's General Manger Tan Keng Wah ("Keng Wah") to have highlighted to Huawei the need for an urgent solution to enable Creative to launch the WiMAX Network as follows:

> KW [Keng Wah] highlighted that we need to launch our network. QMax is unable to launch because of Huawei's failure to deliver what is promised in our contract.
>
> …
>
> KW also highlighted again that there seems to be no urgency on Huawei side to resolve the problems…

Even at this late stage in December 2011, Huawei never once asserted that they could still deliver with the number of base stations stipulated originally in the Contract. Despite the many complaints and accusations from Creative pertaining to lack of connectivity, wrong morphology being used in radio planning, incompetency and an inability to deliver on the part of Huawei, there was no assurance whatsoever from Huawei that it could confidently deliver the WiMAX Network as per the Contract.

[22] PCB 432 to 433.

> Huawei only asserted that it could meet the Contract Requirements in its letters dated 4 and 13 January 2012, six and fifteen days respectively *after* Creative terminated the Contract. If for so long previously Huawei did not appear to have been able to offer a technical solution to obviate the need for 619 additional radio sites, I am most surprised that Huawei could have miraculously found the technical solution within the next six days after termination on 29 December 2011 to resolve the connectivity problems surfaced by Creative to enable it to make the bold and bald assertions in its two letters, which I note had no technical reports attached in support of those assertions.

90 I find that PW1-Koh is a credible witness and I accept his explanation that the Contract was terminated because "the additional 619 sites is really too much." On Creative's calculations, the additional 619 base stations would have increased the capital expenditure by about S$35m, *ie*, S$25.1m for additional equipment cost and S$9.9m for additional infrastructure costs. On top of that, Creative would incur additional operating expenses of about S$1.5m every month.

91 Huawei alleged however that it conducted a new simulation using revised parameters of RSSI at ≥-80dBm and CINR at 8dB with 90% area coverage probability and with HDB estates reclassified as "Dense Urban" instead of "Suburban" because Creative wanted a "new requirement" for the network, upgrading it to be similar to the existing 3G networks being operated by the three major mobile operators in Singapore, which therefore resulted in the additional 619 radio sites for the WiMAX Network.

92 I do not believe Huawei's allegation that Creative had subsequently changed its requirement *after* the Contract had been entered into and desired a

network "similar to the existing 3G networks" which caused Huawei to revise its planning parameters by (a) changing the RSSI value from ≥-85dBm to ≥80dBm; and (b) reclassifying the morphology of HDB estates from "Suburban" to "Dense Urban" in order to meet Creative's alleged "new requirement".

93 Huawei's witnesses admitted that Huawei had already decided on the revised RSSI figure of ≥-80dBm even *before* the topic of a 3G network was first brought up at the 26 September 2011 meeting. Hence there was no causal link between the two. Clearly, the new RSSI figure of ≥-80dBm was not given in order to meet Creative's alleged request for a 3G-like network, because, even by Huawei's own account, Creative had not made the alleged request then.

94 If indeed Huawei was revising the planning parameters to be equivalent to 3G Networks because of Creative's alleged "new requirement" (which I do not believe to be the case), then logically one would expect the revised planning parameters to be similar to that of the existing 3G networks which can attain a coverage probability of between 95% and 98%. But strangely, Huawei's revised planning parameters retained the much lower 90% coverage which is clearly different from the typical specifications of existing 3G networks in Singapore. Additionally, 3G networks have to provide coverage in MRT tunnels and in basements of shopping centres, including coverage in cemeteries and military areas, whereas the WiMAX Network supposedly to be upgraded to be similar to 3G networks on Creative's alleged "new requirement" did not have to.

95 Huawei's allegation is also not borne out by the evidence. In cross-examination, DW1-Leong said:[23]

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[23] XXN of DW1-Leong, Day 5, Page 59 line 22 to Page 60 line 8.

> MR YIM: … Am I not correct, looking at this, that ultimately, going through this, nobody was talking about doing simulation based on 3G-like equivalent, right? The simulation was not for 3G, that's the point the judge is talking about.
>
> A: Yes. This is a new simulation.
>
> Q: Yes, but it is not for 3G equivalent, which would have been 95 per cent or above coverage.
>
> A: It's not a 3G equivalent. It's based on the discussed RSSI and the --
>
> COURT: Just to get the contract going. Correct or not?
>
> A: That's correct.

96 I believe that Huawei itself decided to revise the RSSI value to ≥-80dBm and to reclassify the morphology of HDB estates to "Dense Urban" because of the complaints from Creative about the poor connectivity. Creative did not ask for a WiMAX Network that had a coverage probability that was better than what was already in the Contract Requirements.

97 Given the budget limitations that Creative had, and with no evidence that the Creative's WiMAX Network project team had managed internally to secure a much higher budget amount for the same project from senior management, I find it incredible that any person in Creative's WiMAX Network project team would have dared to suggest changing the WiMAX Network midway through the Contract to an advanced 3G or 4G LTE network that would involve a substantial increase in the cost, if they believed that the WiMAX Network as designed by Huawei could have in fact technically met the performance requirements as stipulated in the Contract.

98 If indeed Huawei had understood Creative to be requesting for a "new requirement" for the WiMAX Network which essentially amounts to a change request or a variation of the Contract works, I would expect DW7-Ng as the senior project manager for Huawei to prepare a written counter-proposal

pursuant to the "Change Management" clause in Art 12 of the Contract for Creative to agree to and sign off on it, particularly when this was a major change in the Contract Requirements which would necessitate a huge increase in the number of radio sites originally provided for in the Contract. Article 12 of the Contract reads:

> ARTICLE 12. **CHANGE MANAGEMENT**
>
> 12.1 The Parties shall have the right to request or reject changes within the scope of this Contract.
>
> …
>
> 12.4 If the change is requested by the Customer, a proposed counter-proposal in response to the change suggested by the Customer shall be prepared by the Supplier within thirty (30) days after receipt of the Customer's request.
>
> 12.5 Any change has to be agreed by the Parties in writing and has to be executed by an authorized signatory of each of the Parties …
>
> [emphasis in original]

However, there was no written change request from Creative or a written counter proposal from Huawei adduced in evidence nor was there any evidence of a sign off by the parties on any agreed change arising from the alleged "new requirement". In fact, no mention of any request by Creative for a "new requirement", "3G-like network" or "3G-like coverage" can be found in any of the minutes, emails or letters discovered in these proceedings. Notably, the original statement of defence that Huawei filed in March 2012 did not include any allusion to a 3G network. Huawei first asserted that Creative had requested for a network similar to a 3G network for better coverage was in DW7-Ng's AEIC filed on 15 August 2013, more than one and a half years after Creative terminated the Contract. I accept Creative's submission that this assertion from Huawei was an afterthought.

99 On the totality of the evidence, I find that Creative had not changed the Contract Requirements or asked for a "new requirement". The revision to the planning parameters and the new simulation by Huawei came about because of the connectivity problems raised by Creative. Huawei's new simulation showed that an additional 619 radio sites were required.

100 Huawei tried to suggest that the increase of the RSSI and CINR figures used for the simulations increases the coverage, which is therefore in line with Creative's "new requirement", purportedly covering an area much larger than the original 257km^2 specified (*eg*, the central water catchment area and new rural areas are purportedly included). This is misleading because the area to be covered is a geographical specification, whereas the RSSI and CINR values are values computed and specified for the cell edge to achieve the requisite connectivity and data link speeds at the cell edge. If there is factually poor connectivity and poor data link speeds during practical test assessments, it necessary means that the theoretical values for the RSSI and CINR are likely to be erroneously computed in the Link Budget as an input factor for radio planning purposes and therefore need to be revised to higher values to have stronger signals at the cell edge location. If everything else is constant (*ie*, same equipment, same antenna gain *etc*), it naturally follows that the theoretical cell edge radii is reduced (*ie*, the cell edge is at a distance closer to the station or radio site), which necessarily entails that more radio sites are needed due to the reduced cell edge radii that each station is expected to be able to send signals of the requisite signal strength to. Accordingly, the increase in RSSI and CINR values specified for the cell edge is in my view more consistent with problems of connectivity due to poor signal strength rather than an increase in physical area of coverage as a new requirement. If more physical area is to be covered and there are no problems with connectivity at the cell edge, then simply more

radio sites are required and there will be no need to increase the RSSI and CINR values for the cell edge, which can remain the same when there is no problem with connectivity and data speeds.

101 Furthermore, if Creative had wanted to upgrade its network and had set out a "new requirement", I do not believe that Huawei, as a commercial company, would have been so accommodating towards Creative as to come out with offers to defray a substantial part of the costs of the additional base stations arising from a "new requirement" that had more stringent connectivity parameters. I do not believe that Huawei could not understand that a "new requirement" is the equivalent of a "variation" and obviously Creative must pay for that "variation" in full without Huawei having to make any concessions or give any discounts for a "variation" or a "new requirement", which originated from Creative. These offers of huge discounts on the price by Huawei indicate to me that it had recognised that it was responsible for having grossly underestimated the number of base stations required for the WiMAX Network. In its attempt to placate Creative, it therefore offered rather unusually large discounts of some 50% on the equipment price as a form of compensation. One of Huawei's presentation slides shown to Creative at the 14 December 2011 meeting had in fact described Huawei's package offer as a "Compensation Offer". A contractor does not need to compensate for the client/owner who asks for a variation or a new requirement. In fact, the natural result of any variation or a new requirement is for the client/owner to pay an additional amount for any variation or new requirement that results in a net increase in costs. Compensation by the contractor to the client/owner in the face of a net increase in costs is the very anti-thesis of there being any "new requirement".

102 Huawei's submission that "these proposals were made purely to resolve [Creative's] unhappiness [with the lack of connectivity] while [optimisation]

was being carried out" is, in my view, a feeble explanation for its most unusual generosity towards Creative if indeed Huawei had believed at that time that it could fulfil its original contractual obligations with only 225 sites. The truth is that Huawei was no longer holding any belief by that time that the WiMAX Network could work with 225 sites, which explains the generous discounts offered, whether it be in its unilateral offer to upgrade Creative's network to a more advanced 4G LTE technology (which Creative rejected) or otherwise. I accept Creative's submission that after Huawei discovered that it could not find a technical solution to obviate the need for 619 additional sites, Huawei tried to appease Creative's anger with massive discounts and upgrades to LTE technology, while hoping to persuade Creative to invest even more money into the project. When Creative challenged Huawei to perform the original Contract, it was met with stony silence from Huawei instead of assurances that Huawei could meet the original Contract Requirements, whether through optimisation, or by rearranging the 225 base stations or through other innovative technical solutions. I find that it is entirely reasonable for Creative to draw the conclusion from Huawei's words and conduct that Huawei could not perform the Contract. It simply was not technically possible to do so with only 225 base stations.

103 Even if it were true (which I do not believe it is) that Creative itself wanted to upgrade its WiMAX Network to LTE technology because of impending competition from M1, Starhub and Singtel, I still cannot see any good reason (and none was furnished to me by Huawei) why a commercial company like Huawei dealing at arm's length with Creative would have provided a huge subsidy by way of unusually large discounts in the equipment price to Creative. I find it unbelievable that Huawei would have been so concerned and paternalistic as to help solve Creative's purported commercial problem with generous offers of huge subsidies curiously labelled as a

"Compensation Offer" that would probably substantially affect Huawei's own financial bottom line.

104 Huawei further alleged that Creative terminated the Contract to cut its losses not because Huawei could not have performed the Contract, but because Creative realised that its WiMAX Network was no longer commercially viable as M1 had already planned to launch its LTE network (using a newer technology giving users a higher upload and download speed) in June 2011 and Singtel in December 2011. I do not think it necessarily follows that Creative's WiMAX Network would lose its commercial viability simply because the LTE networks were being launched. Creative's WiMAX Network catering for the lower end of the market may not be directly competing with the LTE network at the higher end of the market. Creative argued that if Creative's WiMAX Network was launched as originally planned on 29 March 2011, they would have a significant head start of at least nine months before M1 and Singtel finally launched their LTE networks in September 2012 and June 2012 respectively.

105 On the entirety of the evidence, I accept that Creative terminated the Contract not for the reasons alleged by Huawei but because (a) Huawei had, by its words and conduct, committed anticipatory repudiatory breach of the Contract; and (b) Huawei had also misrepresented that nationwide coverage could be achieved with only 225 (±10%) radio sites, when it was not technically possible to do so and thereby induced Creative into entering the Contract with them.

106 Accordingly, I find that Creative is fully entitled to terminate the Contract.

Huawei's breach of contract due to the inability of the WiMAX Network as designed to meet the Contract Requirements

107 Even assuming Huawei was not in anticipatory repudiatory breach of the Contract by reason of its words and conduct from August 2011 to December 2011 leading Creative to reasonably conclude that Huawei could not perform the Contract and hence terminate the Contract, Creative further maintained that Huawei was also in breach of Contract because it could not have delivered a viable nationwide WiMAX Network with 225 base stations *per se*. To a large extent, this is also relied on by Creative in its claim under s 2(1) of the Misrepresentation Act.

108 Establishing this is the most difficult part of this trial as it involves having to determine which of the two diametrically opposite conclusions reached by Creative's experts on the one hand and Huawei's expert on the other, is *more likely* to be correct based on the evidence before me. I do not need to determine with *certainty* that the conclusion that I find to be *more likely* to be correct is indeed *scientifically proven to be correct* in fact. A court trial is certainly not the right place for parties to perform technical research, experimentation or detailed scientific analysis to establish or predict with scientific precision the accuracy of a particular physical phenomenon or outcome. That is better reserved perhaps for institutions or laboratories involved with rigorous scientific research.

Coverage and data rate requirements not satisfied with only 225 (±10%) radio sites

109 Creative bears the burden to prove on a balance of probabilities that Huawei would not have been able at the technical level to meet the Contract Requirements in particular the connectivity, coverage and data rate

requirements with only 225 (±10%) radio sites and that a much larger number of radio sites was in fact required. In other words, Huawei's design of the WiMAX Network was unworkable with only 225 (±10%) radio sites as a matter of fact. However, under s 2(1) of the Misrepresentation Act, Huawei bears the burden of proof to show that it had reasonable grounds to believe that its representation was true.

110 Creative contended that Huawei could not have performed the Contract because Huawei's design of the WiMAX Network grossly underestimated the number of radio sites required. 225 (±10%) radio sites were simply technically insufficient to meet the Contract Requirements, in particular those detailed in paras 8(a), 8(b) and 8(c) of Annexure 6 to the Contract (*ie*, the HLRR). Briefly, to fulfil the Contract, Huawei would have to achieve the following minimum performance criteria with a 90% area coverage probability for approximately 257km^2 comprising the target area as per the polygon (see [16] above):

(a) A signal strength of at least RSSI ≥ -85.76dBm in Dense Urban and Urban areas, and RSSI ≥-87.53dBm in Suburban areas;

(b) Modulation of at least Quadrature Phase Shift Keying ("QPSK") ½ for both DL and UL using a standard USB dongle with 0dBi antenna gain; and

(c) Cell-edge committed data rate of 1Mbps DL and 256kbps UL.

111 Dr Lee and Pandion were the two expert witnesses called by Creative to show that the number of radio sites was grossly underestimated by Huawei in its design of the WiMAX Network.

112 Huawei called Dr Dernikas as its expert witness to explain why the Contract could be technically performed with 225 (±10%) radio sites. Huawei asserted that:

> One of the most crucial shortcomings of the Plaintiffs' case is that in challenging the correctness of the Defendant's evaluation that 225 sites would suffice, the Plaintiffs' experts have come up with a wide range of inconsistent number of sites which they claim would be required (ranging from 361 to 974 sites): …

113 I accept Creative's explanation that the different number of sites arose from the different test assumptions used by its experts for the calculations to gauge the effect of the various errors Huawei was alleged to have made in its radio network planning.

114 Creative's experts used several methods to analyse Huawei's planning of the number of sites in the design of the WiMAX Network:

(a) Determination of the cell coverage of each base station by:

(i) deriving the coverage radius from the results of the 2012 Drive Test; and

(ii) using empirical propagation models; and

(b) Determination of the coverage of the entire network by:

(i) using vector data based propagation models; and

(ii) using the 2012 Drive Test results to conduct a "coverage gap analysis", *ie*, adding sites to areas where the drive test shows a lack of coverage.

Dr Lee's calculations

115 Huawei had used its proprietary Huawei Propagation Model and its own set of correction factors (*ie*, -3dBm for "Dense Urban", -6dBm for "Urban" and -12dBm for "Suburban") to arrive at the theoretical number of radio sites for the nationwide coverage required. To assess the correctness of the results obtained by Huawei with its own modified model and correction factors, Dr Lee applied the standard Cost-231 Hata Propagation Model with the standard Cost-231 Hata Propagation Model correction factors (which are 3dBm for "Dense Urban", 0dBm for "Urban" and 0dBm for "Suburban" as stated in the academic literature) to determine the theoretical number of radio sites required. Applying the standard propagation model *without* the modifications introduced to it by Huawei and even *before* corrections were made to the morphology as classified by Huawei (*ie*, keeping all other things constant), Dr Lee calculated the theoretical number of radio sites to be 589 instead of 225.

116 The simple point Dr Lee was making is that Huawei, in modifying and deviating from the standard Cost-231 Hata Propagation Model, may have introduced significant errors into the wave propagation model resulting in the number of radio sites required being so vastly different. Dr Lee basically felt that the differences in the correction factors between the standard Cost-213 Hata Propagation Model and the Huawei Propagation Model *alone* would already account for more than a doubling of the number of radio sites required from 225 to 589 even *before* taking into account the error in the morphology classification of HDB estates by Huawei.

Pandion's calculations

117 However, I note that Pandion took a slightly different view from Dr Lee in that the default correction factors used by almost all radio network planners

for the standard Cost-231 Hata Propagation Model are 3dBm for "Dense Urban", 0dBm for "Urban" and -12dBm for "Suburban". According to Pandion, these are default values typically used in the industry based on his experience, unless tuning analysis had been conducted for the specific environment. However, without tuning, there would be no justification for any radio network planner to deviate significantly from the default values (which Huawei's radio planners did by a margin of as much as 6dBm) when even radio network planners with knowledge of the specific environment would only deviate by 1 to 3dBm. Pandion therefore would adjust the correction factor only for the "Suburban" clutter to be more favourable (from 0dBm to -12dBm) but not those for the "Dense Urban" and "Urban" clutters, whereas Huawei adjusted the correction factor for all three clutter types to be more favourable by as much as 6dBm. Pandion shared the view of Dr Lee that without any tuning conducted in the Singapore environment, there was hardly any justification for Huawei to have adopted correction factors that were significantly more optimistic than the default correction factors used by the industry.

118 Pandion also calculated the number of radio sites required using the standard Cost-231 Hata Propagation Model but selected correction factors of 3dBm for "Dense Urban", 0dBm for "Urban" and -12dBm for "Suburban". His calculations showed that the number of radio sites required more than doubled from 225 to 463.

119 Pandion made a further theoretical calculation using the standard Cost-231 Hata Propagation Model to illustrate what would have happened if (a) Huawei had properly classified HDB estates as "Dense Urban" instead of "Suburban"; and (b) Huawei had used the correction factors of 3dBm for "Dense Urban", 0dBm for "Urban" and -12dBm for "Suburban". His calculations showed that the number of radio sites required would be 974.

120 In another analysis, Pandion only changed the morphology classification of the HDB estates from "Suburban" to "Dense Urban". He kept the rest unchanged, *ie*, he applied the same parameters and correction factors used by Huawei. Using his own drive test and his outdoor scanner measurements (which were better than USB dongle measurements), he calculated using the ATTOL radio network planning software that a minimum total number of 361 radio sites were required. Pandion however opined that the actual number should be higher because he had used a better measuring equipment (*ie*, an outdoor scanner instead of a USB dongle) and had adopted the more optimistic parameters and correction factors used by Huawei in its Huawei Propagation Model.

121 Pandion explained during the trial that the scanner would always report stronger signals from any radio site (analogue system), while the USB dongle recorded the readings from a particular radio site until it was handed over to the next radio site.

122 Pandion also used the vector-based propagation model (the Crosswave Propagation Model), an advanced modelling approach advocated by Dr Dernikas (who had used a Myriad Propagation Model instead), in order to simulate two scenarios:

(a) Scenario (a): Using the drive test criteria and the Contract's parameters for indoor penetration loss of 18dBm for "Dense Urban", 15dBm for "Urban" and 10dBm for "Suburban", he found that at least **509** radio sites were required for the Crosswave Propagation Model to produce simulation results with at least 90% coverage. Whereas with 237 radio sites, only 44% of the "Dense Urban" outdoor areas (including HDB estates), 70% of the "Urban" outdoor areas and 83% of the "Suburban"

outdoor areas in Singapore would meet the coverage threshold for first wall penetration.

(b) Scenario (b): Using the Crosswave Propagation Model's inbuilt "Indoor Coverage" setting (which Pandion opined was a good proxy for first wall penetration), Pandion found that at least **735** radio sites would be required if 90% coverage was also to be achieved in the indoor areas of buildings within "Dense Urban" and "Urban" areas. Pandion explained that the difference was due to the fact that the simulation in Scenario (a) above was based on the contractually agreed "Indoor Penetration Loss" being more optimistic than the simulation using the Myriad/Crosswave Propagation Model's inbuilt "Indoor Coverage" setting here in Scenario (b). The Indoor Penetration Loss allowance stipulated in the Contract was lower than the Crosswave/Myriad Propagation Model's inbuilt predictor of penetration loss by about 3dBm.

123 As the number of sites required to meet the Contract Requirements far outstrips the planned number of 237 radio sites, by 272 to 498 sites (which is the difference between 237 radio sites and 509 or 735 radio sites in Scenarios (a) and (b) respectively), Pandion, in my view, rightly concluded that it would be impossible for Huawei to bridge this gap simply by optimisation.

124 To sum up, these theoretical calculations based on different models and different approaches (be it the more modern vector-based propagation models with vector-based approaches where morphology classification then becomes irrelevant or the older standard Cost-231 Hata Propagation Model with its original correction factors as stated in the academic literature and with the HDB estates in Singapore changed from "Suburban" to "Dense Urban") all point in one direction and broadly towards a single conclusion: the WiMAX Network

designed with only 225 (±10%) radio sites was grossly deficient and hence, would never have been able to meet the Contract Requirements.

Huawei's calculations in October 2011

125 The above conclusion reached by Creative's experts that it was technically impossible to meet the Contract Requirements with only 225 (±10%) radio sites for the WiMAX Network is amply corroborated by Huawei's own estimates provided to Creative in October 2011.

126 Huawei's DW4-Zhang calculated that **855** radio sites (236 radio sites + 619 additional radio sites) would be required. In my view, this figure of 855 radio sites was arrived at after Huawei had the opportunity to take a close re-look at their original radio planning calculations after Creative had highlighted the connectivity problems experienced in those areas in which the WiMAX Network radio sites were almost completely set up. I am inclined to believe that Huawei, with the expertise and resources it had and as the designer, builder and supplier of the WiMAX Network, would have carefully addressed its mind to the connectivity problem at this critical stage of the Contract and would have checked and re-checked its calculations and corrected whatever errors it might have made earlier, to derive the requirement of 855 radio sites for the revised design of the WiMAX Network.

