

# Opinion evidence in Cell Site Analysis

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## 1. Introduction

1.1 There is a difference between the definition of an “expert” and an “expert witness”. An expert is defined in the Oxford English Dictionary as a:

- “person who has comprehensive and authoritative knowledge of or skill in a particular area”

1.2 An expert witness is not defined in the Oxford English Dictionary, but a working definition may be:

- “an expert who can inform or educate the court or tribunal and provide impartial opinion on particular aspects of matters within their expertise which may be in dispute”. This may be further clarified as:
- “a person who has comprehensive and authoritative knowledge of or skill in a particular area and understands how to apply that knowledge in the context of a question before the court to provide legislatively compliant, reliable, logical, transparent and unbiased opinion”

1.3 The role of an expert witness extends from being knowledgeable about a subject to provision of opinion concerning matters relevant to that subject to the court. They are the only type of witness entitled to do so. To safely provide opinion in this context, they must understand the nature of opinion and the legal framework in which it is applied. For a Cell Site Analysis practitioner, while not all technical evidence necessarily results in opinion (or is expert evidence) opinion evidence is always expert evidence and thus can only be given by an expert witness. This paper focusses on the provision of opinion within Cellsite Analysis, whether it is for Technical, Investigative or Evaluative purposes and is aimed at expert witnesses in this field and those relying on their opinions. Having noted the difference between an “expert” and an “expert witness”, from this point forward and unless otherwise noted, the word “expert” is used as short form of “expert witness”.

1.4 The primary role of Cell Site Analysis experts is to consider Charging Data Records (CDRs). These are generated by Mobile Network Operators for billing and network monitoring purposes. The data may provide valuable insight relevant to criminal investigations and may be requested by those operating with appropriate legal authority within the Criminal Justice System of England and Wales (CJS). Historic Cell Site Analysis involves the analysis of these CDRs to determine areas where a device may, or may not, have been at the time of call activity (ref 1). While the time and the cell used by a given device is amongst the data, the specific location of the device, who was using it, or what was occurring when the device was used, is not recorded in the CDRs; these are often the matters to be addressed by a forensic practitioner. The use of CDRs at court will almost certainly require some form of interpretation (by a practitioner, an investigator, or the court) as to their meaning in the context of a case.

1.5 Cell Site Analysis relies upon the acquisition of CDRs, assessment of that data, and the presentation of it, usually in the form of maps and tables possibly with a report containing commentary and opinion. Additional activity such as radio frequency surveys or terrain profiling may also take place to provide greater precision of findings where necessary. A degree of technical interpretation will always be required either to prepare this output or to understand its use in the context of case circumstances, but not all interpretation results in an opinion being given. The word “interpretation” can mean different things in different contexts (ref 2). In short there is a difference in the meaning of “interpretation” between:

- Interpretation of a Technical Term: Explaining a defined technical process or the meaning of a term is unaffected by case circumstance, does not include opinion and is fact evidence
- Technical Opinion: Interpreting analytical output to elucidate the results. When there is only one reasonable explanation for data, this is deductive reasoning and may not result in opinion, but under other circumstances (such as answering a question as to whether a cell does or does not serve an area including a location) there may be a range of views as to how to answer the question posed or what the source data means; this is technical opinion. The answer given relates purely to a technical view and is not related to case circumstances. A number of technical opinions will normally form the basis of an investigative or evaluative opinion.
- Investigative Opinion: The call data may be interpreted to provide speculative hypotheses. This could be to aid insight into an investigation, or to provide a commentary of the wider context of call data prior to detailed assessment of specific call events immediately relevant to specific allegations under consideration. This is usually, if not always, opinion evidence.
- Evaluative Opinion: The call data may be interpreted to assess whether it would be expected given specific propositions. Examples include assessing whether call data would be expected if the users of devices met, or if a suspect were the user of a given device. This is usually, if not always, opinion evidence.