Empirical data obtained during Dr Lee's 2012 Drive Tests

127 Given that the WiMAX Network was almost completed and accepting that full optimisation had not been completed, I believe that the actual empirical data that could be obtained from the areas with optimised radio sites during Dr Lee's 2012 Drive Tests would throw some additional light and help answer

the question on whether 225 (±10%) radio sites, if completed and fully optimised, would *in fact* be capable of meeting the Contract Requirements.

128 During the drive tests, Dr Lee found that the radio sites that were on-air during the tests (approximately 160 of them) provided coverage of 73%, 63% and 64% for "Dense Urban", "Urban" and "Suburban" cells respectively. Only approximately 70% of the data points recorded had a connection established and therefore 30% of the data points recorded could not even establish a connection to the WiMAX Network. Of the 70% data points with a connection, only about 70% of them had RSSI values greater than -78.5dBm, from which Dr Lee concluded that a minimum RSSI of -78.5dBm was required to establish even a connection with the USB dongle. This value was already higher than the RSSI value of -85.76dBm stated by Huawei that would allow the USB dongle to connect with 90% area coverage probability. Dr Lee opined that the RSSI measurement criterion stated in Huawei's HLRR was incorrect. In a further report, Dr Lee stated that even at Huawei's planning threshold of RSSI -85dBm, the average data rate measured was only 308kbps, which fell significantly short of the DL data rate of 1Mbps required as stipulated in para 8(c) of Annexure 6 of the Contract. The measurement of the DL data rate would be independent of the number of sites uncompleted as it was merely to measure the data rate that could be obtained at any place that the dongle was able to receive the measured signal strength. This was more to check whether the planning threshold of the RSSI was correctly determined by Huawei for a minimum DL data rate of 1Mbps.

129 Dr Dernikas then levelled criticisms against the accuracy of Dr Lee's analysis by asserting that Dr Lee's 2012 Drive Test had "Blank" RSSI readings which recorded significant throughput. According to Dr Dernikas, if Dr Lee had excluded these data points having significant throughput, Dr Lee's results would

be affected. But as I observe, Dr Dernikas' criticisms were made with nary a proper analysis.

130 Dr Lee then reviewed her workings and used a method acceptable to Dr Dernikas to re-analyse her results by comparing the two histograms of the distribution of the through put results for those with RSSI readings and those with "Blank" RSSI readings. I accept Dr Lee's conclusions from her re-analysis that not only did the "Blank" RSSI readings have no significant impact on the overall results (thus showing that Dr Dernikas's criticism regarding "Blank" RSSI readings had no merit), a very large proportion of the data points simply had no connection and therefore the data rate was 0kbps. The two histograms showed that 26.4% of all data points *with* RSSI readings measured could not achieve a connection, and an *even higher* 63.9% of all data points *without* RSSI readings measured (or had "Blank" RSSI readings) could not achieve a connection. These connection results appear to me to be dismal when compared with the desired contractual performance of the WiMAX Network as stipulated in the Contract Requirements.

131 As for throughput on the DL, only 63.38% of the data points *with* RSSI readings measured achieved a DL data rate above 1Mbps and *an even worse* 19.22% of data points *without* RSSI readings measured achieved a DL data rate above 1Mbps. These download throughput results also appear to be dismal when compared with the desired contractual performance of the WiMAX Network as stipulated in the Contract Requirements.

132 As for throughput on the UL, Dr Lee conceded[24] that her UL measurements did not show the actual upload capability of the WiMAX

[24] Day 17, Page 185 line 11 to Page 187 line 24.

Network as she did not upload any files during the April 2012 Drive Tests to properly record the UL data rate. I shall therefore disregard the UL throughput empirical data collected.

133 Dr Lee extrapolated the data collected and estimated that **960** radio sites would be required to achieve 90% nationwide coverage for 11.03km^2 of "Dense Urban" areas, 94.41km^2 of "Urban" areas and 151.49km^2 of "Suburban" areas (based on the same (*ie*, erroneous) morphology classification in the Contract determined by Huawei, with HDB areas classified as "Suburban" instead of "Dense Urban"). Huawei however had earlier provided an estimate in October 2011 that 855 radio sites would be required based on its revised parameters after the connectivity problems were encountered during some preliminary testing of the WiMAX Network at certain locations. 974 radio sites were needed according to Pandion's calculations using the standard Cost-231 Hata Propagation Model using the correction factors of 3dB for "Dense Urban", 0dB for "Urban" and -12dB for "Suburban". Using the vector-based propagation model as advocated by Dr Dernikas, Pandion calculated that a minimum of 735 radio sites was required.

134 Although I do agree with Huawei that there was a fair degree of divergence in the results, it cannot escape notice that the same general conclusion was reached whether using the empirical data approach or the various theoretical approaches using the standard Hata Propagation Model or the vector-based propagation models: that 225 (±10%) radio sites would simply be grossly insufficient to meet the Contract Requirements.

135 I do not accept Huawei's contention that the Creative's experts' inability to provide a broadly consistent number using the various methods strikes at the reliability of the experts' calculations and analysis. The fact that the various

different methods of modelling may produce different results does not automatically lead to the inference that all these methods of modelling are unreliable. Huawei has not shown what fundamental mistakes have been made by Creative experts when they were *applying* those different modelling tools. These modelling tools are not designed by Creative's experts but are standard applications. I can accept Huawei's position that the standard Cost-231 Hata Propagation Model may be more pessimistic in its prediction than other propagation models. In any case, I do not think it is realistic to expect all the different propagation models used in such a difficult area of wave propagation analysis to produce the same results. Variations in the results obtained from the different propagation models are not something that I would regard as alarming.

136 If the propagation models have been generally applied correctly, the presence of variations in the results based on the different modelling methods, on a balance of probabilities and on the facts of this case, does not lead me conclude that Creative's experts' calculations and analyses are unreliable. Whereas Creative has been able to demonstrate to me the fundamental mistakes that Huawei had made in its radio planning exercise using its proprietary Huawei Propagation Model, which caused the number of radio sites to be grossly underestimated, Huawei has not been able to do so with respect to the application of the modelling methods by Creative's experts. The summary of the results shows not an uncomfortably large difference (*ie*, of about ±15%) between Huawei's number of 855 sites and those figures estimated by Dr Lee and Pandion as follows:

Description	**Number of radio sites required**
Dr Lee's figure (using the empirical data)	**960** (*ie*, 12% more than Huawei's figure)

Huawei's figure	**855**
Pandion's figure (using the vector-based propagation model)	**735** (*ie*, 14% less than Huawei's figure)

Optimisation alone insufficient to bridge the gross underestimation in the number of radio sites required

137 Dr Dernikas opined that optimisation could significantly improve the coverage of the WiMAX Network by "more than 20%, depending on the original coverage before optimisation". According to Dr Dernikas, where the original coverage was in the region of 70% to 80%, it might have been possible to increase it to above 90%. In three out of his four reports, Dr Dernikas repeatedly asserted that with optimisation alone, the WiMAX Network would have been able to meet the Contract Requirements *without the need for additional sites*. I note however that Dr Dernikas did not substantiate his assertions with any scientific evidence or calculations of the *degree of improvement* achievable cumulatively through each of the possible methods of optimisation suggested by him in the present case before me.

138 Huawei relied on a comparison between the results of Dr Lee's April 2012 Drive Test for one HDB area (*ie*, Jurong West) that had one round of optimisation with two other HDB areas (*ie*, Yishun and Choa Chu Kang) that had not undergone any optimisation to assert that by just performing one round of optimisation, the average cell area was expected to increase by two to four times (*ie*, an amazing improvement of some 200% to 400%), which translated into a reduction of the number of sites by half to three-quarters.

139 The fundamental flaw in this comparison is that it assumed that the optimised area in Jurong West *before* optimisation would have the same performance as the other un-optimised areas in Yishun and Choa Chu Kang, which Huawei assumed (but had not shown in fact) to be the case. As there were no measurements done of Jurong West *prior* to optimisation to enable comparison with the set of measurements done for the *same area of Jurong West after* optimisation, it is in my view not possible to determine the degree of improvement in the coverage that can be attributed to optimisation for Jurong West. Comparison of the results for Jurong West with totally different areas in Yishun and Choa Chu Kang is meaningless. In any event, using just *one* statistical sample (*ie*, Jurong West) of an alleged improvement in performance due to optimisation to project the effects of optimisation over the entire WiMAX Network over almost the whole of Singapore is far too ambitious statistically speaking as the sample size is just too small. I am not inclined to accept this method of analysis.

140 Huawei also relied on three cluster optimisation reports Nos 2, 3 and 4 of Huawei to show how one round of optimization could improve the coverage between 4.7% and 42.33% for RSSI ≥-70dBm and between 9.5% and 13.68% for RSSI ≥-80dBm. This range of percentage improvement in the coverage appears far more realistic than the amazing improvements suggested by Huawei of 200% to 400% in [138] above.

141 I have no doubt that some limited improvement (but not improvements to the extent of 200% to 400% in coverage) can be achieved by the first round of optimisation through adjustments of the tilt and azimuth of the antenna to avoid obstacles or interference with the antennae from other base stations but subsequent rounds of optimisation may well be subject to diminishing returns and not provide the same degree of improvement of coverage as the first round.

Huawei, of course, would like me to believe that there can be many more rounds of optimisation (while keeping to the same number of planned radio sites), with each round giving just as good improvements to the coverage as the first round, such that the main problem arising from the initial gross underestimation in the number of radio sites can simply be resolved magically through multiple rounds of optimisation. On balance, I find that to be unbelievable. There must be a limit to what optimisation can achieve when the number of radio sites are kept unchanged. If adding new radio sites *without limitation* can be regarded as part of optimisation, of course the problems of poor signal strength, download and upload speed can be readily solved technically by this optimisation option of simply adding radio sites. But when the Contract has *fixed* the number of radio sites, the optimisation option of simply adding radio sites beyond the maximum allowed under the Contract without breaching the Contract is no longer available. That leaves available only the following remaining optimisation options that Huawei had listed at para 267 of its closing submissions:

> a. Troubleshooting, i.e. resolving issues such as software and hardware problems that affect coverage results.
>
> b. Adjusting the tilt of the antenna, i.e. changing the vertical facing of antenna. This is done to either avoid obstacles or to avoid interference with antenna from other base stations.
>
> c. Adjusting the azimuth of the antenna, i.e. changing the horizontal facing of the antenna. This is done to either avoid obstacles or to avoid interference with antenna from other base stations.
>
> d. Changing site location. As the building of network is a dynamic process, site locations often have to be shifted (e.g. where an adjacent site ends up being too near or too far when implemented). Hence, the changing of site locations is often done, sometimes even when sites have been implemented.
>
> e. Increasing site height. This would generally improve the distance by which the signal can travel, but certain areas may have height restrictions.
>
> f. Changing antenna type. Changing the antenna to one with higher gain will generally result in better coverage.

> g. Increasing transmitting power of the base stations. This would generally improve coverage.
>
> h. Other changes to site configuration, e.g. adding elements like Mast Head Amplifiers that will increase the maximum allowed path loss …

142 I shall now examine each of these optimisation options suggested by Dr Dernikas.

143 Options (a), (b) and (c) do not involve any change in the equipment supplied or in the physical installation. After the optimisation processes in options (a), (b) and (c) have been completed perhaps in the first round of optimisation, I do not see how much else one can do in the second round of optimisation with regards to repeating options (a), (b) and (c) to get further improvement in performance.

144 In the case of option (d), I agree with Creative that it is not commercially practical to re-locate radio sites, particularly for those sites that had already been implemented. Optimisation normally takes place after the radio sites have been completed. Creative rightly pointed out that Dr Dernikas in suggesting site re-location as an optimisation option ignored the reality that the leases for the radio sites had been signed, the equipment had been fully set up on-site and re-locating would incur termination fees for the relevant leases and costs in removing and re-locating the existing equipment. New suitable locations might not have been readily available and Creative would also have to negotiate leases for the new locations. All of this would take time. Hence, if a large number of sites required re-location, this might well have caused unacceptable delays to a project that was subject to tight deadlines for completion. More importantly, if the total number of sites were to be kept unchanged, then re-locating the radio sites to new locations to improve the coverage in certain areas might leave

coverage gaps in the original locations. I agree that it was much like a zero sum game, which inherently would have its limits.

145 Option (e) involves increasing the site height to improve the distance by which the signal can travel. Huawei accepted that certain areas might have height restrictions. Apart from height restrictions, building owners might not have readily accepted the installation of an unsightly tall tower on the roof of their building to allow Huawei to raise the site height for the radio antenna.

146 Creative rightly submitted that Dr Dernikas and Huawei were attempting to "move the goal post" to cover up Huawei's mistakes by suggesting the availability of optimisation options (f), (g) and (h). First, the Contract stipulated that the antenna was of the type with an antenna gain of 18dBm. Therefore option (f) of changing the antenna to one with a higher gain was an attempt to change the Contract Requirements. Second, there were regulatory restrictions on the maximum power output allowed by Info-communications Development Authority of Singapore ("IDA"). Dr Dernikas himself acknowledged that the use of a higher gain antenna would be "subject to regulations on maximum EIRP [Equivalent Isotropically Radiated Power]". IDA has imposed a limit on the transmitter power output of each base station at EIRP of 2000 watts, which translates to 63.01dBm. During cross-examination, Tang Jia, who was Huawei's "expert" in WiMAX technology ("DW3-Tang") revealed that "the EIRP of Huawei equipment – their base station is 63.5 dBm".[25] Since the radio sites were already operating at the maximum power allowed by IDA, options (g) and (h) which basically increased the transmission power of the radio sites pumped to a higher gain antenna in option (f) were no longer feasible, even if Huawei was willing to absorb all the extra

[25] XXN of DW3-Tang, Day 7, Page 23 lines 16-19.

costs of providing higher gain antennas and mast head amplifiers to boost the transmission power.

147 Furthermore, according to Pandion, the high gain antennas or mast head amplifiers that Dr Dernikas proposed to use would in fact degrade the WiMAX Network. Mast head amplifiers, being active electronic devices, would require regular maintenance and servicing, and would thus degrade network availability and increase operational expenditure with more site visits for repair. These issues have reduced the popularity of mast head amplifiers. Pandion said that many operators have stopped using them with 3G BTS at 2100MHz. With respect to high gain antennas, Pandion opined that they have narrower vertical beams thus affecting the coverage on the higher floors of buildings and they are not recommended in areas with tall buildings (*eg*, HDB estates). High gain antennas are only suitable to extend coverage in areas with low building heights where the users are concentrated within a narrow interval of elevation angles. For this, Pandion relied on an article titled "*MIMO and Smart Antennas for Mobile Broadband Systems*" (4G Americas, October 2012). I have no good reason to reject his opinion on this. Accordingly, I find that optimisation options (f), (g) and (h) are non-starters for the reasons stated above.

148 Creative made another valid point: if optimisation (with multiple rounds if necessary) was the solution to all the connectivity problems raised by Creative during the numerous contentious project meetings from October to December 2011, why did Huawei not highlight this solution to Creative at any of those meetings? The extensive minutes of meeting failed to indicate any assurance provided to Creative of such an easy solution. I draw the inference that Huawei must have known at that time that optimisation (excluding the option of a substantial increase in the number of radio sites) could not have resolved the connectivity problems. Otherwise, Huawei's representatives would have

confidently asserted (which they never did until well after legal action was taken against Huawei) that optimisation would definitely be able to solve the connectivity problems at no additional cost to Creative and thereby placate Creative. If Huawei had in fact done so, the minutes of meeting would most probably have reflected that.

149 In fact, Huawei's own reports on the clusters with completed sites showed that even after optimisation, additional radio sites had to be added to improve the coverage to meet the Contract Requirements.

Cluster Optimisation Report	Original No. of Sites	No. of additional sites proposed by Huawei	Percentage Increase
1	12	3	25%
2	11	2	18.1%
3	10	1	10%
4	12	3	25%
Total	**45**	**9**	**20%**

150 On the totality of the evidence, I am inclined to conclude that optimisation *alone* (without a very substantial increase in the number of sites) is insufficient to make up for the gross underestimation of the number of sites in Huawei's design of the WiMAX Network. In this regard, I accept the assessment of Dr Lee that there might be a limited improvement of some 5% to 10% with optimisation but it was almost certain that Huawei would not be able to meet the requirements in the Contract. Pandion's view was also broadly in line with that of Dr Lee's when he stated in his report that "to a *certain extent*, optimisation can improve the coverage of a radio network" [emphasis added].

151 Accordingly, I find that given the constraints discussed above, optimisation (leaving aside the option of substantially increasing the number of radio sites) is insufficient to bridge the severe underestimation in the number of radio sites needed because the gap is simply too large. I find on a balance of probabilities that the Contract Requirements simply cannot be achieved technically with only 225 (±10%) radio sites.

Connection difficulties

152 From May to July 2011, Creative's employees conducted their own tests and found that the Huawei USB dongle could only make a connection "less than half the time". Actual throughputs were not measured where connections were achieved. While I accept Huawei's criticism that these were *ad hoc* and non-contractual tests done on a partially built network and the test procedures were not documented, I do note however that Creative was not trying to ascertain statistically from these few test locations what the radio coverage probability for the WiMAX Network might be. Creative was merely doing some preliminary assessments of the performance of the WiMAX Network.

153 Arising from Creative's complaints, Huawei agreed to "identify 20 locations to test out the connection of the dongle at the RSSI -85 and CINR >3" by the target date of 16 September 2011.[26] However, Huawei presented the results from only 11 locations. Of the 11, four locations (with RSSI between -83dBm and -89dBm) could not get connections at all; the other two locations (with RSSI between -81dBm and -85dBm) had connections but webpages could not be accessed, suggesting that the data rates were poor. It must be noted that even when a connection could be established at the dongle, a "Cell-edge

[26] Minutes of Project Meeting on 12 September 2011 at PCB 295.

committed data-rate is 1 Mbps DL and 256 kbps UL" must be achieved under the Contract. The remaining five locations (with RSSI between -74dBm and -82.91dBm) could get connections with no problems opening the YouTube videos.[27]

154 I accept that these were preliminary tests to assess the performance of the network and would not amount to proper tests to ascertain if the WiMAX Network met the Contract Requirements in terms of the 90% area coverage probability, or the 1Mbps DL and 256kbps UL, at the estimated cell-edge RSSI of ≥85.76dBm.

155 Be that as it may, Huawei's DW1-Leong nevertheless confirmed that following the results of the tests by Huawei at 11 locations, Huawei's representatives agreed with Creative that Huawei's USB dongle could not reliably connect or access the network at the minimum contract values of RSSI -85.76dBm (for "Dense Urban" and "Urban") and RSSI -87.53dBm (for "Suburban"). This was the state of play at that time. If Huawei had been so confident at that time (and in the six months' period leading up to the termination of the Contract) that the WiMAX Network they designed could perform to the Contract Requirements once the system was fully rolled out and optimised, then it is surprising that, despite all the time and opportunity available to Huawei, it failed to demonstrate its confidence to Creative and did not provide any assurances to address Creative's concerns arising from these preliminary connectivity tests (*eg*, carry out more tests at other locations and present more successful results to show Creative instead of stopping the testing after obtaining poor test results from the 11 locations).

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[27] PCB 304.

156 Creative made a valid point that if indeed there were no connectivity issues (which Huawei now asserts), there would have been no need to spend so much time on meetings (*ie*, on 11 October, 13 October, 9 November, 9 December and 14 December 2011) to address the connectivity issues during which Huawei made generous commercial offers with substantial discounts, labelled by Huawei as "Compensation Offer".

Huawei's three critical mistakes

157 Creative submitted and I agree that the following three critical mistakes were made by Huawei in designing the WiMAX Network:

(a) Huawei's radio network planners wrongly classified HDB estates (that were classified as "denseblockbuild" clutter type in the Singapore Digital Map) as "Suburban" instead of "Dense Urban" and this error alone, if corrected, would have increased the estimated number of radio sites required from 225 to 452;

(b) Huawei's radio network planners wrongly removed the Interference Margin and Fade Margin amounting to a total of 7.43dBm when calculating the minimum RSSI value for the USB dongle to connect to the WiMAX Network with 90% area coverage probability, which if reinstated would have increased the actual number of radio sites from 225 to 875; and

(c) Huawei's radio network planners wrongly applied the Huawei Propagation Model for the WiMAX Network design without having conducted any tuning tests to ascertain its applicability and suitability for use in the building clutter environment in Singapore, especially when the Huawei Propagation Model was derived from tests conducted in cities

> mainly in China. The Huawei Propagation Model had correction factors for "Dense Urban" and "Urban" that were significantly more optimistic by a difference of 6dB[28] when compared to the correction factors under the default Cost-231 Hata Propagation Model. Both Pandion and Dr Lee shared the same opinion that Huawei had no basis to use such optimistic correction factors. Pandion calculated that this mistake alone, if corrected, would have increased the estimated number of radio sites from 225 to 463.

158 Based on Pandion's calculations, if Huawei had correctly planned the WiMAX Network and the three mistakes referred to above were not made, then the estimated number of radio sites required would be 974. I will address them *seriatim*.

Wrong morphology classification used

159 How certain areas in Singapore which principally comprise HDB blocks (*ie*, HDB estates) under the "denseblockbuild" clutter type should be classified was highly contentious at the trial. After a close scrutiny of the Google satellite maps showing the general density of "denseblockbuild" areas and "Suburban" areas in Singapore, it is clear to me that Huawei had made a serious mistake in classifying and grouping "denseblockbuild" areas under "Suburban". This gravely affected the results of the modelling using whichever wave propagation model because far more radio sites would be needed in areas with high rise buildings and more densely spaced blocks of buildings (*ie*, "denseblockbuild" areas) such as HDB estates than in areas with low rise buildings and less densely spaced buildings such as those in the "Suburban" areas because of greater

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[28] Huawei Propagation Model has correction factors of -3dB for "Dense Urban" and -6dB for "Urban" as opposed to the correction factors of 3dB for "Dense Urban" and 0dB for "Urban" adopted by the Cost-231 Hata Propagation Model.

blockage of the radio waves propagating between the USB dongle and the radio sites in the "denseblockbuild" areas. Furthermore, these HDB estates comprise a substantial area of Singapore and correspondingly, the error in the number of radio sites required is magnified if HDB estates were wrongly classified by Huawei as "Suburban".

160 If the correct classification is "Dense Urban" (which I find to be so for the reasons stated below), it is not a "single jump" but a "double jump" upwards from the lowest to the highest of the three classifications used by Huawei for its morphology classification. In assigning such HDB estates the lowest classification of "Suburban" when it should have been the highest and most dense classification of "Dense Urban", it is not surprising to me when it turns out that the real and true path losses in the HDB estates had been severely underestimated and thus the number of radio sites had been grossly underestimated by Huawei in its radio planning for HDB estates. In fact, Pandion had very helpfully re-calculated the number of radio sites on the basis of Huawei's own Cost-231 Hata Propagation Model (without accepting that the correction factors used in Huawei's model were correct), and by just changing the morphology classification of HDB estates to "Dense Urban" whilst keeping everything else unchanged, he found that this re-classification alone would result in the required number of radio sites escalating upwards from 225 sites to 452 sites, *ie*, doubling the number of radio sites based on Huawei's own Cost-231 Hata Propagation Model. In my view, this is again not a surprising result as a fairly substantial part of the coverage area required by Creative comprises HDB estates. Thus any error in the classification of a large area under coverage would significantly affect the final calculated figure for the overall number of radio sites required for the WiMAX Network.

161 I do not think that it can be seriously disputed that if the computer programme applying the selected wave propagation formula to calculate the number of radio sites required for the coverage is "told" that such HDB estates are similar to fairly low rise suburban areas for the purpose of wave propagation, when in fact they are not, the computer necessarily will churn out the wrong results. The simple logic of "garbage in, garbage out"[29] or "wrong input, wrong output" must prevail. I find as a fact that this fatal error by Huawei during its design of the WiMAX Network for Creative is one of the main causes for the gross underestimation in the number of radio sites required. As has been explained earlier, the gross underestimation was so severe that whatever available mitigation efforts that were practically available then (*eg*, optimisation) could not possibly remedy the serious error in Huawei's design, unless a large number of additional sites were added to make up for the completely wrong morphology classification for HDB estates in the design of WiMAX Network.

162 Even Dr Dernikas ultimately, though reluctantly, accepted that perhaps Huawei should not have classified HDB estates as "Suburban", although Huawei's "classification as Suburban would not strictly speaking be wrong". In his 2nd Report at p 37, Dr Dernikas said:

> The **denseblockbuild** clutter, was categorised by Huawei as Suburban. Aircom considers that some areas within this clutter may be classified as Urban.
>
> By deeply examining this clutter, Aircom considers that about 57.41 km^2 of the clutter may be reclassified as Urban, although their classification as Suburban would not strictly speaking be wrong.
>
> ~~[emphasis in original]~~

[29] This is not environmental recycling, where the input is garbage, and useful products may be the output of that recycling.

163 On day 20 of the trial, Dr Dernikas said, "Your Honour, of course, they made a mistake, I mean, it's clear."[30] If it was already so clear to Dr Dernikas, I am surprised that it took him so long to be forthright with the court. I would not expect Dr Dernikas, knowing the duties expected of him as an expert witness to behave in such a manner before the court. After much time was wasted during his testimony, Dr Dernikas finally conceded that Huawei made a clear mistake in its morphology classification but added that Huawei was "not unjustified" in making the mistake. Creative submitted that Dr Dernikas was a biased expert witness, who was playing with words. To my mind, a mistake had been made, regardless whether making it was justified or not and whether it was made negligently or not. The inevitable conclusion I make is that Huawei had certainly made a serious mistake in its morphology classification of HDB estates as "Suburban" when calculating the number of radio sites required.

164 As can be seen, Dr Dernikas was prepared to move up by only "one jump" or one tier to reclassify "denseblockbuild" HDB areas as "Urban" in his expert analysis in his attempt to show that in spite of Huawei's mistake, the WiMAX Network as designed could still meet the Contract Requirements.

165 Whether Dr Dernikas's re-classification of HDB estates only to "Urban" and not to the highest and most dense level of "Dense Urban" became another highly contentious issue with Creative's experts because that would also call fundamentally into question the credibility of the results of Dr Dernikas' analysis. The same issue of "wrong input, wrong output" applies.

166 First, it is very significant that DW4-Zhang, Huawei's new radio planning head who joined the project in September 2011, had decided to

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[30] Day 20, Page 149 lines 16-17.

re-classify HDB estates as "Dense Urban" and not "Urban" or "Suburban" during his simulation calculations ostensibly for a "new requirement" from Creative. The correct morphology classification for HDB estates in Singapore is a standalone question that is not dependant on what connectivity requirements, RSSI or CINR values for the network system performance levels that Creative might set in the Contract for Huawei to design to meet. In proposing to change the morphology classification of the HDB estates (classified as "denseblockbuild" clutter type in the Singapore Digital Map) to one of "Dense Urban", DW4-Zhang had, *prior* to the dispute, independently ascertained for himself that that would have been the correct morphology classification to use. I give that significant weight because DW4-Zhang would have sufficiently wide expertise and experience in this area before he could be trusted by Huawei to helm the radio planning unit in Huawei, which was reputed to be an advanced technology company in such an area. Furthermore, I am inclined to believe that in the light of the problems raised by Creative during this period and the specific request at a meeting on 16 September 2011 by Creative to Huawei to review its classification because the "[u]rban, suburban and dense region defined by Huawei is questionable", and with DW3-Tang specially flown in from Finland in October 2011 to resolve the connectivity problems with the project, Huawei's personnel would have taken far more care henceforth in carrying morphology classifications for its subsequent radio planning exercises for any WiMAX proposals for Creative.

167 In presenting its proposal on "Coverage Prediction after adding new sites for Qmax" to Creative sometime on 11 October 2011 (which was well before the legal dispute arose), Huawei re-classified HDB estates as "Dense Urban".[31] At another presentation by Huawei on 9 November 2011 titled "QMAX WIMAX project review", Huawei stated in its presentation materials:[32]

> The main challenge: 236 sites not able to meet 90% is due changes on the cluster morphology where most of the HDB defined as sub urban in previous planning. *In practical scenario, HDB will be likely categorize as Dense urban in Singapore.*
>
> [emphasis added]

168 Both of these amount to admissions which I give substantial weight to. Why would Huawei re-classify such "denseblockbuild" clutter type/HDB estates as "Dense Urban" if that was not the correct classification in the first place? By then Huawei would have had ample opportunity to bring in all its expertise to carefully study the morphology, get the classification right and ensure that no more mistakes were made. These admissions by Huawei seriously undermine Dr Dernikas' assertion that HDB estates should be re-classified upwards by only "one jump" to "Urban" and not "two jumps" to "Dense Urban", which was what Huawei had done.

169 Second, Creative's experts were also of the firm opinion that the "denseblockbuild" clutter type/HDB estates should be classified as "Dense Urban". Unlike Dr Dernikas, Pandion was far more familiar with the Singapore environment, having stayed in a HDB flat and lived in Singapore for 16 years. Based on his professional experience as a radio network planning and having done radio network planning in Singapore previously (unlike Dr Dernikas, who had not done so), Pandion was of the view that the characteristics of "denseblockbuild" clutter type/HDB estates warranted a "Dense Urban" classification. Pandion's opinion was also supported by Dr Lee's analysis of the empirical data collected during her 2012 Drive Test. Her morphology analysis via the empirical data collected from six HDB estates where all the radio sites planned were completed and switched on revealed that five (*ie*, Yishun, Jurong

[31] PCB 337.

[32] PCB 389.

West, Toa Payoh, Ang Mo Kio and Choa Chu Kang) out of the six HDB estates should be classified as "Dense Urban" with the exception of Jurong East, which could be classified as "Urban". At an empirical level, this corroborates the fact that HDB estates should more appropriately be classified as "Dense Urban", rather than as "Urban" according to Dr Dernikas, or worse as "Suburban" according to Huawei's radio planners at the time they designed the WiMAX Network for Creative.

170 I have also scrutinised the Google satellite maps presented during the trial (using the large screen overhead projections in the Technology Court No 4) and also exhibit P14 on the "Comparison of Denseblockbuild and Blockbuild Clutter Types" to have a general sense visually of whether the "denseblockbuild" clutter type/HDB estates as built looks more like "Dense Urban" or "Urban" areas in Singapore. To me, they are more visually similar to "Dense Urban" rather than "Urban" areas.

171 For all the reasons stated above, I find that Dr Dernikas, in his search for ways to help Huawei establish its defence that the WiMAX Network could still work with 225 (±10%) radio sites, had been less than objective in his analysis. I reject Dr Dernikas' morphology classification of only a "one jump" upwards from "Suburban" to "Urban" instead of a "two jump" upwards from "Suburban" to "Dense Urban". Everything else being equal, there would be a substantial difference in the ultimate number of radio sites calculated using the various wave propagation models when the assumption made in the density of HDB estates is "Urban" (in the middle tier) and not "Dense Urban" (in the highest tier of density). Therefore Dr Dernikas' continued use of the wrong morphology classification for "denseblockbuild" clutter type/HDB estates in all his complicated theoretical calculations necessarily means that the results of his analysis would be unreliable, if not wrong. This is another reason why I reject

his expert analysis and conclusions, and prefer the analyses and conclusions of Creative's experts. I agree with Creative's submission that Dr Dernikas had not been able to offer any logical or reasonable explanation as to why "denseblockbuild" could be classified together with "blockbuild" as "Urban" when the density and building heights differed so greatly. In my view, Creative's assertion that Dr Dernikas' insistence that all areas of "denseblockbuild" in Singapore should still be classified as "Urban" (instead of "Dense Urban") was clearly biased and aimed at manipulating the numbers to cover up Huawei's mistake is not entirely without basis.

172 What then is the impact of Dr Dernikas' insistence on classifying "denseblockbuild" as "Urban" when I make a specific finding in this judgment that he is completely wrong, on balance, in doing so? One must necessarily look at the total area in the coverage that is under "denseblockbuild". Even by Dr Dernikas' reckoning,[33] the "denseblockbuild" area was at least 57.41km^2. Considering that the total coverage area is 256.93km^2, the "denseblockbuild" area on any view represents a *very significant* proportion (*ie*, some 22%) of the total coverage area. Accordingly, my finding that Dr Dernikas had used the wrong morphology classification (of "Urban" instead of "Dense Urban") for at least the 57.41km^2 of "denseblockbuild" area, which is a very significant input to his modelling calculations, leads me inevitably to the conclusion that the eventual number of radio sites (*ie*, 235 radio sites) that he had derived from his calculations (which included all the other complicated adjustments that he deemed necessary to feed purportedly more accurate input data to his model) must also be completely wrong (even if it were to be accepted that all his other complicated adjustments were in fact justified). Hence, I have to reject his expert opinion that his calculations showed that the WiMAX Network as

[33] Para 208(a) of Huawei's Closing Submissions.

designed with only 225 (±10%) radio sites would still be able fulfil the Contract Requirements.

173 I note that Dr Dernikas had not attempted any calculation to show that *if for the sake of argument and comparative analysis* the "denseblockbuild" areas were classified as "Dense Urban" as what Creative's experts opined should be the case (which I now find on a totality of the evidence to be the far more appropriate classification on a balance of probabilities), the Contract Requirements could still be met. I infer that he had not attempted to do so to help the court (*ie*, to find some common ground among the experts based on certain common assumptions) because he knew that *if* he had done so, he would have arrived at the same conclusion as Creative's experts that the WiMAX Network with only 225 (±10%) radio sites simply could not meet the Contract Requirements. I do note however that Huawei's counsel in their closing submissions at para 212 had unequivocally accepted that if the "denseblockbuild" clutter was indeed classified as "Dense Urban", it "*would result* in a *large… increase* in the required number of sites" [emphasis added]. Huawei's counsel could therefore only challenge the "Dense Urban" classification itself for being "unjustified" and "unduly pessimistic", which I disagree for the reasons I have stated.

Fade margin and interference margin erroneously removed

174 Pandion opined that Huawei was wrong to remove both the Fade Margin (of 5.43dBm for "Dense Urban" and "Urban"; and 4.4dBm for "Suburban") and the Interference Margin (of 2dBm) when calculating the minimum RSSI values that the USB dongle would connect to the WiMAX Network with 90% area coverage probability ("the Coverage Planning Threshold"). The minimum RSSI value computed from the Link Budget is essentially a numerical proxy for the

situation where a USB dongle of a particular specification, upon receiving a signal strength of at least those RSSI values, can theoretically achieve a connection with the requisite UL and DL data speeds with a certain probability. This numerical proxy in the form of the requisite minimum RSSI value as the Coverage Planning Threshold would in turn be used by Huawei's radio network planners to conduct simulations using the Radio Planning Tools software available so as to design the WiMAX Network to meet the Contract Requirements.

175 The values of the Interference and Fade Margins were in fact originally present in Huawei's own Link Budget.[34]

176 Pandion opined that Huawei was also wrong to remove the Interference Margin (of 2dBm) when calculating the Coverage Verification Thresholds.

177 It was not in dispute that Huawei had removed both these Margins in its radio network planning for the WiMAX Network. However, Huawei did not provide its reasons for doing so. Dr Dernikas could not enlighten the court as he had not asked Huawei. Eventually, Dr Dernikas conceded that he would not have totally removed both the Fade Margin and Interference Margin when calculating the Coverage Planning Threshold but he would include a lower margin of 2.5dBm instead of 5.43dBm for the "Dense Urban" and "Urban" areas.

178 I accept Pandion's explanation that the Interference Margin must be included so that the WiMAX Network would be able to work under interferences. The Interference Margin would also ensure that the user devices

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[34] PCB 202 to 205.

have enough "power headroom" to combat interferences due to network traffic and thereby avoid a "cell shrinking' effect".[35]

179 I am also persuaded by Pandion's explanation that the Fade Margin was needed as a buffer to account for signal fluctuation and to ensure that the signal was able to achieve 90% area coverage probability.[36] According to Pandion, its omission was a very serious mistake made in Huawei's radio network planning.[37]

180 In short, the error in completely removing the Interference Margin (of 2dBm) and Fade Margins (of 5.43dBm for "Dense Urban" and "Urban", 4.4dBm for "Suburban") from Huawei's radio network planning calculations further aggravated the problems of connection experienced. According to Pandion, as a rule of thumb a difference of 1dBm translates approximately to a 10% change in the actual number of radio sites needed.[38] Huawei's Ying Guan Xiang, Director of Network Planning and Optimisation Technology Development Department of Huawei's affiliate company, Huawei Shenzhen ("DW8-Ying") agreed[39] with Pandion on this.

181 Therefore, the erroneous removal by Huawei of the Interference and Fade Margins of a total of 7.43dBm (for "Dense Urban" and "Urban") and 6.4dBm (for "Suburban") from the Link Budget meant that the number of radio sites required for the Dense Urban and Urban areas would be underestimated by approximately 74.3% and 64% respectively. This in my view will severely

[35] Pandion's 2nd Report Page 26 para 99.

[36] Experts' Conference, Day 16 Page 158 line 17.

[37] Pandion's 1st Report Page 52.

[38] Expert's Conference, Day 16 Transcript Page 177 lines 11-17; Exhibit P29.

[39] XXN of DW8-Ying, Day 15, Page 37 lines 2-22.

underestimate the number of radio sites for the WiMAX Network as a whole because the "Dense Urban" and "Urban" areas together constitute a very large portion of the entire target coverage area required under the Contract.

182 Creative, in its closing submissions, helpfully provided some calculations to demonstrate in more concrete terms the effect of, for instance, a wrongful exclusion of 7.43dBm in Huawei's planning calculations. Based on the rule of thumb of a change 10% for every 1dBm, and therefore an approximate 74.3% difference for the 7.43dBm wrongful exclusion by Huawei, the actual number of radio sites required for the WiMAX Network would be approximately 875 radio sites (100%) instead of 225 radio sites (25.7%).

183 To the extent that the wrong RSSI values were arrived at for the Coverage Planning Threshold (*ie*, 85.76dBm for "Dense Urban" and "Urban"; and -87.53dBm for "Suburban") by Huawei because of its removal of those Interference and Fade Margins, and the wrong RSSI values were thereafter used in its radio network planning to derive a theoretical estimate of the number of radio sites, this had further aggravated the underestimation by Huawei of the number of radio sites actually required to meet the connectivity requirements in the Contract.

Huawei Propagation Model inappropriate for the Singapore environment

184 Creative's experts criticised the use of the Huawei Propagation Model essentially on the basis that without comprehensive tuning and calibration of Huawei's proprietary model in Singapore, or in environments with similar building density to Singapore, Huawei had no justification to use its own proprietary model which used significantly more optimistic correction factors that deviate substantially by 6dBm from the internationally accepted standard

Cost-231 Hata Propagation Model (*ie*, from 3dBm corrected to -3dBm for "Dense Urban" and from 0dBm corrected to -6dBm for "Urban").

185 However, I note that Pandion did not take issue with Huawei's adjustment of the correction factor for "Suburban" from 0dB in the Cost-231 Hata Propagation Model to -12dB in the Huawei Propagation Model whereas Dr Lee took the purest approach and preferred to use the standard Cost-231 Hata Propagation Model as it is, with no changes whatsoever to any of the default correction factors, including that for the correction factor for "Suburban". In other words, Dr Lee preferred to use the standard Cost-231 Hata Propagation Model in its original form for all three different clutter types whereas Pandion took a slightly different view from Dr Lee and was prepared to accept only one of the three adjustments made by Huawei to the correction factor in the standard Cost-231 Hata Propagation Model in respect of "Suburban" areas in Singapore.

186 Dr Lee asserted that based on her experience working on measurements in Singapore, the standard Cost-231 Hata Propagation Model already tended to underestimate the path loss for the Singapore environment. Hence, it would not be justifiable to use a proprietary model that was even more optimistic than the standard Cost-231 Hata Propagation Model for the Singapore environment in any of the three areas: "Dense Urban", "Urban" and "Suburban". On the other hand, Dr Dernikas asserted that the standard Cost-231 Hata Propagation Model overestimated path loss in the Singapore environment.

187 As the experts from both sides have not adduced sufficient supporting evidence (*eg*, scientific papers of international repute) in support of their assertions apart from invoking their working experience, I am unable to determine with any degree of confidence whether the alleged adjustments to the correction factors for "Dense Urban" and "Urban" by Huawei in its Huawei

Propagation Model made it more accurate for the Singapore environment or less accurate for the Singapore environment. As for the substantial correction factor adjustment of 12dB to the standard Cost-231 Hata Propagation Model made by Huawei for the "Suburban", it appears that Pandion agreed but Dr Lee disagreed with this adjustment. Since Creative has decided not to take issue with the use of the Huawei Propagation Model for the "Suburban" areas in Singapore (probably as a result of Pandion's opinion on this), I need not concern myself with it.

188 The only disagreement between the parties is therefore with respect to the *relative accuracy* of the two models in predicting the wave propagation and the theoretical path loss within the "Dense Urban" and "Urban" areas in Singapore and therefore the ultimate effect that would have on the total number of radio sites predicted to be required to meet the Contract Requirements. I will focus now on this disputed issue.

189 I start with the standard Cost-231 Hata Propagation Model, which I *prima facie* accept as being fairly reliable for general use and which has been generally accepted internationally as a theoretical model to predict the wave propagation and path loss. If any change is to be made to the standard formula of the Cost-231 Hata Propagation Model (be it in the correction factors or otherwise) to better predict the wave propagation and path loss for the "Dense Urban" and "Urban" areas and that change is disputed by the parties, then the party asserting that such a change is needed to an internationally accepted theoretical model to make it more accurate specifically for use in Singapore for whatever reason must prove its assertion.

190 What is clear is that Huawei has not provided any empirical evidence to validate that the standard Cost-231 Hata Propagation Model must be adjusted

by 6dBm for "Dense Urban" and "Urban" areas in Singapore. It is not disputed that Huawei itself had never done any tuning or testing for Singapore. Huawei asserted that it had developed its Huawei Propagation Model (which made changes to the default correction factor used in the Cost-231 Hata Propagation Model) based on tests conducted in 24 cities within China, one city in the United Arab Emirates and another city in Morocco. However, there were no checks made to ascertain whether these cities in China, United Arab Emirates and Morocco were of a largely similar density for the different clutter classifications as those in Singapore for the purpose of determining the path loss in respect of wave propagation so that the Huawei Propagation Model could reasonably be said to be more appropriate than the standard Cost-231 Hata Propagation Model at least in respect of the "Dense Urban" and "Urban" clutter types within Singapore.

191 I have read Dr Lee's 2nd Supplemental AEIC filed on 13 November 2015 explaining why the validity of Huawei's calibration was questionable, especially for use in Singapore. She noted the huge variation in the correction factors at 2.1GHz even within the same morphology classification. From her experience, such large variations within a small sample size suggested that caution should be exercised before adopting the 'calibrated' correction factor values for application in a universal context. As a whole, I find that Dr Lee had given sound reasons for questioning the validity of Huawei's calibration for the correction factor values, which I have no basis to reject.

192 In her 2nd Supplemental AEIC, Dr Lee also referred to and produced four scientific papers showing that the Cost-231 Hata Propagation Model is an accurate predictor of path loss in frequencies higher than 2.0GHz, which I have no reason to doubt is the case on a balance of probabilities. I accept Dr Lee's opinion that without comprehensive tuning and calibration of the Cost-231 Hata

Propagation Model in Singapore, or in environments of similar density to Singapore, there is no reason for Huawei to assume that the path loss in the Singapore environment should be so much less than that prescribed by the Cost-231 Hata Propagation Model at least for the "Dense Urban" and "Urban" clutters within Singapore.

193 Without carrying out any comprehensive tuning and calibration within Singapore to determine whether and to what extent the default correction factors for the standard Cost-231 Hata Propagation Model should be altered to cater specifically for the "Dense Urban" and "Urban" areas in Singapore, or to establish that the Huawei Propagation Model would be far more accurate than the standard Cost-231 Hata Propagation Model for use in Singapore, I would think that Huawei was negligent in simply assuming that its Huawei Propagation Model tuned to different cities in different countries and which deviated from the standard Cost-231 Hata Propagation Model substantially by as much as 6dBm for the "Dense Urban" and "Urban" clutters would be immediately applicable to Singapore.

194 I therefore accept Creative's submission that Huawei had no reasonable basis to conclude that it was justified to use the Huawei Propagation Model in Singapore without having carried out any proper checks or tuning of its Propagation Model in the Singapore environment.

195 According to Pandion, the estimated number of radio sites required would have increased from 225 to 463[40] on account of Huawei's 6dBm alteration of the default correction factors in the standard Cost-231 Hata Propagation Model for the "Dense Urban" and "Urban" areas.

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[40] Pandion's 1st Report page 48.

196 Huawei then latched on to Dr Lee's 2012 Drive Test results in an attempt to validate the Huawei Propagation Model[41] for use in Singapore. Unfortunately, Huawei would need to make a 4dBm adjustment to Dr Lee's 2012 Drive Test results to skew those results upwards in order to achieve a better fit with and therefore validate its Huawei Propagation Model (which used correction factors for the "Dense Urban" and "Urban" that were 6dBm more optimistic than the standard Cost-231 Hata Propagation Model). Since I have rejected the need to make a 4dBm adjustment to account for the alleged metal plate effect of the car roof on the USB dongle (see [213] onwards), it necessarily follows that Dr Lee's 2012 Drive Test results *without the 4dBm adjustment* do not validate the Huawei Propagation Model. In fact, those drive test measurements *without the 4dBm adjustment* negate the validity of the Huawei Propagation Model for the "Dense Urban" and "Urban" areas.

197 For the reasons stated above, I find that Huawei has failed to prove on a balance of probabilities that its Huawei Propagation Model is an appropriate model to calculate the number of radio sites for "Dense Urban" and "Urban" areas in Singapore.