1.6 It is common for a Cell Site Analysis expert report to switch between these modes (explanations of terms or concepts, deductive explanations for data, technical opinion concerning the area over which a given cell might reasonably be expected to provide service, investigative commentary and evaluation of the data given specific propositions); A practitioner may create maps and tables, explain terms used, explain the results of tests, provide commentary of cell usage of a given device in periods when there is no proposition presented and then assess the data given a specific proposition.

1.7 The approach taken during an analysis may strongly influence the type of findings produced and the way they are expressed. The dangers of treating these different types of activity in a similar manner are outlined in a series of papers by Evett et al (ref 3, ref 4, ref 5, ref 6). It is essential that the practitioner must understand their changing role as the language used and approach differs for each requirement, and there is an enhanced risk that there may be issues with evidence given if the differences are not understood and acted on.

## 2. Technical Processes within cell Site Analysis

2.1 Most examinations within cell Site Analysis require a series of tasks to be performed. From the author's personal experience, a commonly encountered form of analysis in Cell Site Analysis is to predominantly perform these tasks independently of each other. For example, generic tasks may consist of:

- **Purpose** The Purpose directly reflects the Customer Request which is entirely defined by the customer (and often generic, such as X phones and y addresses with a time and location of an offence)
- **Perform tests.** Perform surveys (often using a standardised approach), process the survey data and technically interpret it. This often results in a list of cells detected as serving during a survey at each location, presented as factual evidence. Surveys would often be defined in the "purpose" as an overt task, distinct from any consideration of the resulting data
- **Generation of exhibits – Call Sequence Tables, Maps etc.** The Call Data Record is turned into a Call Sequence Table (CST). Maps can be created from these tables. Generation of a CST or Maps would often be defined in the "purpose" as an overt task, distinct from any consideration of the data
- **Generate report.** The analysis/ commentary may be generated by direct comparison of the Call Sequence Table with the survey results from locations of interest. Alternative hypotheses may be generated from these technical findings. Conclusions often primarily consist of a summary of the commentary.

2.2 The modular approach lends itself to both automation and delegation, and is an attractive model for a unit seeking a flexible workflow, enabling multiple cases to be more easily parallel-processed and reduced to a series of largely unrelated technical tasks (for example, conversion of call data, mapping, surveys, etc.). These tasks might be progressed independently of one another, thus enabling workflow resilience and the ability to reduce costs. Reports generated may be at the end of the process, with an expert witness presented with a series of questions, survey results and exhibits and asked to provide opinion on their meaning.

### 3. Case Example

3.1 The following example, although anonymised, is from a report in the personal experience of the author and broadly representative of much cellsite evidence encountered. Please refer to figure 1, which illustrates a process following this approach to Cell Site Analysis. Within this figure Such reports often include phrases such as:

#### 3.2 Purpose

*(Company or organisation) have been instructed to:-*

- *Undertake Surveys using scanner equipment at the Locations listed.*
- *Produce a consolidated, chronological call schedule for the telephones listed for the specified Periods of Interest.*
- *Analyse the survey results against the CDRs for any activity during the Periods of Interest.*
- *Produce and exhibit overview maps showing any movement of the subject 'phones with reference to the Locations of Interest.*

#### 3.3 Perform Tests - Survey Measurements

- *All Surveys are undertaken by a survey engineer. The role has included data collection, its' analysis, reporting on the findings and, when necessary, presentation at court.*
- *A 'Location Measurement' is a static survey carried out inside/outside a specified property or at a specified location of interest (LoI). They are intended to identify the cell or cells which provide server coverage and neighbour coverage to the property or specific location.*
- *Staff undertook surveys relevant to this enquiry on (dates).*
- *I have analysed the results of the radio surveys and interpreted the results as appropriate to create this Technical Report.*
- *Note. Any radio survey can only reflect the state of the network at the date and time of that survey. It is assumed that the mobile telephone network was functioning correctly and that it was in the same configuration at both the time of the incident under investigation and at the time the surveys were carried out. Should the results of surveys be inconsistent or anomalous it is possible to apply to the Communications Service Providers for a history of any site reconfiguration or service interruption. In this case that action was not considered necessary.*
- *The survey results are presented as follows:*