198 Accordingly, for the purpose of analysing whether the WiMAX Network can possibly meet the Contract Requirements with only 225 (±10%) radio sites, and if I have to select which propagation model to rely on to give me a good and reliable prediction, I will on balance select the internationally accepted standard Cost-231 Hata Propagation Model over that of the Huawei Propagation Model. If Dr Dernikas' calculations to estimate the number of radio sites required for the "Dense Urban" and "Urban" areas are still based on the Huawei Propagation Model, and if Creative's experts' calculations for the same

[41] See paras 228 to 232 of Huawei's Closing Submissions.

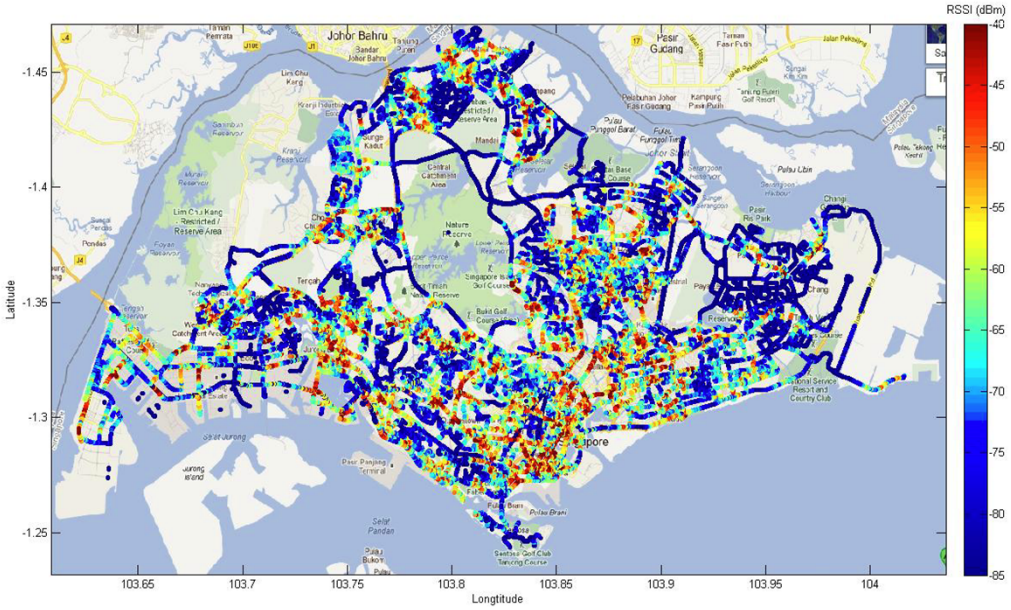
are based instead on the standard Cost-231 Hata Propagation Model, then I prefer the results or estimates of the number of radio sites predicted by Creative's experts for the simple reason that they used an internationally accepted standard Cost-231 Hata Propagation Model, and Huawei's proprietary model has not been proved to me to be an appropriate propagation model for "Dense Urban" and "Urban" areas in Singapore.

Reliability of Dr Lee's 2012 Drive Test results

Initial analysis of the 2012 Drive Test results

199 Paragraph 8(a) of Annexure 6 of the Contract sets out the drive test pass criteria (see [16]). The drive test pass criteria states the minimum CINR values and minimum RSSI values with 90% area coverage probability based on indoor loss values of 18dBm for "Dense Urban", 15dBm for "Urban" and 10dBm for "Suburban" areas.

200 What is clear is that in January 2012, 175 base stations had been set up and were on-air. 162 radio sites still remained on-air and 42 of them had been optimised by Huawei when Dr Lee conducted her drive tests which took approximately eight hours a day over 14 days in April 2012. Dr Lee opined that the drive test routes were able to cover most of the areas of interest and that she had obtained a large enough sample size (with the RSSI and CINR, DL and UL data rate logged at the rate of one sample per second which works out to be approximately one data point for every 10m on the route) to represent the intended coverage area for the purpose of her analysis. She produced in her 1st Report a pictorial representation of the RSSI results recorded by the USB dongle placed flat on the edge of metal roof of the vehicle that bordered the top of the windscreen at the front of the car.



201 Dr Dernikas mounted several criticisms against Dr Lee's 2012 Drive Test results. To begin with, he said that the drop in the number of on-air base stations from 175 to 162 suggested that the network maintenance was lax and inattentive after Creative had terminated the Contract, to such an extent that the network was deteriorating very fast. Dr Lee provided no evidence that she independently checked on factors that could have affected connectivity, *eg*, if the on-air stations were functioning properly, whether the USB dongle used for the test was defective and whether there was any external or internal interference during the drive test. Huawei submitted that "without sufficient evidence on what problems the network was experiencing and what (if any) maintenance work was being carried out, the true extent of the problems within the network is unclear. The results of Dr Lee's April 2012 Drive Test are therefore unreliable, and likely to be pessimistic."

202 Creative said on the other hand that there was also no evidence before the court to show that there were maintenance problems that would have

affected the 2012 Drive Test results. Huawei therefore failed to discharge its burden under s 105 of the Evidence Act (Cap 97, 1997 Rev Ed) to prove its assertion that the existence of sub-standard equipment performance was due to maintenance problems.

203 Given that the equipment supplied was brand new, I am surprised that the equipment would have needed such extensive maintenance or that deterioration could be setting in so quickly so soon after installation. If new equipment deteriorated so quickly, that would call to question the quality and reliability of the *new* equipment that Huawei was supplying. I note that the parties had proceeded with a joint data collection and inspection exercise on every radio site between August and October 2012 prior to dismantling the radio sites and equipment. Having been given the opportunity to observe any deterioration in the WiMAX Network due to maintenance problems (if any), I would have expected Huawei to gather the evidence and surface them at the trial to justify its assertion but Huawei did not do so. Neither was this point on a deteriorating WiMAX Network in April 2012 pleaded. Furthermore, none of Creative's witnesses were cross-examined or challenged that Creative failed to properly maintain the WiMAX Network. Accordingly, I do not accept the rather speculative assertions of Huawei and in particular, Dr Dernikas, about maintenance problems that could possibly have impinged on the reliability of the 2012 Drive Test results.

204 It is all too easy to criticise the extensive work done by another expert. If Huawei believes so strongly that the WiMAX Network it designed could have performed to the Contract specifications, it could have easily performed its own drive tests to demonstrate that to Creative prior to Creative's termination or to prove that fact to the court. I believe that with as many as 175 out of 237 radio sites already installed, there were sufficient areas where installations could be

regarded as completed and sampling these areas through drive tests could provide a good indication of the likely overall performance of the network to a fair degree of accuracy. Why Huawei had chosen not to provide contrary evidence through its own drive test to counter the adverse results of the drive test carried out by Creative might have been its own litigation strategy. Certainly in this case, I am not persuaded by Huawei's tactic of merely having its expert or its witnesses imagine possibilities and start "throwing stones" at Dr Lee's comprehensive drive test results and analysis.

205 The result of such a tactic had also caused extensive time taken at the trial to examine whether there was any factual basis for each of the criticisms. One example was the assertion of likely signal interference from unknown external sources affecting the WiMAX Network connectivity and the 2012 Drive Test results.

206 Huawei referred to a contemporaneous Interference Analysis Document dated 5 December 2011 prepared by DW3-Tang, which showed that interference was detected in some parts of the WiMAX Network. It was unclear from the report which were the areas with significant interference and which were the areas having only minor interference. If anything, this only proves the point of Pandion that in a real network, interference is to be expected and cannot be totally eliminated, and thus the Interference Margin must not be removed when calculating the Coverage Verification Thresholds, which was what Huawei radio planners did for the radio planning exercise for the WiMAX Network.

207 To expect no interference from other sources in a real network is unrealistic. Hence, it is not a justifiable criticism that Dr Lee's 2012 Drive Test results were unreliable because she did not perform the drive test in laboratory-

like conditions with all interference eliminated. In fact, performing the drive test in an "as is where is" condition along the roads in Singapore is what was expected in the Contract. The Contract did not stipulate as a condition that all manner of interference was to be eliminated before the drive test could be carried out.

208 In any event, Dr Dernikas' 2nd Report identified (at paras 140 to 141) signs of possible external interference (particularly for radio sites C070-1 and C170-2) for Dr Lee's 2012 Drive Test results. To my mind, if the results only showed two particular radio sites with possible external interference, then the overall results of the drive test should not be significantly affected by the presence of possible external interference at only two sites out of a total of 162 radio sites on-air at the time of the drive test.

209 In fact, when the two radio sites (labelled as C070-1 and C193-1) were identified by Huawei in the Interference Reports to be "problematic", Creative followed up with IDA on Huawei's Interference Reports to investigate the two radio sites. The interfering wireless video transmitter located at the building of radio site C070-1 was eventually tracked down and switched off by January 2012. For radio site C193-1, IDA informed Creative in February 2012 that "there was no offending signal present detected". Accordingly, the interference issue at the two radio sites was resolved well before Dr Lee conducted her drive tests in April 2012.

210 DW3-Tang testified that since Singapore has a small area, many radio sites would be affected even if there was just one source of interference, thereby suggesting that many more radio sites would naturally be required to counteract just one unknown source of interference to achieve the required connectivity if such an unknown interference was permanent.

211 I note however that in Huawei's theoretical analysis, the additional 619 sites were needed not because there was any significant "interference" to be overcome. Calculations using the theoretical wave propagation models are based on the radio planner's assumptions as to whether (a) interference is ignored completely (an idealistic assumption); or (b) some unavoidable interference is taken into account, whereby a certain amount of "Interference Margin" is to be included in the Link Budget to account for inevitable interference. I think the latter makes for a more robust prediction of wave propagation and connectivity and data speeds in the real world.

212 DW3-Tang later conceded that the presence of external interference had nothing to do with Huawei's proposal involving an additional 619 radio sites, which was made even *before* the external interference issues had surfaced. As can be seen, the issue of external interference is a red herring.

213 Another criticism of Dr Lee's 2012 Drive Test results was the manner of placement of the USB dongle on the roof of the test car during the test drive. According to Dr Dernikas, the metal surface of the test vehicle would have materially and adversely affected the results. Dr Dernikas relied on a new report produced overnight titled "Verification of USB Dongle Drive Test" report dated 18 April 2016 based on an overnight drive test conducted in Shenzhen by Huawei's employees Rong Ke and Zhouqing (the "Shenzhen drive test"), which showed that the RSSI value recorded was 5dBm worse than when the dongle was placed on a non-metallic block above the car roof to isolate the effects of the metal roof of the car.

214 I then directed the parties to conduct a joint test in Singapore to determine whether the RSSI reading of the USB dongle in Dr Lee's 2012 Drive Test was affected by the fact that it was mounted directly onto the metal car roof

and if so, then what desired correction should be applied to the drive test results (the "Metal Plate Test"). I asked the parties to agree on the testing methodology and I left that to the parties to settle. If parties could not settle the testing methodology, I would have expected parties to revert to me for a decision before commencing the extensive testing. If there was an issue over the rigidity or the method of the physical attachment of the dongles during the testing, I would have expected the parties to revert. The parties did not revert at all on any issue. What I would certainly view dimly is for a party to allow a test to proceed when I have specifically asked for the methodology to be agreed in the first place (and if not, it is understood to be settled by the court), and then for that party later to mount multiple criticisms of the test methodology after the tests have been completed in order to challenge the measured test results when they turn out to be adverse to that party. Tests generally involve an expenditure of a considerable amount of resources in terms of manpower, time and money, and it will be a wasteful exercise if the test methodology cannot be agreed or is not settled by the court (if not agreed) to ensure that it is an appropriate and accurate test.

215 On 25 June 2016, Dr Lee conducted the Metal Plate Test using two types of USB dongles: the Huawei E392 USB dongle and the Sierra 320 USB dongle. Essentially, the "control" USB dongle was suspended on a stiff extension protruding from the back roof of the car. The extension was 30cm long as Dr Dernikas insisted that the "control" USB dongle be 30cm away from the metal roof of the car. I accept that placement of the "control" USB dongle on a stiff extension protruding as much as 30cm horizontally away from the back of the roof of the hatchback vehicle would have sufficiently eliminated any potential influence on the USB antenna performance due to the metal roof and would in my view form a reasonable basis for comparison with another USB

dongle of the same make mounted directly on the metal roof of the vehicle with simultaneous logging of RSSI results from both USB dongles during the test drive. A representative from Huawei was present during the test. A copy of the drive log files from the test was given to Huawei immediately following the test. At the same time, Huawei also conducted their own separate drive test in a separate vehicle along the same route.

216 Dr Lee's comprehensive analysis of the Metal Plate Test results showed that the placement of the USB dongle on the metal roof of the car had "no impact on the results of the 2012 Drive Test, save for the adjustment of ±1-2dBm". I understand this to mean that there is no significant impact when the statistical variation is in the narrow range of ±1-2dBm based on the RSSI test measurements. The difference apparently can be a plus or minus, and not always a plus or always a minus, which is probably within the statistical dispersion in the measurements. Dr Dernikas' criticism of the manner of placement of the USB dongle directly on the roof of the test vehicle during Dr Lee's 2012 Drive Test is not borne out by the Metal Plate Test that I have directed to be done. It is therefore unnecessary to apply any correction to Dr Lee's 2012 Drive Test results due to an allegedly wrong or improper method of placement of the USB dongle on the metal roof of the test vehicle.

217 As for the Shenzhen drive test conducted unilaterally by Dr Dernikas, Dr Lee commented that no reliable or meaningful conclusion can be drawn from the Shenzhen drive test because a short route of only 2km was used, which could be completed in minutes. The sample data size would be extremely small in comparison with the route taken by Dr Lee which took over an hour. I agree with Dr Lee that with a small sample size, the mean value would not be representative of the mean especially when the results vary substantially between different sections of the route resulting in a large standard deviation.

In any event, I would disregard the Shenzhen drive test results as Huawei did not call the persons who conducted the test to testify and defend the test results.

218 I note that Huawei chose not to produce before the court evidence of the results and an analysis by Dr Dernikas of its separate drive test conducted in Singapore on the same day as that conducted by Dr Lee. Instead, Huawei relied on its other unverified tests and reports (set out below and referred to collectively as the "Anechoic Chamber Test and Tajikistan Drive Tests") produced very late in the course of the trial and long after the completion of the Metal Plate Test, to continue its assertion that Dr Lee's drive test results should be corrected upwards by 4dB due to the incorrect placement of the USB dongle on the metal roof of the car:

(a) Huawei's Anechoic Chamber Test report prepared by Huawei's engineer Li Zheng Hao dated 16 September 2016 based on an Anechoic Chamber Test in China conducted by Huawei Shenzhen in July 2016;

(b) Huawei's 1st Tajikistan Drive Test report prepared by Huawei's engineer Barashkov Marat dated 16 September 2016 ("Huawei's 1st Tajikistan Report") based on the results of a drive test conducted by Huawei Shenzhen in August 2016 using a WiMAX network in Tajikistan at the 2.3GHz frequency; and

(c) Huawei's 2nd Tajikistan Drive Test report also prepared by Huawei's Barashkov Marat dated 4 October 2016 ("Huawei's 2nd Tajikistan Report") based on the results of a drive test conducted by Huawei Shenzhen in September 2016 using a WiMAX network in Tajikistan at the 2.3GHz frequency.

219 Creative strenuously objected to the Anechoic Chamber Test and Tajikistan Drive Tests on the ground of hearsay, quite apart from the fact that they were produced at a very late stage of the trial. The tests were not carried out in the ordinary course of work but specially conducted for the purpose of providing evidence for this trial by Huawei's staff who did not testify. Dr Dernikas was also not present to supervise the tests. These were rather complicated experiments involving far more than just the mere collection of raw data by equipment because the manner in which the equipment was set up and how the test was conducted would be important considerations directly affecting the raw data itself. Accordingly, I do not accept Huawei's submission that the results of these tests constitute documentary evidence such that they could be proved merely by their production for inspection by the Court under ss 32, 63 and/or 64 of the Evidence Act. Creative's objection is valid and I will disregard these test results.

220 Since Dr Dernikas relied primarily on the inadmissible hearsay evidence (*ie*, the Anechoic Chamber Test and Tajikistan Drive Tests and more particularly the results of the 1st Tajikistan Drive Test) as the basis for his expert opinion that Dr Lee's 2012 Drive Test results should be adjusted upwards by a conservative 4dB, I will reject his opinion on this point, including any analysis by Dr Dernikas that relies on an adjustment upwards of 4dBm to all of Dr Lee's 2012 Drive Test results. Where an expert seeks to give an opinion, the basis of which is dependent upon the truth of hearsay evidence, the expert's evidence is inadmissible. An expert is only permitted to give his opinion when the primary facts upon which that opinion is based has been proved by admissible evidence: *Gema Metal Ceilings (Far East) Pte Ltd v Iwatani Techno Construction (M) Sdn Bhd* [2000] SGHC 37 at [74].

221 In any event, Dr Lee had very helpfully performed a further analysis of her 2012 Drive Test to ascertain the effect of adjusting or correcting all her drive test results upwards by 5dBm (which is a compensation 1dBm greater than that advocated by Dr Dernikas). She found that in spite of this large adjustment, 225 (±10%) radio sites would still remain grossly insufficient to meet the Contract Requirement of a 90% area coverage probability. I accept her analysis on this point which shows that even if the adverse effect of the metal roof on the dongle is real and a signal loss compensation of 5dBm is given, it still would not go far enough to show that the 225 (±10%) radio sites would have been sufficient.

222 Creative submitted and I agree that if the manner of placement of the USB dongle on the metal roof of the test vehicle by Dr Lee was indeed such a "serious error" (as Huawei now alleges), then why did Dr Dernikas not highlight this immediately in his 1st, 2nd and 3rd Reports in January, May and November 2015 respectively, especially when Dr Lee's 2012 Drive Test was made known to Huawei as early as in October 2014? I would have expected a "serious error" to be immediately obvious to an expert given his reputed proficiency and expertise in the field and I would expect him to raise those serious errors at the first available opportunity. Apart from potentially causing trial disruptions, last minute criticisms sprung on the other side very late in the course of the trial would not reflect well on the expert's proficiency and the degree of conviction in his criticisms of the work done by another expert.

223 In any event, Annexure 6 the Contract simply states that "[t]he test terminal will be placed *on* the roof of vehicle." It does not specify that the USB dongle must be placed vertically or on a thick foam platform to raise it some distance (*eg*, 10cm) *above* the roof of the vehicle as appears to be suggested by Dr Dernikas. Again, if raising the dongle above the roof of the test vehicle for the test drive is such a critical issue, then I would have expected the Contract to

have specified the manner of placement of the dongle to, for instance, 10cm *above* the roof of the test vehicle. I will therefore adhere to the Contract specifications for the manner of placement of the dongle for the test drive to be *on* the roof and not elevated *above* the roof, and the stipulated pass test criteria in dBm in determining whether the Contract Requirements could technically be met with only 225 (±10%) radio sites.

Re-analysis of the 2012 Drive Test Results

224 During the trial, Dr Dernikas opined that Dr Lee's analysis was unreliable as not all the radio sites for the entire network had been completed and optimised. He contended that the results would thus be skewed in areas where not all radio sites had been completed and switched on. Dr Dernikas explained that as not all of the sites were on-air during Dr Lee's 2012 Drive Test, this meant that the on-air base stations were overreaching beyond their planned coverage areas to cover areas they were not meant to cover, thus giving an impression of weak coverage (*ie*, weak signals in areas with base stations not yet on-air or not switched on) because these areas would be covered by on-air base stations further away.

225 To address this significant issue, I thus directed Dr Lee to re-analyse the data collected for all "areas in which all the antenna stations have been built, all the antenna stations built are operating".[42] Dr Lee's results after her re-analysis showed that *none* of the 15 radio sites in the six *completed* areas with all radio sites switched on and in operation (*ie*, Yishun, Jurong East, Jurong West, Toa Payoh, Ang Mo Kio and Choa Chu Kang) met the 90% area coverage probability requirement for "Dense Urban" and "Urban", while only one out of

[42] Experts' Conference, Day 16, Page 251 lines 13 to 25.

four radio sites in Jurong East met the 90% coverage probability requirement for "Suburban". In fact, for the "Dense Urban" criterion, the coverage probability in the "Dense Urban" areas fell far short of 90% ranging from 21.1% to 68.3% (see Table E of Dr Lee's 3rd Report dated 4 October 2016 at para 53, which I have reproduced below). The results from the sample were dismal as can be seen from Table E of Dr Lee's 3rd Report.

Table E

Location	Optimised	% of data points above Dense Urban Criteria (-67.76 dBm)	% of data points above Urban Criteria (-70.76 dBm)	% of data points above Suburban Criteria (-77.53 dBm)
4 Sites in Yishun	N	57.1%	62.3%	74.5%
	N	30.0%	36.3%	48.9%
	N	22.3%	29.0%	43.7%
	N	38.7%	52.8%	71.4%
4 Sites in Jurong East	N	55.3%	62.5%	73.7%
	Y	44.6%	50.3%	64.6%
	N	68.3%	76.5%	88.9%
	Y	61.4%	71.1%	92.7%
4 Sites in Jurong West	Y	42.4%	47.9%	60.7%
	Y	31.7%	38.1%	67.0%
	Y	50.6%	59.0%	82.1%
	Y	44.9%	57.3%	72.2%
Toa Payoh	N	52.1%	59.6%	73.5%
Ang Mo Kio	N	21.1%	26.1%	43.5%
2 sites in Chua Chu Kang	N	37.1%	40.3%	65.3%
	N	55.8%	65.8%	83.2%

The values in Red are the % that fall beneath the 90% probability requirement stipulated in paragraph 8 , Annexure 6 of the Supply Contract

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227 I accept that these are samples of the target coverage areas in Singapore. Sometimes we have no other choice but have to make do with whatever limited data from the measurements already taken to make assessments and decisions. But random samples of a sufficient size (*ie*, a total of 16 radio sites in six completed areas with all radio sites switched on and in operation) may be enough to enable a person with some knowledge of statistical analysis to reach a fairly reliable predicted conclusion for the entire target coverage area in Singapore that are of *similar* morphology to the largely HDB estate areas of Yishun, Jurong East, Jurong West, Toa Payoh, Ang Mo Kio and Choa Chu Kang (for which all radio sites have been completed and switched on) with a certain confidence level. Though this may only represent HDB estates, these estates nevertheless do represent a fairly large area of 57.41km^2 out of the target coverage area of 257 km^2 (*ie*, approximately 22%), and are very important areas for connectivity since most residents in Singapore live in HDB estates. I do not accept that a fairly reliable assessment of the "whole" can never be derived from a reasonably sized sample of the "whole".

228 Based on the above results, Dr Lee concluded that even if the WiMAX Network had been completed and optimised, it would not have been able to meet the Contract Requirements of nationwide coverage with 90% area coverage probability. In other words, 225 (±10%) radio sites were grossly insufficient.

229 Having scrutinised Dr Lee's very comprehensive 3rd Report of her re-analyses, I accept her overall conclusion therein that:

> 87 It is therefore clear that, based on **real-life measurements** from the completed sections of the WiMAX network, it was impossible for Huawei to meet the requirements in **Paragraphs 8(a), 8(b) and 8(c), Annexure 6 of the Supply Contract**.
>
> [emphasis in original]

230 In any event, I do not have to decide on what is the exact or accurate number of radio sites that will in fact meet the Contract Requirements. I only need to decide on a balance of probabilities whether 225 (±10%) radio sites as designed for by Huawei will broadly be sufficient or insufficient to meet the Contract Requirements.

231 After examining the available evidence, I am inclined on balance to accept that the 2012 Drive Test results based on the USB dongle are sufficiently reliable, given the practical limitations with which Dr Lee had to work under. From those results, Dr Lee used a reasonable methodology to analyse and project the number of base stations that would be required for the WiMAX Network to meet the Contract Requirements. That is the best estimate based on practical measurements of the actual network performance, albeit of an almost completed WiMAX Network as opposed to a different mode of analysis using purely theoretical modelling based on wave propagation principles and morphologies.

232 Huawei submitted that the April 2012 Drive Test results, with a conservative correction of 4dBm, validated Huawei's planning of the WiMAX Network (including Huawei's use of the Huawei Propagation Model instead of the Cost-231 Hata Propagation Model). I reject this submission because I do not accept the radio network analysis of Dr Dernikas, which adjusted Dr Lee's 2012 Drive Test results by 4dBm to correct for the allegedly wrong placement of the USB dongle horizontally on the metal roof of the test car. I have earlier given my reasons why no such correction was needed because a practical test drive test conducted by Dr Lee had demonstrated that such a correction was in fact not required.

233 I also note the further criticism by Creative's experts that Dr Dernikas should not have removed the Interference Margin of 2dBm from his analysis (thus boosting the theoretical performance of the network by a further 2dBm) because the purpose of the 2dBm Interference Margin in the first place was to allow the network to be able to work in the presence of external interferences to be expected in the real world. I find this criticism to be valid. By giving his radio network analysis a total boost of 6dBm, Dr Dernikas would have already underestimated the number of radio sites required for the WiMAX Network by approximately 60% (based on a rough guideline that a difference of 1dBm translates to approximately a 10% difference in the number of radio sites required). Since Dr Dernikas' analysis of between 237 and 247 sites being sufficient was a 60% underestimate of the true number of sites (because of the 6dBm correction he made to Dr Lee's 2012 Drive Test results, which I do not accept), then implicitly the correct number of sites would have been between 592 (being 237 ÷ 0.4) and 617 (being 247 ÷ 0.4) sites based on Dr Dernikas' analysis. This is without factoring the wrong treatment by Dr Dernikas of "denseblockbuild" clutter type (HDB estates) being classified as "Urban" instead of "Dense Urban".

Reliability of the Shenzhen Connectivity Test

234 Huawei additionally attempted to rely on a report prepared by Rong Ke dated 13 November 2015 which was exhibited in Dr Dernikas' 3rd Report as an exhibit (the "Shenzhen Connectivity Test Report"). Huawei relied on this report to show that the WiMAX Network would have been able to achieve the data rates of 1Mbps on the DL and 256kbps on the UL at the cell edge, for which the contractual RSSI would be -85.76dBm for "Dense Urban" and "Urban", and -87.53dBm for "Suburban". I note that these contractual DL data rates must be the *minimum* down load rates to be achieved because the reference point is the

RSSI at the cell edge, which is theoretically the point furthest from the radio site and therefore, the point with theoretically the weakest signal strength.

235 The Shenzhen Connectivity Test Report concluded that there was an almost 100% successful rate for the UL and DL data throughput at signal strengths at around -86dBm.

236 I accept Creative's submission that the use of the Seowon (GCT) SWU-3020 USB dongle, which had a gain of 3dBm, for the Shenzhen Connectivity Test was inappropriate considering that the Contract called for "a standard USB dongle with 0dBi antenna gain". This would unduly skew the results. In comparison, Dr Lee had correctly used a USB dongle with 0dBi antenna gain for her drive tests. I do not understand why Huawei selected a USB dongle with a higher gain for its tests when it knew all along the reference point was a 0dBi gain USB dongle. It is not as if they could not have readily procured "a standard USB dongle with 0dBi antenna gain" for the tests, in order to produce results that the court could safely rely on. This certainly raises questions whether or not Huawei had tested with a 0dBi antenna gain dongle first, and after finding that the results were not to its satisfaction, it then changed to a higher gain 3dBi dongle to get the results it wanted and then tried to explain later in its report why there would be basically no difference between the two types of dongles. This approach by Huawei in developing its defence for the trial is certainly not helpful to the court and wastes the court's time. If so much time, effort and resources are to be spent in carrying out the test, then surely care must be taken to ensure that the test is properly done in the first place with parameters as close as possible to the appropriate reference levels in order to obtain reliable results at the correct reference levels.

237 Second, I give some weight to Dr Lee's opinion that these tests being carried out in Huawei's laboratory in Shenzhen naturally produced results that were amplified and better than the actual environment in which Dr Lee carried out her 2012 Drive Test. In a real environment which the WiMAX Network was supposed to be operating, the presence of some external interference would be expected and that would affect to some extent the signal strength and quality, and therefore also the expected connectivity and data throughput rate as recognised by Dr Dernikas in his 2nd Report. In my view, it is implied in the Contract that the reference levels are not the kind of levels that are based on an ideal laboratory environment but in a real environment with actual drive tests for acceptance testing.

238 I therefore prefer the connectivity and DL data rate results from Dr Lee's 2012 Drive Test over the laboratory results of Huawei with the use of a higher gain dongle than that stipulated as the reference dongle in the Contract Requirements.

The Myriad Propagation Model and the Crosswave Propagation Model

239 Dr Dernikas, in his 3rd Report, introduced the Myriad Propagation Model, a vector-based propagation model which he opined would be a more accurate method to determine the number of radio sites required to meet the Contract Requirements because it takes into account actual vector data in the map to calculate path loss. According to Dr Dernikas, the vector-based propagation model "eliminates the need for the classification of areas into clutter types… with generic definitions of clutter loss… [as it] uses the actual building structure to determine how signals will behave around it, and therefore better models the environment experienced by real users without the need for a subjective categorisation of an environment into clutter types".[43]

240 Dr Dernikas ran multiple simulations using the Myriad Propagation Model basically to demonstrate that 237 radio sites (within the range of 225 ±10% radio sites) were sufficient to meet the Contract Requirements of nationwide coverage with 90% area coverage probability.

241 Pandion criticised the parameters used by Dr Dernikas in his Myriad Propagation Model and the manner in which Dr Dernikas had interpreted the meaning of "90% area coverage probability" for his simulations. I will briefly set out Pandion's extensive criticisms and my views on them:

(a) I agree with Pandion that it was wrong for Dr Dernikas to exclude the Fade Margin for the reasons stated earlier in this judgment. Hence, those simulations of Dr Dernikas that failed to take the Fade Margin of 5.4dBm into account would have to be ignored.

(b) The coverage percentage computed by Dr Dernikas was a composite of the outdoor and indoor percentage coverage. For Dr Dernikas' composite percentage coverage, if the outdoor areas constituting 90% of the total area received the requisite signal strength but all indoor areas covering the balance 10% of the total area did not receive the requisite signal strength, then Dr Dernikas could still achieve his composite percentage of 90%, and he would therefore conclude that the 90% coverage under the Contract was met. However, Pandion said that Dr Dernikas' use of the composite percentage was misleading and did not in fact reflect the Contract Requirements of nationwide coverage with first wall penetration, because indoor users behind only one wall should also enjoy 90% area coverage probability.

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[43] Dr Dernikas' 3rd Report Page 18, para 113.

(c) In connection with this, PW2-Foo offered his explanation on the technical meaning of "90% area coverage probability" referred to in paras 8(a), 8(b) and 8(c) of Annexure 6 of the Contract. PW2-Foo explained[44] that the USB dongle should be able to connect to the network 90% of the time, within the coverage area:

> A: So if you allow me to quote one example. So for design purpose, so let's say -- take for example, I want to cover whole Singapore. If I say I want to cover the whole Singapore, based on 90 per cent reliability, statistically it's the same, I cover the whole Singapore, *but at every location*, I have a chance of connection, *9 out of 10 times, this is the same as 90 per cent of the area I can get connection.*
>
> [emphasis added]

Therefore, even within all the indoor areas after first wall penetration (*ie*, where users in their homes use their mobile phones to connect to the internet via the WiMAX Network for example), there should also be a 90% probability of getting a connection with the minimum desired data rates stipulated in para 8 of Annexure 6 of the Contract.

(d) However, I prefer Pandion's more precise clarification of the technical term "coverage probability of 90%" or "90% area coverage probability", which he explained is the 90% probability of obtaining data rates of 1Mbps on the DL and 256kbps on the UL using a USB dongle with 0dBi gain and QPSK ½ modulation. This "90% area coverage probability" is not the same as "the probability of connection" at the cell edge. Since connection only requires 10 seconds of kbps in both directions on the DL and UL, "the probability of connection" must necessarily be much higher than 90% before the "90% area coverage probability" can be

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[44] XXN of PW2-Foo, Day 4, Page 48 line 21 to Page 49 line 3.

achieved.[45] I accept Pandion's clarification on the technical term including the more important technical fact that a "probability of connection" of *above 90%* is needed before the Contract Requirements of, *inter alia*, a "90% area coverage probability" as spelt out separately for each of the areas of "Dense Urban", "Urban" and "Suburban", can be met (see [16] above).

(e) I accept this to be the correct and sensible interpretation of the technical phrase "90% area coverage probability" which is entirely consistent with what Pandion had said: that indoor users behind only one wall should also enjoy "90% area coverage probability". Accordingly, I reject Dr Dernikas' interpretation of "90% area coverage probability", which allowed him to use a composite method of computation that would likely result in those indoor users having a much lower coverage probability than the stipulated "90% area coverage probability".

(f) Pandion used the Crosswave Propagation Model to demonstrate how Dr Dernikas's "composite method" of calculation enabled him to achieve an area coverage percentage close to 90%, but he had in fact masked the very poor *indoor area percentage coverage* of only about 60% even on Dr Dernikas' input parameters, which Pandion asserted were in themselves overly optimistic and erroneous, as can be seen in the table below:[46]

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[45] Pandion's 2nd Report at paras 215 to 218.

[46] Pandion's 3rd Report p 22 at Table F.

Morphology	**% <u>Whole Area</u> Coverage with Dr Dernikas' Inputs**	**% <u>Indoor</u> Coverage with Dr Dernikas' Inputs**
Dense Urban	85.69%	58.72%
Urban	88.91%	57.01%

(g) I agree that Dr Dernikas' use of a composite coverage percentage was erroneous and indeed misleading. Hence I reject entirely Dr Dernikas' composite method of computation and also the results of that computation which he said demonstrated on the whole that the "90% area coverage probability" was met. What use is it if those indoors behind one wall are not going to have a minimum "90% area coverage probability" (and in reality they get only about "60% area coverage probability" which is probably a wholly unacceptable level of performance for indoor users) and they have to go outdoors in order to get a better chance of getting a connection with a "90% area coverage probability"? The Contract Requirement of a "90% area coverage probability" separately for each of the three different clutters of "Dense Urban", "Urban" and "Suburban" does not mean that those indoors behind one wall in each of the three respective clutters can be sacrificed in terms of connection quality when they are also supposed to be getting at least a "90% area coverage probability". I agree that the Contract Requirement can only be interpreted sensibly to mean that *both* indoor and outdoor areas will have "90% area coverage probability" for each of the three different clutters.

(h) Based on his experience working with his previous employers Cybercom, which had performed a tuning of the Crosswave Propagation Model in Singapore, Pandion said that vector-based propagation models

tended to underestimate of the path loss in Singapore by at least 3.3dBm and therefore, an additional loss of 3.3dBm should be added so as to calibrate the vector-based model for use in the Singapore environment, which Dr Dernikas failed to do. Pandion disagreed with Dr Dernikas' assertions that his coverage simulations using the Myriad Propagation Model, un-tuned and without taking into account the morphology, were accurate in the Singapore environment. Dr Dernikas admitted that the Myriad Propagation Model had not been tuned for the Singapore environment.

(i) Dr Dernikas also removed the Interference Margin of 2dBm when using the Myriad Propagation Model for his simulations. I agree with Pandion that there was again no justification for him to do so because this margin should be included to ensure that the WiMAX Network would still be able to work reasonably well despite the inevitable presence of interference in a real environment due to other network traffic.

(j) Pandion demonstrated the difference in the percentage door coverage for the "Dense Urban" and "Urban" areas between *excluding* and *including* the 2dBm Interference Margin and the 3.3dBm correction factor for the Singapore environment. Pandion established (using the Crosswave tool's inbuilt "Indoor Coverage" setting) that once the 2dBm and 3.3dBm adjustments were both taken into account, the percentage coverage drops even further to well below the Contract Requirements (*inter alia*, of 90% coverage) as can be seen in the table below:[47]

[47] Pandion's 3rd Report p 22 at Table F.

Morphology	**% Indoor Coverage excluding both the 2dBm Interference Margin and the 3.3dBm correction factor**	**% Indoor Coverage including both the 2dBm Interference Margin and the 3.3dBm correction factor**
Dense Urban	58.72%	35.62%
Urban	57.01%	34.54%

242 Creative's counsel further pointed out two significant errors in Dr Dernikas' calculations where Dr Dernikas used lower indoor loss values than those set out in the Contract. Dr Dernikas used a "10dBm" and a "0dBm" loss respectively for the "Urban" and "Suburban" morphology classification whereas the Contract required a much higher loss at "15dBm" and "10dBm" respectively. This error again translated into another underestimation of the indoor loss in his calculations.

243 Having regard to all the above valid criticisms and the calculation errors, I am of the view that the results of Dr Dernikas' simulations using the Myriad Propagation Model are not reliable. I therefore reject the results of his simulations.

244 I turn now to examine Pandion's analysis using a similar vector-based propagation model called the Crosswave Propagation Model. Pandion explained that the Myriad Propagation Model is TEOCO/AIRCOM's name for the propagation model developed by Orange LABS (France Telecom) integrated as part of TEOCO/AIRCOM's ASSET planning tool. Other major radio network companies have also integrated the exact same Orange LABS (France Telecom)'s propagation model under licence into their radio planning tools. Forsk's ATOLL planning tool identifies it as the Crosswave Propagation

Model. Infovista's MENTUM PLANET planning tool, the third major radio planning tool after ASSET and ATOLL, calls it the Universal Propagation Model.

245 I accept Pandion's opinion that the ASSET's Myriad Propagation Model was exactly the same as the ATOLL's Crosswave Propagation Model because both were based on the same Orange LABS (France Telecom)'s propagation model.

246 Pandion agreed with Dr Dernikas that the Myriad Propagation Model would be a more accurate propagation model than the Cost-231 Hata Propagation Model.

247 Huawei submitted that predictions from Pandion's Crosswave Propagation Model of a requirement of 509 radio sites for the WiMAX Network (with a real-life tuning adjustment of 3.3dBm included) when compared with the requirement of 1118 radio sites[48] for the WiMAX Network as derived from the standard Cost-231 Hata Propagation Model using correction factors of 3dBm (for "Dense Urban"), 0dBm (for "Urban") and -12dBm (for "Suburban") and with HDB estates classified as "Dense Urban", showed that the latter (*ie*, the Cost-231 Hata Propagation Model) significantly overestimated path loss in the Singapore environment and consequently, the number of sites required.

248 In my view, merely showing that the standard Cost-231 Hata Propagation Model is significantly more pessimistic in its prediction than the Myriad/Crosswave Propagation Model does not take Huawei's case very far. Regardless of whether it is 509 or 1118 radio sites as predicted by the

[48] See para 236 of Huawei's Closing Submissions.

Myriad/Crosswave Propagation Model or the standard Cost-231 Hata Propagation Model, these numbers in any event far exceed Huawei's WiMAX Network design based on its own proprietary propagation model that only provides for 225 ±10% radio sites.

249 For the sake of argument, if HDB estates were to be properly re-classified from "Suburban" to "Dense Urban" while keeping everything else unchanged,[49] I believe that even Huawei's own proprietary propagation model would show that the 225 (±10%) radio sites Huawei originally planned for in its WiMAX design will be grossly inadequate, for the simple reason that the 225 (±10%) radio sites is just barely adequate even when HDB estates remain wrongly classified as "Suburban". In other words, 225 (±10%) radio sites will become far too few in number by whichever wave propagation model is used once HDB estates are correctly treated as "Dense Urban".

Election to rescind

250 Thus far I have found that Huawei is liable to Creative for both damages under s 2(1) of the Misrepresentation Act and also for breach of contract. Huawei argued that, in light of these findings, rescission of the Contract for misrepresentation was "conceptually impossible" since Creative succeeded on its primary ground of breach of contract, and therefore the contract was terminated. There was nothing to rescind. This argument was based on Creative's letters. By a letter dated 29 December 2011, Creative terminated the Contract for repudiatory breach. It was only nearly one month later on 20 January 2012 that Creative also sought to do the same for misrepresentation.

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[49] Keeping the same correction factors of -3dB (Dense Urban), -6dB (Urban) and -12dB (Suburban), which Creative's experts have stated are too optimistic.

251 It is unclear whether Huawei's argument that rescission was "conceptually impossible" was that Creative was precluded from even *raising* misrepresentation given that it had initially chosen to base its position on breach of contract, or whether Huawei was contending that the Contract could only be terminated or rescinded, and not both. But I find that neither argument supports Huawei's ultimate contention that Creative was not entitled to the damages that it sought.

252 I do not accept the first argument that Creative is precluded from raising the misrepresentation issue because of its letters. While it is true that a contract can only either be terminated or rescinded but not both (and I shall elaborate on this later), this does not prevent Creative from raising both. It is trite that a party can plead inconsistent rights in the alternative as long as doing so does not offend common sense (*Ng Chee Weng v Lim Jit Ming Bryan* [2012] 1 SLR 457 at [36]). It would not offend common sense to plead both termination and rescission because Creative would not be contradicting itself by saying that Huawei did not comply with the Contract Requirements and that Creative was induced into entering the Contract by a false statement of fact, even if the Contract cannot be both terminated and rescinded. The real question is whether, by its conduct, Creative had given up the right to raise misrepresentation in the first place, and this is governed by the general law on waiver by election. In essence, there must have been an unequivocal act amounting to an election of one right over another (*Jurong Town Corp v Wishing Star Ltd* [2005] 3 SLR(R) 283 at [171]).

253 I find that Creative did not make such an unequivocal expression of its intention *not* to pursue misrepresentation in the trial. To the contrary, Creative had made it quite clear in its letter of 29 December 2011 at para 10 that "all of Creative's and Qmax's rights are expressly reserved" and that "[n]othing in this

letter is to be construed as a waiver of *any* of [their] rights to assert and/or pursue any other claims under the Contract" [emphasis in original]. When read together with the subsequent letter of 20 January 2012 which expressly referenced this earlier letter, it cannot be said that Creative had been so unequivocal in its conduct that it had given up its right to raise misrepresentation.

254 If Huawei's argument was that the Contract could only be terminated or rescinded but not both, I agree with this. Terminating a contract is prospective in that the contract is discharged from that point forward, but rescission is retrospective in that the contract is discharged *ab initio*. The Contract can only be discharged from one point in time and the parties must be able to know when that point is. But this does not take Huawei's case very far. Even if Huawei were right and Creative was unable to elect to rescind the Contract for misrepresentation because its primary case was breach of contract, Creative would still be entitled to the sums claimed for in principle, subject of course to the precise computation of damages (see below from [290]).

255 Creative claimed two sums: (a) amounts it advanced to Huawei under the Contract, and (b) damages for wasted expenditure that Creative incurred to complete the Contract (see above at [2]). Since Huawei breached the Contract, Creative would be able to claim damages for its reliance loss, which would include both these sums as the "costs and expenses the claimant incurred in reliance on the defendant's contracted-for performance, but which were wasted because of the breach of contract" (*Alvin Nicholas Nathan v Raffles Assets (Singapore) Pte Ltd* [2016] 2 SLR 1056 at [24]). Accordingly, Huawei's argument on election, regardless of which interpretation is taken, must fail.

Conclusion for Suit No 55

256 Based on the totality of the evidence, I find that 225 (±10%) radio sites would not meet the Contract Requirements of nationwide coverage for Singapore with first wall penetration, based on a measurement criteria of ≥-85dBm RSSI and CINR of 3dBm, with military areas, cemeteries and large bodies of in-land water being excluded from the coverage. As such, the Contract could not be performed by Huawei because Huawei had designed the WiMAX Network wrongly.

257 Based on the vector-based Crosswave Propagation Model, I find that over 700 radio sites would probably be needed. The estimate from this theoretical propagation model is corroborated by Huawei when it informed Creative sometime in October 2011 that 855 radio sites would be required based on its revised parameters after the connectivity problems were encountered during some preliminary testing of the WiMAX Network at certain locations. Huawei's conduct and admissions of mistakes in radio planning from October to December 2011 and the absence of an assertion in the contemporaneous documents that the Contract could still be performed with 225 (±10%) radio sites severely undermines Huawei's defence that the WiMAX Network was correctly designed by Huawei and that it could therefore meet the Contract Requirements.

258 I find that Huawei, as the designer of the WiMAX Network for Creative under the Contract, was responsible for ascertaining the correct number of radio sites to meet the Contract Requirements to Creative. I accept that Huawei's design errors resulting in the gross deficiency in the number of radio sites stipulated in the Contract can reasonably be attributable to the following three critical mistakes made by Huawei during its design of the WiMAX Network:

(a) Huawei's radio network planners wrongly removed the Interference Margin (2dBm) and Fade Margin (5.43dBm) when calculating the minimum RSSI value that would allow the USB dongle to connect to the WiMAX Network with 90% area coverage probability.

(b) Huawei's radio network planners wrongly classified HDB estates ("denseblockbuild" clutter type) as "Suburban" instead of "Dense Urban".

(c) Huawei's radio network planners applied the Huawei Propagation Model (without justification) which had correction factors for "Dense Urban" and "Urban" that were significantly more optimistic than the correction factors under the standard Cost-231 Hata Propagation Model.

259 Accordingly, I find that Creative lawfully terminated the Contract for repudiatory breach based on the repudiatory conduct by Huawei and also on the technical inability of Huawei to perform the Contract due to Huawei's faulty design of the WiMAX Network, and in the alternative, it lawfully rescinded the Contract for misrepresentation. Huawei's counterclaim in Suit No 55 must necessarily be dismissed.

Suit No 606

260 ZiiMAX, a wholly-owned subsidiary of CTL, did not dispute that it (a) issued purchase orders to Huawei in respect of 1000 units of WiMAX indoor CPE for use in Creative's WiMAX Network ("ZiiMAX Purchase Orders"); and (b) received these items delivered to it on 28 June 2011 pursuant to the CPE Agreement. Therefore, the sum of US$104,860 (inclusive of GST) being the outstanding payment for the purchase of the 1,000 units of WiMAX indoor CPE

is due and owing to Huawei, which forms the basis of Huawei's claim in Suit No 606.