LOI	Location Name	Address	Cell ID
1	Scene	(Address 1)	12345
			67890
3	Suspect 1 Home Address	(Address 2)	09876
2	Suspect 2 Home Address	(Address 3)	12345
			75682

### 3.4 Analysis/ Conclusions

- *Calls of relevance for the mobile telephone attributed to Suspect 1, between 21:43 and 23:37*
  - *Between 21:43hrs and 23:37hrs the mobile telephone attributed to Suspect 1 used cell 12345 in the Newtown area of Birmingham. As shown in the survey results, cell 12345 is a serving cell for both the scene and the home address of suspect 2*
  - *The data is consistent with the mobile telephone attributed to Suspect 1 having been at or in the area of the scene and/or the home address of suspect 2 between 21:43hrs and 23:37hrs”*

3.5 At first read, these findings may appear to be an entirely acceptable approach to cellsite analysis. Technical skills and knowledge beyond those expected of the jury have been deployed in an attempt to address questions posed by the Police as part of an investigation and then used at court in support of a prosecution of a named suspect. Within this case example, the defendant (suspect 1) accepted he had the phone, but disputed being at the scene at the times of the calls, and stated that he was home throughout the period. It is not clear whether the expert was made aware of this (or had asked for clarification) but the expert was aware of, and had survey data for, the home address. If presented with the report as it stands, it is reasonable that the jury may understand the findings to mean that:

3.5.1 The data is “consistent” with suspect 1 being at the scene in the period defined (the prosecution position)

3.5.2 The data is also “consistent” with them being at the home address of suspect 2 – an alternative hypothesis not presented by either prosecution or defence

3.5.3 There is no explicit mention of whether the data is “consistent” with being at the home address of suspect 1 (the defence position), but while the survey results mention the cell used (Cell ID 12345) serving at the scene and the home address of suspect 2 they do not mention the home of suspect 1; a different cell (Cell ID 09876) was detected serving at the home address of suspect 1. There is an implication that Cell ID 12345 does *not* serve an area including the home address

3.5.4 The results therefore appear to distinguish between cell usage to be expected if the phone were at the scene (the stance adopted by the prosecution) from that expected if at home (the stance adopted by defence)

3.5.5 The findings are presented as balanced, flagging an alternative hypothesis (albeit one that wasn’t specified by either prosecution or defence). A standardised approach has been taken, apparently logical, transparent and without fear or favour to either side. Given thus, it is reasonable that a jury might believe that these results have probative value in establishing whether Suspect 1 committed the offence and was lying about being at home, or being truthful about being at home and innocent of the offence

3.6 There are other ways in which the analysis could have been conducted. Prior to examining another approach, it is useful to review an example of where the presentation of scientific

opinion was known to cause issues and the legal and regulatory framework within which Cell Site Analysis opinion evidence is now produced in the UK.

#### **4. The Legal and regulatory framework of opinion evidence**

##### **4.1 R v Preece – an example of a failure in expert evidence**

Preece v HM Advocate. Criminal Law Review 1981; 783. Excerpt taken from the Ph.D thesis of Graham Jackson (ref 7)

"In 1972, Jack Preece was convicted of the murder of a woman in the cab of his lorry in Scotland. At his trial, scientific evidence relating to the analysis and comparison of body fluids, fibres, hairs and other material was presented by forensic scientist Dr Alan Clift. No-one can say precisely what the impact his evidence had on the jury's decision but it seems reasonable to assume that it added significant weight to the prosecution's case against Mr Preece. In 1981, after questions were raised over the reliability of Dr Clift's evidence, the case was referred to the Court of Appeal. New evidence was presented at this hearing about Dr Clift's analysis of semen stains in the case and his subsequent interpretation of the results. In particular, the court heard that the victim and the defendant shared the same bloodgroup type and there was doubt that, contrary to Dr Clift's evidence, it was not possible in this case to distinguish the contribution to the analytical results of the female victim from that of the male offender (whoever he may have been). The Court of Appeal ruled:

*...that had the jury heard the new evidence they must have found Dr Clift to be discredited as a scientific witness and that accordingly the whole of the scientific evidence he gave would have been regarded as unreliable; and the appeal must be allowed and the conviction quashed.*

There are issues in this case about the role of prosecution and defence lawyers in teasing out the strengths and weaknesses of scientific evidence. For example, it could be argued that both prosecution and defence, for different reasons, failed to help the court arrive at a fair decision on Mr Preece. Prosecution failed to ask the witness whether the bloodgroup of the victim was of the same type as the defendant. For its part, the defence failed to challenge the basis of Dr Clift's opinion that it was possible to differentiate the victim's body-fluid components from those of the offender. However, a key issue remained in this case - what is the duty of the expert witness in such cases and how should they discharge that duty? Commenting on the case, Brownlie refers to earlier authorities:

*"The law's requirements of an expert have hitherto been that he shall give his evidence..... in a fair and unbiased manner making a full and frank disclosure so as to provide the court with the material necessary to enable it to come to a reasoned decision on the merits of the scientific issue" - Davie v. Magistrates of Edinburgh, 1953 S.C. 34?*

*"For the first time it appears that the High Court is spelling out the supreme requirements for the expert, namely that he shall not only give his evidence to the best of his ability but also supply a critique of that evidence drawing attention to its weaknesses as well as its strengths"*

And, quoting Sir Roger Ormerod:

*"It should be a rigorous obligation on all experts to give the court as clearly as they can the limits of accuracy of their evidence, whether it is experimental or theoretical, and to disclose, if it be*

*the fact, that other views exist in their profession. It should also be their duty to the court to indicate what inferences cannot be drawn from their evidence."*

In short the expert didn't:

- Address, or falsely excluded, an obvious and legitimate Defence proposition
- Have or present a valid understanding of whether the results obtained *could* discriminate between alternative propositions.

## 4.2 **The Legal and Regulatory environment for opinion evidence**

4.2.1 Preece v HM Advocate was one of a number of transgressions concerning scientific evidence taking place in the 1970's and 1980's that were highlighted in the media and resulted in adverse comment from Judges. The failures took the form of the following basic types:

- Failure of proactive disclosure of relevant facts to the court
- Use of non-standard or unusual techniques with no validation or peer review
- Lack of documentation
- Adopting Police assumptions and/ or only seeing the Police side of the story (resulting in lack of, or apparent lack of, impartiality)

4.2.2 As a result there was new legislation passed, including the Criminal Procedure Rules (CrimPR) and Criminal Practice and Direction (CPD) to address shortcomings in expert evidence. The problems arising also informed the code of conduct issued in the Forensic Science Regulator (FSR) Codes of Conduct and Practice (ref 8, ref 9) and legal obligations (ref 10). All experts are required to comply with both the required legislation and the FSR Codes. Standards for the formulation of evaluative forensic science expert opinion are published by the Association of Forensic Science Providers, whose members include expert witnesses practising in a wide range of scientific fields from DNA to Footwear to Glass Analysis and many other disciplines (ref 11) and by the European Network of Forensic Science Institutes (ref 12). There are books and papers specifically focussed on interpreting scientific or technical evidence and the provision of opinion that apply to all of forensic science (ref 13, ref 14), and guidance for use of expert testimony in the light of legislative changes (ref 15) The fact that such disparate disciplines share similar concerns surrounding opinion evidence demonstrates that those issues are not unique to any specific branch of science; it is reasonable that concerns affecting forensic inference, and solutions to those concerns, also apply to Cell Site Analysis (ref 16).