261 ZiiMAX counterclaimed against Huawei in the same Suit No 606 for the return of US$85,600 paid by ZiiMAX to Huawei for 2,000 pieces of USB dongles supplied by Huawei to ZiiMAX pursuant to the USB Agreement, which were to be used by ZiiMAX for the WiMAX Network.

ZiiMAX's submissions

262 I will first summarise ZiiMAX's submissions, although I note that Creative appears to be submitting on ZiiMAX's behalf for certain parts[50] of those submissions in Suit No 606. I will in any event treat then as ZiiMAX's submissions.

263 ZiiMAX contended that Huawei, as the designer and builder of the WiMAX Network for Creative and also the supplier of USB dongles and indoor CPEs, knew that CTL, through its wholly-owned subsidiary ZiiMAX, had entered into the CPE and USB Agreements to purchase the indoor CPEs and USB dongles to be exclusively used by end users in the WiMAX Network. Huawei was also aware that ZiiMAX was the business arm of CTL to market the WiMAX Network to end users.

264 ZiiMAX argued that without the WiMAX Network, there would be no need for ZiiMAX to purchase the indoor CPEs and USB dongles from Huawei on *behalf of Creative*. Huawei was fully aware of this.[51] ZiiMAX submitted that

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[50] Creative's Closing Submissions at paras 670 and 673.

[51] XXN of DW1-Leong, Day 5 Page 176 lines 4 to 19; XXN of DW2-Cao, Day 6 p.127 line 25 to p.128 line 12.

Creative and Huawei had always treated the Contract and ZiiMAX Purchase Orders as linked and for the same single purpose – the WiMAX Network project.

265 Critically, the indoor CPEs and USB dongles purchased were specifically engineered and designed to connect to a radio frequency of 2.3GHz, the radio spectrum assigned to Creative for the WiMAX Network.[52] According to PW3-Lian, programmed into the indoor CPEs and USB dongles' firmware is a Public Key Infrastructure certificate which corresponds to the authentication engine in the WiMAX Network. Hence, the indoor CPEs and USB dongles could not be used with any other wireless networks.[53] Only Huawei, as manufacturer of the indoor CPEs and USB dongles, could change the Public Key Infrastructure certificate; ZiiMAX did not have the technical capabilities to do so.[54] In other words, the indoor CPEs and USB dongles, being specially designed for use only with the WiMAX Network of 2.3GHz, would be completely useless in the hands of ZiiMAX without the successful completion of the WiMAX Network of 2.3GHz by Huawei.

266 Having regard to the nature and effect of the CPE and USB Agreements, and the circumstances in which they had come into being, ZiiMAX submitted that there was an implied term in these agreements that if the WiMAX Contract between Creative and Huawei were rightfully terminated or rescinded by Creative on account of breach or misrepresentation *by Huawei*, then ZiiMAX who had purchased the indoor CPEs and USB dongles *on behalf of Creative*,

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[52] AEIC of PW3-Lian Page 10 at para 37.

[53] AEIC of PW3-Lian Page 11 at para 38; XXN of PW3-Lian, Day 5 Page 234 line 24 to Page 235 line 5.

[54] XXN of PW3-Lian, Day 5 Page 239 line 24 to Page 240 line 10

would also be entitled to avoid or terminate the CPE and USB Agreements. The performance of the CPE and USB Agreements by ZiiMAX was inextricably linked to the performance of the WiMAX Contract by Huawei for obvious business efficacy. ZiiMAX contended that it would be plainly unjust for ZiiMAX (and its principal Creative) to be saddled with useless Huawei indoor CPEs and USB dongles ordered exclusively for use in the WiMAX Network when the WiMAX Network itself was not launched due to Huawei's own mistakes in its design of the network. If an officious bystander were to be asked if a term would necessarily have been included in the CPE and USB Agreements for the supply of exclusive equipment for the WiMAX Network to allow ZiiMAX to terminate or rescind the agreements if the WiMAX Network could not be launched on account of Huawei's fault, the answer would have been a resounding "yes". ZiiMAX relied on the case of *Ng Giap Hon v Westcomb Securities Pte Ltd* [2009] 3 SLR(R) 518 ("*Ng Giap Hon*") for the implied term under the "officious bystander" test. ZiiMAX submitted in reliance on [81] and [89] of the Court of Appeal's decision in *Ng Giap Hon* that the term would be implied by the court if it was necessary to give business efficacy to the contract (*ie*, the "business efficacy" test as implemented practically though the "officious bystander" test) and the key focus here, with terms implied in fact, was to give effect to the presumed intention of the parties.

267 Since it was entirely Huawei's fault that the WiMAX Network could not be launched, Huawei necessarily rendered the indoor CPEs and USB dongles it supplied to ZiiMAX totally redundant. According to ZiiMAX, the redundancy of the indoor CPEs and USB dongles was directly attributable to and an unavoidable consequence of the termination of the Contract by Creative on account of Huawei's breach of the Contract and/or Huawei's misrepresentation.

268 ZiiMAX also relied on the Court of Appeal decision in *Teknikal dan Kejuruteraan Pte Ltd v Resources Development Corp (Pte) Ltd* [1996] 1 SLR(R) 207 ("*Teknikal*") at [17] for its *own* legal proposition that where multiple contracts are entered into for a single purpose, the termination by the innocent party of any one of these contracts allows the termination of the remaining related contracts. Hence, ZiiMAX contended that it was entitled to terminate the CPE and USB Agreements following the lawful termination of the Contract between Huawei and Creative for the WiMAX Network on account of Huawei's contractual breach and/or misrepresentation. ZiiMAX submitted that *Teknikal* was clear binding authority in Singapore that the wrongful rescission and/or repudiation of the Contract by Huawei would allow the ZiiMAX Purchase Orders to be terminated when the CPE and USB Agreements were intended solely for the same single purpose – the WiMAX Network project.

269 In this regard, ZiiMAX referred to various discussions and correspondence exchanged between Creative and Huawei leading up to the ZiiMAX Purchase Orders to show that (i) Huawei's representatives drew no distinction between the representatives of Creative, QMAX, or ZiiMAX; (ii) Huawei liaised and negotiated with the Creative's representatives in respect of the ZiiMAX Purchase Orders; and (iii) Huawei's representatives were well aware that ZiiMAX's purchase of the indoor CPEs and USB dongles were for use in the WiMAX Network.[55]

270 During the trial, Huawei's counsel did not challenge PW3-Lian's evidence on how Huawei, Creative and ZiiMAX had treated ZiiMAX's CPE and USB Agreements with Huawei as inextricably intertwined with the Contract to implement the WiMAX Network project embarked upon by Creative and its

[55] AEIC of PW3-Lian, Page 11-13 at para 39.

business arm, ZiiMAX. These interlinked contracts were intended sole for one single purpose – the WiMAX Network.

271 ZiiMAX pointed out the significant factual similarities between the present case and *Teknikal*, where there was no use for the lease of equipment to develop the quarry if the quarry contract was terminated. Similarly, there was no use for the indoor CPEs and USB dongles purchased by Creative, through the ZiiMAX Purchase Orders, if there was no WiMAX Network established which met Creative's requirements under the Contract.

272 ZiiMAX contended that implying this term would not be precluded by the entire agreement clause in the Amendment Agreement, phrased as follows:

> … The Agreement, this Amendment and the Warranty contain the entire understanding between the parties with respect to the subject matter and supersedes all previous written or oral negotiations, commitments and undertakings in relation thereto …

273 According to ZiiMAX, the clause did not contain sufficiently "clear and unambiguous language" so as to exclude implied terms nor was there any express reference in the clause to implied terms. ZiiMAX therefore submitted that the parties to the CPE and USB Agreements had not intended by way of the entire agreement clause to exclude implied terms. The implied term sought by ZiiMAX was not inconsistent with the termination clause in the Amendment Agreement nor would it render the termination clause inoperable. ZiiMAX argued that the implied term would simply complement the termination clause and the court ought to allow the term to be implied.

Huawei's submissions

274 Huawei took the simple position that it sold and delivered 1,000 units of indoor CPE to ZiiMAX pursuant to the ZiiMAX Purchase Orders, which remained unpaid.

275 Huawei submitted that there was no legal basis for the implied term under the "officious bystander" test. Neither was it necessary for the implication of such a term. While ZiiMAX contended that the "business arm" of Huawei marketed the WiMAX Network, ZiiMAX had in fact insisted that Huawei was to treat it as a separate entity from Creative to enter into a contract on its own behalf for Huawei's supply of 1,000 units of indoor CPE to it. In support of this, Huawei referred to an email dated 25 April 2011, where Raymond Tiew, a representative of ZiiMAX, specifically instructed Huawei to "change the buyer's name to [ZiiMAX] on the service agreement cos we are not creative technology".[56]

276 Huawei accepted that while *Ng Giap Hon* might stand for the proposition that an entire agreement clause *per se* would not exclude implication of terms generally, the express termination clause *and* the entire agreement clause present together in the Contract demonstrated that it would fly in the face of the parties' intentions to allow such an implied term. Huawei submitted that the inclusion of these clauses into the agreement showed that the parties had applied their minds to provide for termination (on an exhaustive basis) upon the occurrence of certain stipulated events or for convenience with written notice. Parties did not intend to allow the avoidance or termination of this contract upon the Contract being terminated or rescinded (or they would have provided for

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[56] 3 DCB 101.

such an event). Huawei contended that the entire agreement clause was deliberately inserted to provide that no other terms were to govern the contract.

277 Huawei distinguished *Teknikal* on the basis that the two contracts were concluded between the *same* parties and this enabled the court to decide that the two contracts were in fact "linked", whereas in the present case, the USB and CPE Agreements were concluded by Huawei with a *different* and a *third* party, ZiiMAX.

My decision

278 I do not accept ZiiMAX's reading of *Teknikal*. In *Teknikal*, the two parties had a quarry contract and also multiple leases between them. The appellant terminated the quarry contract and then treated the leases as terminated because of the termination of the quarry contract, even though no provision in the lease allowed the appellant to do so. The court accepted this argument but only because *both* the appellant and respondent treated the quarry contract as linked, both in their claims against one another (at [15]) and even when they were before the court (at [17]). This led the court to conclude that "[t]he position impliedly adopted by the parties was simply: breach or no breach of quarry contract, ergo breach or no breach of the leases" (at [17]). In other words, the court implied the term based on the parties' mutual intentions (as expressed through their conduct) that they intended the contracts to stand and fall together.

279 Since this is the case, *Teknikal* should properly be confined to its facts, namely, to situations where the same two parties had multiple contracts between them, and not a situation where *multiple parties* had contracts between them. Only where the parties to both contracts are the same can the court conclude

that the parties intended both contracts to be inter-linked. Where the contracts in question are between A and B, and between A and C, then B's intention to link the first contract with the second contract is irrelevant since B's consent or lack thereof cannot affect a contract which he is not party to. I therefore agree with Huawei's contention that *Teknikal* is properly confined to situations where the contracts are between the same parties.

280 But even if *Teknikal* can be extended to multiple party situations, B and C (in the example that I have given above at [279]) must have been so closely connected that B's consent can be taken to affect C's contract with A, and *vice versa*. For instance, this could operate where B was an agent of C (or *vice versa*), or where B and C were so closely related to one another that it would be safe to piece the corporate veil. This accords with the business efficacy test as expressed through the officious bystander test since it is unlikely that a contract between A and B would be considered unworkable if there were no implied term to link this contract with a separate contract between A and an entirely different and unrelated third party, C.

281 Here, with the strong tone and apparent indignation expressed in his email dated 25 April 2011 that "we are not creative technology", Raymond Tiew of ZiiMAX had, in my view, clearly and expressly conveyed to Huawei that ZiiMAX was contracting *on its own behalf* and not on behalf of Creative or CTL. Objectively, there was hardly room for Huawei to understand or construe that it could be otherwise.

282 I do not believe that the circumstances were such that Huawei and ZiiMAX themselves intended that (a) ZiiMAX was to act as an agent for Creative or CTL; and (b) Creative or CTL was the principal party to contract with Huawei for the CPE and USB Agreements. ZiiMAX did not sign as an

agent for and behalf of Creative or CTL. There was nothing in the CPE and USB Agreements to indicate that Creative or CTL was the principal and that ZiiMAX was merely acting as the agent for Creative or CTL in executing the CPE and USB Agreements.

283 Having made it abundantly clear to Huawei that ZiiMAX was contracting *on its own behalf* and after having signed the contract with Huawei in its own name as principal at its own insistence, I find it hard to accept ZiiMAX's about-turn that it was actually at that time contracting for the supply of the equipment on *behalf of Creative or CTL*.

284 As far as I understand it, since ZiiMAX was going to market the WiMAX Network and deal with the end users directly, I would imagine that end users would sign user agreements directly with ZiiMAX as the principal party. I do not think ZiiMAX intended to act merely as an agent for Creative or CTL in these end user agreements. End users would likely look to ZiiMAX as the principal party who would be contracting with them. End users would purchase USB dongles directly from ZiiMAX or would be given these USB dongles free of charge by ZiiMAX, depending on ZiiMAX's marketing strategy. For that to work without legal complications, the property in the USB dongles should logically be with ZiiMAX and not Creative or CTL, so that ZiiMAX would be in a position to legally transfer the property in the USB dongles to its end users when ZiiMAX entered directly into user agreements with its end users. This analysis would be consistent with my finding that ZiiMAX contracted with Huawei *on its own behalf* (and not on behalf of Creative or CTL) when the equipment was purchased for its own use pursuant to the CPE and USB Agreements.

285 Given my finding, it must then be emphasised that this is no longer a case of implying a term in the Contract between Creative and Huawei to enable the design and construction of the WiMAX Network to be operationalised. This concerns a very different scenario concerning the implication of a term in a totally different contract entered into between Huawei and essentially a *different* and a *third* party, ZiiMAX.

286 Huawei was also in no position at the time of contracting to know whether ZiiMAX had other uses for those (or parts of those) CPEs and USB dongles for its other business activities, although Huawei knew that ZiiMAX intended to market the WiMAX Network to its own end users and supply them with USB dongles. It is also not necessary that the equipment that ZiiMAX purchased from Huawei must exclusively be used in the same WiMAX Network that Huawei was designing and building for Creative, a third party vendor. It is feasible for ZiiMAX to have a link-up with other third party vendors of similar wireless networks in other countries or locally and market the USB dongles to those end users. Clearly, other alternative uses (including reselling for profit) were available for the equipment purchased by ZiiMAX from Huawei for ZiiMAX's own business use. I do not think that the other technical issues of the usability of the USB dongles in other circumstances were insurmountable.

287 Strictly speaking, Huawei was not concerned with why ZiiMAX purchased the equipment, what was the business relationship between ZiiMAX and Creative in respect of the CPE and USB equipment and what uses the equipment might be put to by ZiiMAX. Hence, the implication of the term is not necessary to give "business efficacy" to the simple sale and purchase CPE and USB Agreements between Huawei and ZiiMAX.

288 Accordingly, I accept Huawei's submission that there is no legal basis for the term to be implied in fact. In the result, I find that ZiiMAX was not entitled to terminate or avoid the CPE and USB Agreements following Creative's termination of the WiMAX Contract. The "business efficacy" test, even when practically implemented using though the "officious bystander" test, is not satisfied on the particular facts of this case. I therefore allow Huawei's claim for US$104,860 (inclusive of GST) and disallow ZiiMax's counterclaim.

Computation of Damages

289 To recapitulate, Creative claimed US$9,295,388.98, being the amount it paid under the Contract, and also damages of S$19,253,120.01 and US$22,000. Huawei says, in the event it is found liable, that (a) its liability is limited to US$9,295,388.98 by virtue of Art 15 of the Contract, and (b) that Creative cannot claim the full sum of damages because it failed to mitigate its loss. I will deal with each argument in turn.

Limitation of liability and damages under Art 15 of the Contract

Article 15 of the Contract

290 Huawei relied on Art 15 of the Contract to limit the total possible quantum of damages payable to Creative. Article 15 provides that:

> 15.1 Notwithstanding any other provision in this Contract, the total liability of the Supplier on any claim, whether in contract, tort (including but not limited to negligence), product liability or otherwise, arising out of or in connection with the supply of equipment or service, *shall not exceed one hundred percent (100%)* of the relevant purchase order value received by the Supplier from the Customer under this Contract, *save in the event of* death, personal injury, breach of confidentiality, acts of fraud, *gross negligence or wilful default.* lf there is a breach of this Contract, both Parties shall use commercially reasonable efforts to mitigate any resulting loss and damages.

> 15.2 NOTWITHSTANDING ANY OTHER PROVISION IN THIS CONTRACT, EXCEPT FOR OBLIGATIONS UNDER ARTICLE 18 (CONFIDENTIALITY) AND ARTICLE 19 (INTELLECTUAL PROPERTY RIGHTS; LICENSES· INDEMNIFICATION), NEITHER PARTY SHALL HAVE ANY LIABILITY FOR LOSS OF PROFITS, LOSS OF REVENUES OR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES WHATSOEVER, EVEN IF THE PARTY HAS BEEN ADV1SED OF THE POSSIBILITY OF SUCH DAMAGES.
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> [emphasis added; capital letters in original]

My decision

(a) Rescission of the Contract for misrepresentation

291 Upon a lawful rescission of the Contract for Huawei's misrepresentation, Creative is entitled pursuant to s 2(1) of the Misrepresentation Act to claim for all losses and damages flowing directly as a result of Creative's entry into the Contract "regardless of whether or not such loss was foreseeable, and would include all consequential loss as well": *Wishing Star Ltd v Jurong Town Corp* [2008] 2 SLR(R) 909 at [21]. Where the Contract has been lawfully rescinded, the Contract becomes void *ab initio* and Art 15 of the Contract is no longer applicable to limit the damages payable to Creative on account of Huawei's misrepresentation. The effect of rescission is succinctly set out in *The Law of Contract in Singapore* at para 11.098, as follows:

> The right to rescind a contract entitles a party to the contract to have it set aside and thus be restored to his original position. This involves first the *avoidance of the transaction ab initio*, and second the *restoration of the parties to the position occupied prior to the entry into the contract*. The effect of the first is the cancellation of all future obligations, and the second involves the retrospective restoration of any benefits that may have already been transferred at the date of the rescission.
>
> [emphasis added]

292 Huawei submitted that the rescission (*ie*, avoidance *ab initio*) of a contract does not mean the former existence of the contract is denied, or that the

contract cannot be used to ascertain the consequences of its avoidance. Certain clauses of the contract should be treated as distinct within the same document (*ie*, the contract), and unaffected by the invalidity of the substantive obligation clauses of the contract. These would include limitation of liability clauses (see John Cartwright, *Misrepresentation, Mistake and Non-Disclosure* (Sweet & Maxwell, 3rd Ed, 2012) at para 4-16) ("*John Cartwright*")).

293 I agree that some clauses in a contract may *potentially* survive rescission. But the passage in *John Cartwright* cited to me by Huawei does not provide me any guidance as to when such clauses may survive rescission apart from merely stating that the clause would make "provision for the consequences of rescission". In my view, the starting point is that rescission entails avoiding the transaction from the very beginning because some defect in consent by the contracting parties affects the formation of the contract in the first place. Once the innocent party elects to rescind, it is unsafe to retain *any* of the clauses given this defect in the parties' consent. The only exception therefore is where both the parties have indicated their intention that notwithstanding the defect in their consent they agree to keep such a clause. But because rescission is generally meant to protect the innocent party, in my view this intention by the parties (if any) must be expressed in a clear and unequivocal fashion. The clearest way to do this is for the clause itself to state that it survives rescission. Otherwise, another way is where the clause deals *only* with the consequences of rescission. If this is the case then the parties must have meant it to survive rescission; otherwise the clause would be nugatory.

294 Article 15 of the Contract is not such a clause. It deals with Huawei's liability in the event of a claim under contract, tort or product liability, and liability arising out of and in connection with the supply of equipment or service. This is certainly wide enough to cover situations of rescission, for

misrepresentation or otherwise. But crucially, it is *also* wide enough to cover non-rescission events, such as termination of contract for breach. Its breadth means that it is an insufficiently unequivocal signal of the parties' intent to have it survive the event of rescission. Accordingly, I find that Art 15 would not survive rescission, and therefore given that the Contract was lawfully rescinded, Art 15 does not assist Huawei in limiting the quantum of damages payable to Creative.

(b) Termination of the Contract for anticipatory repudiatory breach

295 In the case of a lawful termination of the Contract for anticipatory repudiatory breach by Huawei, Creative submitted that on a proper construction of Art 15 of the Contract, Creative's claim for "Wasted Costs" incurred for the sole purpose of the construction of the WiMAX Network, which therefore would have been reasonably in the contemplation of the parties if the Contract was broken, was not excluded by Art 15 for the following three separate reasons:

(a) Article 15.1 relates to the exclusion of liability for the "supply of equipment or service" under the Contract.

(b) Article 15.1 does not apply when Huawei is guilty of gross negligence.

(c) The express terms of Art 15.2 do not exclude Creative's "Wasted Costs".

296 First, it bears reminding that clauses excluding liability must be construed strictly and the application of such clauses must be restricted to the particular circumstances that parties had in mind at the time they entered into

the contract: *Hong Realty Pte Ltd v Chua Keng Mong* [1994] 2 SLR(R) 90 at [19].

297 I shall deal with Art 15.2 first. Article 15.2, written in capital letters for emphasis in the Contract, expressly excludes liability of Huawei for "ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES WHATSOEVER, EVEN IF THE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES." Although there is no express exclusion for "Wasted Costs" in Art 15.2, I am of the view that, even on a strict construction, "Wasted Costs" would be adequately covered by the words above in capital letters which relate basically to damages that arise in "special circumstances" under the second limb of the rule in *Hadley v Baxendale* (1854) 9 ExCh 341.

298 This interpretation was also taken in several judicial decisions, where exclusion or limitation clauses using the terminology of "indirect" or "consequential" losses were interpreted to cover damages under the second limb of *Hadley v Baxendale*. In *Transocean Offshore International Ventures Ltd v Burgundy Global Exploration Corp* [2013] 3 SLR 1017 at [30], Tay Yong Kwang J (as he then was) traced the history of this approach from the English courts, which was then adopted by the Court of Appeal in *Singapore Telecommunications Ltd v Starhub Cable Vision Ltd* [2006] 2 SLR(R) 195 (at [59]-[62]) and the High Court in *Kay Lim Construction & Trading Pte Ltd v Soon Douglas (Pte) Ltd* [2013] 1 SLR 1 at [70]. I agree with this line of authorities and find that they also apply to Art 15.2.

299 Even on a plain reading of Art 15.2, *all* its limbs pertain to damages that could accrue on a basis that is out of the ordinary: whether indirectly, incidentally, or on a special basis such as punitive or exemplary damages. The

various limbs of Art 15.2 were drafted widely and were clearly meant to encompass all situations in which such 'special' costs can be granted. Wasted costs are similarly special situations which would fall within one or more of these limbs. As such, Huawei is not liable for "Wasted Costs" incurred by Creative arising from Huawei's anticipatory repudiatory breach of the Contract.

300 With respect to Art 15.1, it is my view that the words "supply of equipment or service" are wide enough to encompass Huawei's radio network planning and design for Creative. Under the Contract, Huawei is not only to supply equipment for the WiMAX Network but is also to supply a *design service* in the form of radio network planning and design. In fact, the preamble of the Contract (which is called "Supply Contract for Wireless Broadband Network (WiMAX Infrastructure) Solution") states that:

> (a) The Customer wishes to purchase certain telecommunication equipment and services from the Supplier in accordance with the terms and conditions herein contained, and
>
> (b) The Supplier has agreed to supply the Equipment and provide the Services (as defined herein below) to the Customer in accordance with the terms and conditions contained.

Article 1.1 of the Contract further states that:

> "Services" shall mean the totality of the services to be provided under this Contract and covered by the Contract Price including but not limited to survey, engineering, installation, supervision, testing, commission of the Equipment and maintenance, and technical support during the Warranty Period.

301 The entire scope of the Contract is for the supply of equipment and services. In my view, this clearly includes Huawei's radio network planning and design work for Creative, which is part of the totality of services to be provided under the "Design, Build and Operate" Contract. As such, Huawei's work in

designing the WiMAX Network falls into "the supply of equipment or service" referred to in Art 15.1.

302 If there is "gross negligence" on the part of Huawei in carrying out its radio network planning design, Art 15.1 will be rendered inapplicable to limit the quantum of damages payable to Creative by Huawei resulting from its "gross negligence". I shall now examine whether Huawei is guilty of any gross negligence in planning and designing the WiMAX Network for Creative.

(c) Gross negligence

303 *Sie Choon Poh (trading as Image Galaxy) v Amara Hotel Properties Pte Ltd* [2005] 3 SLR(R) 576 ("*Sie Choon Poh*") has provided some guidance on how gross negligence is to be determined as a matter of fact:

> 6 The term "gross negligence" as a concept is not susceptible of definition. Nor is it possible to lay down a standard, derived logically from past cases, by which a court can confidently rule when negligence should be deemed to be gross negligence. This is because the circumstances giving rise to the duty to act, including the duty to remove a potentially damaging or dangerous situation, vary from case to case and they also vary in infinite degree. It should be recognised that it is a practical impossibility that all the relevant circumstances which point to the degree of the negligence involved should be the same in any two cases that may arise.
>
> 7 *But the meaning of the term within a contractual term is a matter of construction and my task is to find the intended meaning. In doing so, I shall consider the text in the context. The aim and purpose of the provision should be seen in light of its factual matrix.* In a shopping and hotel complex such as the Amara, where there are many shops and a food court, it is understandable for the defendant to exclude liability for any damage caused by negligence, however slight the dereliction of the duty of care. *But what is not so easily acceptable is the exclusion of the consequences of serious errors.*
>
> 8 *How is a court to find as a matter of fact that there is gross negligence?* Obviously the particular circumstances at play in each case have to be examined and evaluated. *Cases have shown that factors,* such as *notice or awareness of the*

> *existence of the risk, the extent of the risk, the character of the neglect, the duration of the neglect and, not least, the ease or difficulty of fulfilling the duty …* are *important*, and in some cases *vital*, in determining whether the fault (if any) of a defendant is 'so much more than merely ordinary neglect that it should be held to be very great, or gross negligence': see *Belanger v Michipicoten (Township)* 31 MPLR (2d) 198 and *Holland v Toronto (City)* [1927] 1 DLR 99 discussed therein.
>
> 9 […] In construing the term "gross negligence" in the contract, Mance J stated [in *The Hellespont Argent* [1997] 2 Lloyd's Rep 547] at 586 RHC: "'Gross' negligence is clearly intended to represent something more fundamental than failure to exercise proper skill and/or care constituting negligence. *But, as a matter of ordinary language and general impression, the concept of gross negligence seems to me capable of embracing not only conduct undertaken with actual appreciation of the risks involved but also serious disregard of or indifference to an obvious risk.*"
>
> [emphasis added]

304 In *Great Scottish & Western Railway Company Limited v British Railways Board* (2000) WL 389473, the English Court of Appeal held at [37] that "whether negligence is gross is a function of the nature of the error and the seriousness of the risk which results from it."

305 The learned authors of *Charlesworth & Percy on Negligence* (Christopher Walton gen ed) (Sweet & Maxwell, 12th Ed, 2010) at para 1-15 express the view that the term "gross negligence" has practical utility to describe "a high degree of careless conduct, such as where a defendant did not intend a particular consequence to happen but nevertheless must have been able to foresee its occurrence".

306 With the above observations in mind, I turn now to examine all the relevant facts and circumstances, including the manner in which Huawei had carried out its network planning and design for the WiMAX Network, the nature of the errors, the seriousness of the risk resulting from the errors, the

foreseeability of that risk, the notice or awareness of the extent and likelihood of the potential harm that may be caused should there be these errors in the input factors, the extent of the extra cost and effort that could have been but were not expended to reduce or remove the risk of errors with grave consequences and the extent of the disregard or indifference shown to mitigate or minimise (if not prevent) the risk of such errors being made in the network planning and design. In other words, I have to determine whether Huawei's careless conduct was so serious having regard to all the facts and circumstances that it justifiably amounts to "gross negligence".

307 The starting point is the three critical mistakes that Pandion said were committed by Huawei, which I have set out earlier at [157].

308 In support of its submission that Huawei had conducted its radio planning in an extremely careless manner given the serious consequences and Huawei was therefore grossly negligent, Creative contended that Huawei had committed three critical mistakes in its radio planning:

(a) Huawei's radio network planners wrongly classified the majority of HDB estates ("denseblockbuild" clutter type) as "Suburban" instead of "Dense Urban";

(b) Huawei's radio network planners wrongly removed the Interference Margin (2dB) and Fade Margin (5.43dB) when calculating the minimum RSSI for the Huawei USB dongle to connect to the WiMAX Network with 90% area coverage probability; and

(c) Huawei used correction factors (in the Huawei Propagation Model) for "Dense Urban" and "Urban" that were significantly more optimistic (*ie*, by 6dBm) than the standard Cost-231 Hata Propagation

Model when there was no basis for Huawei to conclude that those correction factors were suitable for the Singapore environment.

309 I will address the above mistakes *seriatim* in relation to the issue of gross negligence. I agree with Creative's submission that the correct classification of Singapore's morphology is a key part of the radio planning process because it has a significant impact on the site count, especially when a large part of the target area to be covered under the planning exercise is wrongly classified.

310 In this case, HDB estates are important, not only from the point of view of the concentration of users in these areas, but because they constitute a fairly significant percentage of the target area to be covered. However, HDB estates were wrongly placed in the lowest category of "Suburban", when they should have been classified in the highest category of "Dense Urban". This is a gross mistake because (a) HDB estates comprise a large part of the target area of Singapore to be covered; and (b) it is a two-step error when what obviously should have been "Dense Urban" was wrongly classified two steps lower to "Suburban", which together greatly magnified the error in the number of radio sites computed by Huawei's radio planners. The significance of this error may be assessed by reference to Pandion's calculations which showed that by correcting this mistake alone (*ie*, by reclassifying "denseblockbuild" clutter which HDB estates were under to "Dense Urban"), the estimated number of sites required would increase from 225 to 452 sites.

311 Huawei's radio planners have been extremely careless because satellite images, Google maps and morphology maps (including street directories) of Singapore with detailed morphologies are readily available to enable the radio planners to correctly slot or map the more finely graded morphologies of ten or more different types provided in the morphology maps of Singapore into the

more coarsely graded morphology classification of three density gradations of "Dense Urban", "Urban" and "Suburban" used by Huawei for its radio planning design for the WiMAX Network. If it is a small area, I can understand how it could be inadvertently missed from the radio planners' examination and a wrong classification was then applied. But for HDB estates which form a large part of the target coverage area, they can hardly be missed and inadvertently given a wrong classification unless there was a very high degree of carelessness involved and I so find. The mistake is so obvious and can be so easily detected if the same radio planner had bothered to make a second more careful check, or if a second radio planner had been engaged to verify the correctness of the morphology classification of the first radio planner. I seriously doubt that such simple risk mitigation measures had been put in place by Huawei.

312 Second, Huawei should have known better than to engage a radio planner for the WiMAX Network project, DW5-Zou, with no prior experience in Singapore radio planning and who was not based in Singapore. He did not even know the whereabouts of Tampines, Ang Mo Kio and Geylang nor how they looked like. DW5-Zou did not appear to have consulted anyone from Huawei's Singapore radio frequency planning unit about Singapore's morphology.

313 DW5-Zou's failure to consult his Singaporean colleagues about the morphology of Singapore, a very simple and commonsensical thing to do if he was unsure of the Singapore terrain, and his failure to properly study the materials easily available that would have readily disabused his assumption that HDB estates could be fitted into the lowest category of "Suburban", inexorably leads me to the conclusion of "gross negligence" on the part of DW5-Zou. Any of Huawei's radio planners based in Singapore familiar with how densely built HDB estates are by comparison with other areas of Singapore, would

immediately recognise the gross error of fitting HDB areas into the lowest "Suburban" category and would have advised DW5-Zou accordingly if only DW5-Zou had bothered to check with them.

314 In the map purchased by Huawei, HDB estates were classified under the clutter type named "denseblockbuild", while areas such as the low rise residences in NTU and the Cashew area, Pine Grove Condominium in Ulu Pandan, Neptune Court in Marine Parade and the three condominiums next to Bedok Reservoir were classified under the clutter type "blockbuild". DW5-Zou mapped the clutter "blockbuild" into "Urban" and the clutter "denseblockbuild" into other lower category of "Suburban". It is very obvious from the descriptions of the clutters provided in the map that the "denseblockbuild" clutter (*ie*, HDB estates) must be denser than the "blockbuild" clutter (*ie*, low rise areas and condominiums). If DW5-Zou was unsure, he could have easily found out the answer instead of guessing what the building density might be before slotting the various clutter types into his three tier morphology classification of the target coverage areas for the WiMAX Network. DW5-Zou claimed that he had done a quick review of the satellite images from Google Earth but he said that caused him instead to reclassify the "denseblockbuild" downwards from "Urban" to the lowest tier of "Suburban". Either he had not applied his common sense or had looked at the wrong satellite images. The third and more likely possibility is that DW5-Zou was lying in court in a futile attempt to explain how he could have made such a gross error. I do not believe he had carried out any checks on the various map clutters with Google satellite maps. If he had in fact done so, the gross mistakes he made would have been avoided.

315 Other errors in the morphology classifications pointed out to me in the course of trial give me the impression that DW5-Zou had been rather haphazard or illogical, or had simply been lackadaisical in the manner he approached the

morphology classification of the various target coverage for the WiMAX Network. When Good Class Bungalow areas were classified as "Urban" and HDB areas were classified as "Suburban", I cannot but find that these were gross and unforgivable mistakes committed by DW5-Zou.

316 Indeed, the mistakes could have been avoided with minimum effort on Huawei's part. It does not take much additional manpower or costs to ensure that a proper and accurate morphology mapping of the target area for the WiMAX Network is done. As a technology company, Huawei must certainly have understood that a wrong morphology mapping, in a case where the error involves treating a very densely area as a sparsely built area, would result in severe underestimation of the number of radio sites. The consequence is very serious because the WiMAX Network once built will not function properly and there are huge sunk costs involved in getting the leases for the radio sites and in building the network.

317 The multiple errors made in the morphology classification alone are sufficient for me to find on a balance of probabilities that Huawei had been grossly negligent.

318 I turn now to the erroneous removal by Huawei of the Interference Margin of 2dBm and Fade Margin of 5.43dBm when determining the minimum RSSI value for the USB dongle to connect to the WiMAX Network with 90% area coverage probability, which resulted in a minimum RSSI threshold value being calculated for the required USB dongle connection that was much too low and hence erroneous.

319 By way of comparison, it is pertinent to note that based on Dr Lee's analysis of the empirical data, the RSSI value in order for the end users to

establish a data link with throughput is a minimum of -78.5dBm and this is approximately 7.2dBm higher than the -85.76dBm assumed by Huawei to be the correct value for the RSSI in the HLRR. Hence, the RSSI measurement criterion in the HLRR advised by Huawei is totally wrong. The actual measured minimum RSSI value required by the USB dongle is much higher than the RSSI value which Huawei assumed in its calculations would allow the USB dongle to connect with 90% area coverage probability. Correspondingly, the drive test criterion ought to be adjusted upwards by 7.2dBm: (a) from -67.76dBm to -60.56dBm for "Dense Urban"; (b) from -70.76dBm to -63.56dBm for "Urban"; and (c) from -77.53dBm to -70.33dBm for "Suburban" in order to achieve an area coverage probability of 90%.

320 Dr Lee opined in her 1st Report that the RSSI value of -85.76dBm would not be sufficient for the USB dongle to communicate with the WiMAX Network. After examining her report, I am satisfied with the thoroughness and reasonableness of her analysis of the empirical data that the minimum RSSI required by the USB dongle to have throughput is actually approximately -78.5dBm. I also accept her conclusion from the 2012 Drive Test's empirical data that the probability of an end user receiving signal strength of RSSI -85.76dBm within the cell area of each radio site was between 63% and 75% only. I find her conclusion to be quite unassailable that with optimisation, these figures may only rise by 5% to 10% and therefore, even if all 230 radio sites were on-air and optimised, the WiMAX Network would not have been able to achieve 90% area coverage probability as required in the Contract.

321 Based on Pandion's calculations using the Huawei Link Budget, the minimum RSSI values should be -78.34dBm for "Dense Urban" and "Urban", and -81.13dBm for "Suburban" at which the USB dongle would connect to the WiMAX Network with a 90% area coverage probability. These values are close

to the minimum RSSI threshold of -80dBm used by Huawei for its other WiMAX networks in other countries. It is also fairly consistent with Dr Lee's derivation of the minimum RSSI value of approximately -78.5dBm to obtain a data link with throughput based on the empirical evidence from Dr Lee's 2012 Drive Test.

322 It would appear from the evidence of DW3-Tang, an experienced Huawei radio planner based in Finland, who had worked on Huawei's WiMAX projects in South Africa, Libya, Bahrain and Finland that Huawei normally uses a minimum RSSI of -80dBm and CINR of 8dBm in its other WiMAX projects as the *minimum threshold* for the USB dongle to connect. Therefore, Huawei's use of a much lower minimum threshold for the RSSI of -85.76dBm and -87.53dBm for Creative's WiMAX Network project instead of -80dBm as in other WiMAX projects is a substantial deviation from the normal internal practices of Huawei. Huawei has not demonstrated with any empirical test results that the substantial deviation can be technically justified. It is very important for connectivity that the minimum signal strength or the RSSI value required for a proper connection to a dongle is set correctly during the design stage of the WiMAX Network.

323 Having regard to the above, it is inexplicable why before proceeding with the radio planning exercise, DW5-Zou did not even take the elementary step of checking or inspecting Huawei's internal records or conferring with his more experienced colleagues on what minimum thresholds for RSSI and CINR were previously used by Huawei in designing its WiMAX networks elsewhere in the world. Again, minimal effort is needed to verify the correct RSSI value to use as the minimum threshold for connection. This failure to do so further buttresses my view that DW5-Zou in his role as Huawei's radio planner for the WiMAX Network had been grossly negligent in not performing those

elementary checks to ensure that a correct theoretical RSSI value for connection to a dongle was chosen when performing the radio planning exercise.

324 By the time Huawei realised that there were serious connectivity problems after complaints from Creative, and DW4-Zhang at a meeting on 26 September 2011[57] thereafter recommended to Creative new higher values of "RSSI -80 dbm and CINR 8dbm" "[w]ith reference from other WiMAX sites deployment" networks, it was much too late in the day to try and resolve these connectivity problems caused by Huawei's initial bad design of the WiMAX Network. The entire WiMAX Network was almost built by then.

325 I find that this is a second serious mistake on the part of Huawei not to use its usual minimum RSSI value of -80dBm for its radio planning exercise to determine the number of radio sites required. The gravity of this error can be seen from the increase in the actual number of radio sites required (as calculated by Pandion) from 225 to 875 had the error not been made by Huawei (or DW5-Zou in particular). This second serious mistake fortifies my finding that Huawei was grossly negligent. With two grossly negligent mistakes made in the theoretical computation of the required number of radio sites, the seriousness of the underestimation is compounded as has happened in this case.

326 In assessing whether there is further evidence of gross negligence, I do not think it is necessary for me to consider the third mistake made, *ie*, in the use of correction factors derived from tests and research principally in cities in China for its Huawei Propagation Model, in particular for "Dense Urban" and "Urban" areas, without first checking whether cities in China were of roughly similar morphology to those in Singapore and whether the same correction

[57] Minutes of the 26 September 2011 meeting at PCB 326.

factors remained suitable for use in the Singapore environment, and without considering whether Huawei had to re-tune the correction factors by doing some practical empirical tests of the Huawei Propagation Model in Singapore to ensure that the correction factors remained largely applicable for the Singapore environment. I accept that it is a fairly major and time-consuming exercise (even apart from the expenses involved) to perform re-tuning and perhaps Huawei might have reasonably thought that it was unnecessary to do so. Hence, if I have to rank the degree of seriousness of negligence involved in making each the three mistakes, this third mistake is the least egregious.

327 Creative submitted that Huawei was fully aware of Creative's heavy reliance on Huawei's estimate of the required number radio sites in entering the Contract, given its strict budget of US$20m. Yet, Huawei adopted a completely lackadaisical attitude in ensuring the accuracy of its radio site estimate.

328 Creative further contended that Huawei's primary objective was to entice Creative to enter into the Contract and then, force Creative later into purchasing more radio sites if necessary. Huawei's attitude bordered on outright deception, let alone gross negligence. I will however not attribute to Huawei having such a commercial motive based on the evidence before me.

329 I do note that the burden is on Creative to prove that Huawei was grossly negligent in its radio planning. *Prima facie*, Creative has proved on a balance of probabilities that Huawei was grossly negligent because I find that gross mistakes were in fact made on two important aspects of the radio planning by Huawei. They are essentially gross and indefensible mistakes made without due care and consideration of the high risks and severe consequences involved. The wrong morphology classification is probably the most egregious in terms of the degree of negligence involved followed next by the wrong RSSI value chosen

for connectivity to a dongle. Last is the mistake in the correction factors adopted when applying the Huawei Propagation Model.

330 Since I find that Creative has proved that Huawei was *prima facie* grossly negligent because of the nature and serious consequences of the two mistakes and the serious disregard and indifference to the obvious high risks involved by Huawei's team of radio planners when they carried out the radio planning exercise, it is for Huawei to produce evidence to show that the manner Huawei's radio planners went about its morphology classification and its choice of the minimum RSSI value for dongle connection were in accordance with some recognised and established practice (preferably international practice, if any) and therefore, despite the mistakes made, there was no negligence (let alone gross negligence) because Huawei's radio planners, in performing the radio planning exercise, had met the requisite standard of care expected of them as responsible and competent radio planning professionals.

331 I do not find Dr Dernikas to be of any assistance here. He did not provide any evidence of a recognised and established practice for radio planning exercise. He did not show that despite all the mistakes made, Huawei had nevertheless complied with a recognised and established practice used by responsible and reasonably competent radio planning professionals to verify the correctness of assumptions and inputs to be used for radio network planning and wave propagation modelling so as to ascertain the number of radio sites required. Without any rebuttal evidence to show that Huawei's radio planning professionals for the WiMAX Network had in fact met the requisite standards of their duty of care as such professionals, I have to find, given the evidence before me, that Huawei was grossly negligent in making the two serious mistakes referred to above.

332 I will further add that even if there is no established recognised practice pertaining to the manner in which responsible and reasonably competent radio planners are to perform radio planning, it does not follow that there can be no possible negligence on the part of Huawei's radio planners when they made the three mistakes in the course of performing their radio planning exercise for the WiMAX Network.

333 Accordingly, with gross negligence proved, Art 15.1 does not operate to limit the liability of Huawei to the sum of US$9,295,388.98, being the amount which the plaintiffs have paid Huawei to date.[58]

Amount that Creative claimed in damages

334 Creative has provided at para 585 of its closing submissions a convenient table summarising the various expenditures it has incurred for the WiMAX Network (see below). Evidence of the total expenditure of S$19,253,120.01 and US$22,000 for the purpose of the WiMAX Network can be found in the Supplemental AEIC of PW3-Lian.

S/No.	DESCRIPTION OF HEAD OF EXPENDITURE	SUM	REFERENCE
1.	Payments made to IDA for the **purchase of the WBA spectrum rights and necessary licences to operate the WiMAX Network**	S$3,276,362.82	Supplemental AEIC of PW3-Lian at [29] – [45]
2.	Cost of **Leasing Roof-top Premises for the installation of WiMAX network equipment** to establish the radio sites / base stations for the WiMAX Network	S$3,359,208.99	Supplemental AEIC of PW3-Lian at [16] – [19]

[58] Defence and Counterclaim at para 45A and "Main Facts not in Dispute" in parties' respective Lead Counsel Statements at para 28.

3.	**Site Access Fees paid to various Town Councils** to conduct site surveys prior to establishing radio sites / base stations for the WiMAX Network	S$19,275.76	Supplemental AEIC of PW3-Lian at [56] – [57]
4.	All costs and expenses incurred in **installing the radio sites / base stations on the roof-top premises**. The installation works would include, *inter alia*, supply of the equipment, the steel works and concrete works necessary to establish a radio site; and any waterproofing necessary for the radio site / base station.	S$3,438,424.60	Supplemental AEIC of PW3-Lian at [10] – [14]
5.	**Radiation measurements conducted by the National Environment Agency** had to be taken for the radio sites to be commissioned at 3 locations.	S$1,986.00	Supplemental AEIC of PW3-Lian at [15]
6.	**Cost of utilities for the WiMAX equipment after installation of the radio sites / base stations**	S$226,268.06	Supplemental AEIC of PW3-Lian at [16] – [19]
7.	**Cost of leased line services and internet bandwidth** necessary to connect the WiMAX equipment at the radio sites to the backend servers	S$4,517,023.04	Supplemental AEIC of PW3-Lian at [20] – [25]
8.	**Costs of rental of 16 racks of space from IDC to house the backend servers and switches for the WiMAX Network**	S$246,400.00	Supplemental AEIC of PW3-Lian at [26] – [28]
9.	**Operating expenses incurred to run and administer the WiMAX Network Project**	S$2,498,414.74	Supplemental AEIC of PW3-Lian at [46] – [51]
10.	**Other miscellaneous equipment required for the WiMAX Network Project** aside from those acquired under the Contract	US$22,000.00 and S$4,552.00	Supplemental AEIC of PW3-Lian at [52] – [53]

11.	**Costs of dismantling and disposing of the WiMAX equipment at each radio site / base station after the termination of the Contract**	S$1,665,204.00	Supplemental AEIC of PW3-Lian Yam Fei at [54] – [55]
TOTAL		**S$19,253,120.01 and US$22,000**	Supplemental AEIC of PW3-Lian at [58]

[emphasis in original]

335 Huawei's counsel did not cross-examine any of Creative's witnesses on the veracity of the above wasted expenditures. The only challenge as I understand it relates to whether Creative had mitigated its losses. I shall therefore allow the entire claim of Creative in relation to all the wasted expenditures on the WiMAX Network subject to my findings below on the mitigation of loss.

Whether Creative mitigated its loss

336 The Court of Appeal in *The "Asia Star"* [2010] 2 SLR 1154 at [24] and [44] summarised the relevant rules in relation to mitigation. Essentially, the innocent party must take all reasonable steps to avoid incurring loss which it could have avoided. The innocent party need not actually avoid all such losses but only needs to take reasonable steps to do so. Both Creative and Huawei accept the principle that Creative must mitigate its loss but they differ as to when Creative should have mitigated its loss from. Creative says that it only needed to mitigate its losses from September 2012, which was when the negotiations between the parties in relation to dismantling the radio sites fell through. Huawei's primary position is that Creative should have mitigated its loss from October 2011, which was when Huawei first indicated that it might have been unable to meet the Contract Requirements. Alternatively, Huawei says that

Creative should have mitigated its losses from 29 December 2011 at the latest, which was when Creative actually terminated the Contract.

337 Specifically, Huawei submitted that Creative failed to take reasonable steps to minimise its loss in nine specific areas to which Creative had provided a point by point rebuttal in its submissions as set out in the table below:

S/NO	CREATIVE FAILED TO TAKE REASONABLE STEPS	CREATIVE'S SUBMISSIONS IN REPLY
1	Transferring the WBA spectrum rights for value instead of incurring additional annual fees and extending its WBA spectrum rights for the period 1 July 2012 to 30 June 2013 for an additional cost of S$156,906.52.	Creative's termination of the WBA spectrum rights with effect from 1 April 2013 was reasonable given that: (a) Creative's experts had to carry out their drive tests in April 2012 which were completed by 16 May 2012; (b) Creative was in negotiations with Huawei regarding the dismantling of the radio sites; and (c) Six (6) months' notice had to be given to IDA for the termination of the WBA spectrum rights.
2	Terminating the Annual Operator Licence instead of extending the Licence for the period 1 December 2011 to 30 November 2012 thereby incurring additional costs of S$100,000.	Creative's termination of the Annual Operator Licence with effect from 1 April 2013 was reasonable given that: (a) Six (6) months' notice had to be given to IDA for the termination of the Annual Operator Licence; (b) Negotiations with Huawei regarding the dismantling of the radio sites continued into September 2012 as Huawei refused and/or objected to the dismantling of the

		radio sites ("Negotiations with Huawei"); (c) By this time, the Annual Operator Licence had already been renewed; and (d) Creative's experts had to carry out their drive tests.
3	Promptly terminating the Public Mobile (Spectrum) Network Licence instead of extending the Licence from 1 December 2011 to 30 November 2012 thereby incurring additional costs of S$17,616.67.	Creative's termination of the Public Mobile (Spectrum) Network Licence with effect from 3 December 2012 was reasonable given that: (a) Creative gave notice to IDA to terminate the Public Mobile (Spectrum) Network Licence approximately 2 months after the Negotiations with Huawei ceased in September 2012; and (b) Creative's experts had to carry out their drive tests in April 2012.
4	Promptly dismantling the base stations	Any delay and corresponding increased loss (if any) is attributable to Huawei as Huawei refused and/or objected to the dismantling of the radio sites / base stations.
5	Promptly terminating the leases of roof-top premises instead of continuing with the leases from 1 November 2011 thereby incurring additional costs of S$2,396,304.53.	Leases were terminated at the earliest possible dates depending on: (a) when the WiMAX equipment was dismantled and radio site was handed over to Creative; (b) the notice period in the individual leases; and (c) for lease agreements which did not allow for termination, rental was paid by Creative until the end of the lease or until an arrangement was reached with the building owner for

		an earlier handover.
6	Promptly terminating the relevant agreements relating to lease line services and internet bandwidth instead of incurring costs of about S$3,773,991.42 for the period 1 November 2011 to 28 February 2013.	Creative terminated the leased line services and internet bandwidth subscriptions agreements with Singtel in December 2012 after: (a) Creative's experts had completed their drive tests; and (b) Negotiations with Huawei from May to late August / early September 2012 fell through.
7	Promptly cutting down on operating expenses instead of incurring costs of about S$1,141,265.98 for the period December 2011 to September 2012.	Following the termination of the Contract in or around late December 2011, QMAX gradually reduced the number of staff up until in or around September 2012 when Negotiations with Huawei fell through. Staff were still required by QMAX up until September 2012 to settle the residual administration of the WiMAX Network project.
8	Immediately stopping the use of data centre rack space instead of incurring additional costs of S$145,600 for the period 1 November 2011 to 30 November 2012.	Rental of rack space from IDC was ceased in November 2012, approximately 2 months after Negotiations with Huawei from May to early September 2012 fell through.
9	Immediately stopping the use of office space.	Office space was still required for QMAX's staff settling the residual administration of the WiMAX Network project.

338 I then directed the parties to attempt to reconcile their positions as to each of the sums that Creative claimed, assuming that the court found that there

was a breach of contract and the only issue was mitigation of damages. The parties came to an agreement on the following sums:

(a) Creative would be entitled to site access fees paid to various town councils to conduct site surveys prior to establishing radio sites or base stations for the WiMax Network at S$19,275.76.

(b) All costs and expenses incurred in installing these radio sites or base stations on the roof-top premises, including supplying equipment, the steel and concrete works necessary to establish the sites, and any waterproofing that was necessary. This would total S$3,438,424.60.

(c) Costs for radiation measurements that needed to be conducted by the National Environment Agency in order for the radio sites to be commissioned, which totalled S$1,986.

(d) Other miscellaneous equipment required for the WiMax Network project apart from those already acquired under the Contract, totalling US$22,000 and S$4,552.

(e) Costs of dismantling and disposing of the WiMax equipment at each radio site or base station after the termination of the Contract, which totalled S$1,665,204.

It must be noted that these sums, although they were eventually agreed upon between the parties, were the sums initially claimed by Creative. Hence there is no need to make a finding on mitigation in relation to these sums, which add up to a total of S$5,129,442.36 and US$22,000.

339 However, the parties contested the following sums as set out in the table below. The table sets out both parties' positions relating to the remaining sums.

Huawei took different positions depending on whether the court finds that Creative should have mitigated from October 2011 or from 29 December 2011. I shall refer to these positions as the "October mitigation" and "December mitigation" positions respectively.

Item	**Creative's revised position**	**Huawei's revised position**
Payments to IDA for purchasing WBA spectrum rights and licences	S$2,206,092.55	S$1,693,731.52 (October mitigation) S$1,770,807.65 (December mitigation)
Leasing roof-top premises to install WiMax Network equipment for radio sites	S$2,536,250.19	S$1,253,262.02 (October mitigation) S$1,672,309.80 (December mitigation)
Utilities for the WiMax Network equipment after installation	S$114,212.52	S$78,651.40 (October mitigation) S$105,557.42 (December mitigation)
Leased line services and internet bandwidth to connect WiMax equipment to radio sites	S$4,097,523.04	S$757,978.39 (October mitigation) S$1,479,173.79 (December mitigation)
Renting racks of space to house backend servers and switches for WiMax Network	S$134,000	S$100,800 (October mitigation) S$123,200 (December mitigation)
Operating expenses for WiMax Network	S$2,257,054.30	S$1,055,646.08 (October mitigation) S$1,461,488.39 (December mitigation)

Total	S$11,345,132.60	S$4,940,069.41 (October mitigation) $6,612,537.05 (December mitigation)

340 I will first examine when Creative should have begun mitigating its loss before examining the exact quantum that Creative can claim in relation to the contested sums.

341 The Court of Appeal in *The "Asia Star"* said at [24] that "[t]he evaluation of the aggrieved party's conduct in mitigation ought to start from the date of the defaulting party's breach". Huawei's best case (assuming I find that there is a breach) is that this breach occurred by its course of conduct between August and December 2011 (see above at [89]) and that this coincides with its case that Creative should have mitigated its losses from October 2011. But even if I accept that this is the case, I find that Creative had reasonably mitigated its losses up to December 2011 when it decided to terminate the Contract.

342 I do not accept that, as Huawei says, there was unreasonable delay by Creative in terminating the Contract, and that Creative should have terminated its contracts with third parties from October 2011. The WiMAX Network was a relatively big project costing some US$20m and much money had been spent as the project was nearing completion by that time. Termination at a late stage of the Contract is a very serious matter. It is not unreasonable for Creative to have taken some time to consider the matter very carefully before taking such a drastic step. It had to establish for itself that such a drastic step could also be justified if litigation ensued. It is reasonable for Creative to have given sufficient time to Huawei, as a reputable technology company to solve the technical problems encountered with the connectivity if it could. Time was needed for

troubleshooting. Numerous meetings took place to try to resolve the connectivity issue and there were also delays on Huawei's part in trying to address the issue. Huawei also made various proposals for Creative to consider. Having regard to the tight project deadlines and the delays, it is not unreasonable for Creative to have continued with the acquisition and installation of the remaining sites *pending* resolution of the technical issues.

343 Further, having examined the evidence and the explanation from PW1-Koh on how Creative's project team tried to resolve the connectivity problems with Huawei to save the Contract first before finding that they had no alternative but to escalate the matter to senior management with a view to terminate the Contract, I do not think Creative had on the whole been dilatory in terminating the Contract.

344 This leaves us with the sums from December 2011 onwards. The parties both accept that if the duty to mitigate began from December 2011 then this would have to take into account Creative's delay in terminating its other third party contracts which were related to the Contract. But even so they differed on the quantum of damages that Creative was entitled to claim. Huawei's submission was essentially that Creative needed to do so as soon as its contracts with these third parties made it possible for Creative to terminate, and since Creative did not do so immediately, it cannot claim all the sums that it says it has lost.

345 On the other hand, Creative says that any delay in the steps it should have taken was not due to its own choice. For instance, Creative said that the radio sites would have had to be dismantled before it could commence steps to terminate the related contracts or subscriptions in relation to those radio sites. Many of its contracts were also terminated sometime in 2012 given that there

were mandatory notice periods that Creative needed to observe, and even if there were no mandatory notice periods, Creative was contractually liable to pay the full contractual sum if it terminated those contracts early. Creative therefore accepted many of Huawei's deductions but included reasonable notice periods for some of the contracts equivalent to the industry standard, and also included fees that were either non-refundable or contracts that were not cancellable.

346 I will evaluate each of the contested areas in turn. I note, however, that as the Court of Appeal in *The "Asia Star"* said, "the burden of proving that the aggrieved party has failed to fulfil its duty to mitigate falls on the defaulting party" (at [24]). Therefore, to the extent that there is insufficient evidence to resolve the question of whether mitigation has taken place, I err on the side of allowing Creative's claim. The parties could not come to an agreement in the following areas:

(a) The payments in relation to the WBA spectrum rights (and related licences).

(b) The payments in relation to leasing the roof-top premises.

(c) The utility payments for equipment on the roof-top premises after they were installed.

(d) The payments in relation to the leased line services and Internet bandwidth.

(e) The payments in relation to renting rack spaces to house certain equipment for the WiMax Network.

(f) The operating expenses for the WiMax Network project post-termination.

I will deal with each in turn.

347 In relation to the WBA spectrum rights, Huawei sought to limit Creative's claim on two bases. First, Huawei said that the WBA spectrum rights could be transferred and Creative should have transferred these rights to a third party once the Contract was terminated. Therefore the value of the lump sum payment (*ie*, S$2.2m) should be pro-rated to take into account the number of months remaining after December 2011. Second, Creative should not have renewed the rights (and the associated licences) for the period 1 July 2012 to 30 June 2013 since the Contract was terminated in December 2011. Creative said that it was close to impossible to find another buyer for the rights *immediately* and hence a reasonable period of six months should be given to find such a buyer. In relation to the renewal on 1 July 2012, Creative said that this was reasonable since the relevant contract provided for a six-month notice period to terminate.

348 I agree with Creative and allow its claim in relation to the WBA spectrum rights. In relation to transferring the spectrum rights, it would be unreasonable to expect Creative to find a third party willing and able to take over the spectrum rights immediately upon termination of the Contract. Huawei bears the burden of showing that Creative failed to take reasonable mitigating steps. If Huawei were able to show there was such a third party and that Creative had rejected it, Huawei would have a much stronger case. But it could not. Hence, Huawei has not discharged its burden of showing that this was a reasonable step that Creative failed to take.

349 As for the annual fees pertaining to the period of 1 July 2012 to 30 June 2013, the relevant contract provides that IDA's approval in writing is required at least six months in advance, *ie*, for the annual period between 1 July 2012

and 30 June 2013, Creative needed to obtain IDA's written approval to terminate latest by 1 January 2012. If Creative did not terminate on 1 January 2012, then the entire set of annual charges for the period between 1 July 2012 and 30 June 2013 would have been payable on 1 July 2012. Hence, although it was technically possible for Creative to have avoided the annual fees by terminating on 1 January 2012, it would have been unreasonable to expect Creative to have made that decision in the three days between 29 December 2011 (the date on which the Contract was terminated) and 1 January 2012. I therefore allow Creative's claim of S$2,206,092.55 for this item.

350 In relation to the leases of the roof-top premises, the parties primarily differed on whether some of the relevant leases could be cancelled. Creative said that 13 of the leases were non-cancellable in the sense that it would still have to pay 100% of the fees in the event of early termination. In reply, Huawei referenced documents relating to three specific leases to show that they were in fact terminated early, and therefore Creative *could* have done so even earlier if it chose to do so. I find that Huawei has satisfied its burden of proof in relation to these three leases (*ie*, sites 4011, 6098, and 6124). I therefore take Creative's claimed sum that was revised after the parties' correspondence (*ie*, S$2,536,250.19) and reduce this amount by the rent for the number of months that Creative should have mitigated. In doing so I bear in mind that Huawei has accepted that although sites 4011 and 6098 do not have a specified notice period, a three-month period is reasonable. I also took into account that for site 6098, Creative still had to pay 50% of the rental fee even after it had successfully terminated the contract early. I therefore deduct S$43,500[59] from Creative's claim which gives a remainder of S$2,492,750.19.

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[59] This sum is taken from the total delay in terminating sites 4011, 6098, and 6124. Site 4011: terminated November 2013, a 23-month delay, but taking off three months that Huawei

351 In relation to the utilities payments for the roof-top expenses, I likewise deducted the relevant number of months from the total sums based on the three sites that I have referenced above. I therefore deduct S$3,039.99[60] from Creative's claimed sum, which gives a remainder of S$111,172.53.

352 In relation to the payments for the leased line services and the Internet bandwidth, Huawei said that Creative should have terminated these services from December 2011. Creative rejected this for three reasons: first, a 30-day notice period was required under the contract; second, some of the contracts had early termination fees of 100% or 50% of the total fee; and third, some of the services rendered before December 2011 were only charged in the bills post-2011.

353 I will deal first with the second and third objections. These objections appear to have already been addressed in the table of payments in PW3-Lian's own Supplemental AEIC. That table makes reference to the "Adjustment for Prior Month's Billing & Penalty for Pre-Termination of Bandwidth",[61] which

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conceded was reasonable gives a 20-month delay. 20 × S$1,200 rent per month = S$24,000 (see PW3-Lian's Supplemental AEIC at p 42). Site 6098: terminated June 2013, an 18-month delay, reduced to 15 months after Huawei's concession. Rent of S$2,000 per month for seven months until October 2012 and thereafter rent of S$1,000 per month for the next eight months, giving S$22,000. But assume that Creative would still have had to pay 50% of the termination fee even with early termination, this gives S$11,000 (see AB0052646 to AB0052648). Site 6124: termination letter sent mid-September 2012 (actually terminated mid-November 2012 due to 60-day notice period), a delay of 8.5 months. Rent at S$1,000 per month gives S$8,500 (see PW3-Lian's Supplemental AEIC at p 46). Total reduction is $43,500.

[60] This sum is also taken from the delay to sites 4011, 6098, and 6124. Site 4011: S$1,811.59 (total payment) ÷ 32 (total months) × 20 (delayed months) = S$1,132.24. Site 6098: S$1,382.54 (total payment) ÷ 16 (total months) × 15 (delayed months) = S$1,296.13. Site 6124: S$1,007.38 (total payment) ÷ 14 (total months) × 8.5 (delayed months) = S$611.62. Total reduction = S$3,039.99 (see PW3-Lian's Supplemental AEIC at pp 42, 45, 46, 48, and 50).

[61] PW3-Lian's Supplemental AEIC at p 61.

are precisely the sums that Creative is disputing. Hence, to the extent that these sums have already been taken into account in the table of payments, I accept Huawei's submission that they cannot be taken into account again.

354 I accept Creative's submission that a 30-day notice period is required under the contract. Creative terminated the Singtel contracts in two batches: in May 2012, and in December 2012. For the May 2012 terminations, Creative acknowledged in its letter dated 13 July 2017 at para 22 that if it had needed to mitigate after December 2011, then its claim should be reduced by S$419,500 for a five-month delay between December 2011 and May 2012. However, this sum takes into consideration a 50% discount for the alleged non-cancellable contracts which I have found to have been factored into Creative's table of payments in PW3-Lian's Supplemental AEIC. Hence, the total reduction for the May 2012 terminations should be S$839,000.

355 The second batch of terminations in December 2012 was made late because Creative continued to use the radio sites for their drive tests until end-August 2012. These contracts should have been terminated at the end of August 2012 but were only terminated in December 2012. Taking into account the 30-day notice period required under the contracts, the excess payments that Creative should have mitigated would be for the months of October 2012 to January 2013, which gives a total reduction of S$352,600.[62] After reducing Creative's initial claim of S$4,517,023.05 (as found in the table of payments) by these two sums, the total claimable sum that remains is S$3,325,423.05.

356 In relation to the renting of rack spaces, I accept Creative's explanation that a one-month period should be allowed for Creative post-termination in

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[62] See table of payments in PW3-Lian's Supplemental AEIC at p 61.

December 2011. Again, it would be unrealistic to expect that Creative to discontinue this immediately and Huawei did not show any evidence that this was possible. I allow Creative's claim for this item, amounting to S$134,000.

357 Finally, in relation to the operating expenses for the WiMax Network post-termination, Creative pointed to its table of expenses to show that it had steadily been decreasing the number of employees from 19 to four up until the stations were eventually shut down in September 2012. Creative did accept that there was a two-month period between December 2011 and February 2012 where it continued to hire 19 staff and this was factored into its calculations. Huawei did no more than to assert that these staff were not needed. It had the opportunity to cross-examine Creative's witnesses during the trial on this point but chose not to do so. I find that Huawei has not discharged its burden of proof and accept Creative's revised calculation of S$2,257,054.30.

358 As a final note, many of Huawei's submissions on mitigation have also centred on arguments that Creative's losses were not caused by Huawei's alleged breach of contract and that Creative would have incurred those losses in any event. These submissions are without basis and I find that Creative's claims were made out.

359 For the reasons above, I find that the total damages claimable by Creative on the disputed items is S$10,526,492.62.

Total damages claimable by Creative

360 For the above reasons, the following are the sums that I have found to be claimable by Creative as damages:

(a) S$5,129,442.36 and US$22,000 being the sums agreed by the parties under the court's direction (see above at [338]); and

(b) S$10,526,492.62, being the sums contested by the parties (see above at [346]).

This gives a total of S$15,655,934.98 and US$22,000.

Indemnity costs

361 Creative sought costs against Huawei on an indemnity basis on the basis that (a) Huawei's conduct in the proceedings had been vexatious, dishonest and an abuse of process; (b) Huawei's defence was speculative and baseless; and (d) Creative had suffered significant prejudice due to Huawei's conduct.

362 Both parties submitted on the unreasonable conduct of the other party in the proceedings. Numerous instances were cited by both parties in support of their respective submissions. Explanations were given in response.

363 It is pointless for me to cite them which will increase the length of this already long judgment. It suffices for me to say that I do not find that indemnity costs are justified. The experts as guided by the respective parties could have better coordinated. They should have cooperated as much as possible with respect to the proper tests to be conducted jointly in order to establish certain facts and maximise the areas where common ground could be reached. This would then have saved much of the court's time. If necessary, the parties should seek the assistance of the court to determine the appropriate parameters or boundaries for the joint tests if these could not be resolved among experts despite their best efforts.

364 I do note also that new issues (not always foreseeable during the trial preparation stage) have arisen in the course of this technically challenging trial. Just as an illustration, Dr Lee's reports comprise 404 pages and Pandion's reports comprise 420 pages leaving aside the similarly lengthy expert reports of Dr Dernikas. There were belated amendments of pleadings. Consequently, experts (having their own time constraints) have to investigate and re-investigate at a technical level, and perhaps conduct new tests on whether the new issues are valid and how the results and their opinion may be affected. Complex technical reports take time to prepare and further delays are sometimes inevitable. To the party that receives them late, it is not surprising that the expert reports appear to have been sprung on it at the last minute.

365 In my view, this is not an appropriate case to order indemnity costs. I do not find that Huawei's defence on the whole is speculative and completely without basis as contended by Creative. Much of my decision is on the basis of a balance of probabilities. Except perhaps on a small part of Creative's case that the wrong morphology classification was used for HDB estates, I do not find it generally that straightforward to decide on the merits of the rest of Huawei's defence. The high threshold to justify an order for indemnity costs is not met on the facts of this case.

Orders of the court

366 Under Suit No 55, Huawei is to pay Creative:

(a) the sum of US$9,295,388.98 that was paid by Creative to Huawei under the Contract;

(b) the sums of S$15,655,934.98 and US$22,000, being the damages suffered by Creative for having incurred wasted expenditure for the purpose of the WiMAX Network; and

(c) interest on the sums in paras (a) and (b) above, at the rate of 5.33% per annum from the date of the writ (20 January 2012) to the date of satisfaction of the Judgment.

367 Huawei's counterclaim in Suit No 55 is dismissed.

368 Costs in Suit No 55 for the claim and counterclaim are awarded to Creative on a standard basis to be taxed if not agreed.

369 Under Suit No 606, ZiiMAX is to pay Huawei the sum of US$104,860 (inclusive of GST) with interest at the rate of 5.33% per annum from the date of the writ (2 May 2012) to the date of satisfaction of the Judgment.

370 ZiiMAX's counterclaim in Suit No 606 is dismissed.

371 Costs in Suit No 606 for the claim and counterclaim are awarded to Huawei on a standard basis to be taxed if not agreed.

Chan Seng Onn
Judge

Yim Wing Kuen Jimmy *SC*, Soo Ziyang, Daniel, Lee Yicheng Andrew (Li Yicheng), and Huang Junjie (Drew & Napier LLC) for the plaintiffs;

Andre Francis Maniam *SC*, Yong Shuyi, Alma, Ho Weijie, and Siew Guowei (WongPartnership LLP) for the defendant.