4.2.3 Digital Forensics is generally aimed at data recovery and presentation, and the requirement for opinion on anything other than a purely technical matter is comparatively rare. Cell Site Analysis is an obvious exception to this. Practising experts, however, are likely to have come from a purely technical background and may not have received training in, or be aware of, the legislative and forensic context of opinion evidence; this lack of awareness may extend to use of interpretation models such as the Case Assessment and Interpretation (CAI) Model to reach valid, transparent, balanced, logical and robust opinions.

## 4.3 **The effect of Legislation on Cell Site Analysis:**



Throughout the FSR codes, CPD and CrimPR there are stated requirements to ensure that issues such as those arising in R v Preece are less likely to occur going forward. There are a range of very specific stipulations that are highly relevant to Cell Site Analysis. Legal requirements include:

#### 4.3.1 Criminal Practice and Direction (CPD)

*The court may take into account:*

- *the extent and quality of the data on which the expert's opinion is based, and the validity of the methods by which they were obtained;*
- *if the expert's opinion relies on an inference from any findings, whether the opinion properly explains how safe or unsafe the inference is (whether by reference to statistical significance or in other appropriate terms);*
- *if the expert's opinion relies on the results of the use of any method (for instance, a test, measurement or survey), whether the opinion takes proper account of matters, such as the degree of precision or margin of uncertainty, affecting the accuracy or reliability of those results;*
- *the extent to which any material upon which the expert's opinion is based has been reviewed by others with relevant expertise (for instance, in peer-reviewed publications), and the views of those others on that material;*
- *the extent to which the expert's opinion is based on material falling outside the expert's own field of expertise;*
- *the completeness of the information which was available to the expert, and whether the expert took account of all relevant information in arriving at the opinion (including information as to the context of any facts to which the opinion relates);*
- *if there is a range of expert opinion on the matter in question, where in the range the expert's own opinion lies and whether the expert's preference has been properly explained;*
- *whether the expert's methods followed established practice in the field and, if they did not, whether the reason for the divergence has been properly explained.*

#### 4.3.2 Criminal Process Review (CrimPR)

- *where the expert has based an opinion or inference on a representation of fact or opinion made by another person for the purposes of criminal proceedings (for example, as to the outcome of an examination, measurement, test or experiment)—*
- *identify the person who made that representation to the expert,*
- *give the qualifications, relevant experience and any accreditation of that person, and*
- *certify that that person had personal knowledge of the matters stated in that representation;*
- *where there is a range of opinion on the matters dealt with in the report—*
  - *(i) summarise the range of opinion, and*
  - *(ii) give reasons for the expert's own opinion;*

#### 4.4 The Forensic Science Regulator Codes (ref 9)

The Forensic Science Regulator Appendix covering Cell Site Analysis define (as would be expected) much more specific requirements for a Cell Site Analysis examination, for example:

4.4.1 **Purpose.** Under section 5 ("Independence, Impartiality and Integrity"), section 7 ("Setting the Forensic Strategy"), section 9 ("Competence") and section 12 (test reports, statements and presentation of evidence") requirements of an expert are stated including:

- *Consideration of both the prosecution and defence hypothesis, if available, or attempting to determine the defence hypothesis*
- *Assess whether the question to be addressed is valid or may be prejudicial; if overly specific questions have been posed that, in the view of the practitioner, are so restricted that to answer them without additional commentary may be misleading, this shall be highlighted and a more balanced approach taken in the analysis.*
- *Review the strategy adopted to answer the question and highlight any areas in which they believe they are constrained (i.e. highlight the differences between the approach they have been committed to and that which they would have adopted if they had set the strategy themselves).*
- *Alternative hypotheses in the investigative mode and alternative hypotheses in the evaluative mode have been properly considered.*
- Setting the purpose is within ILAC-G19 4.1, 4.2 and 4.3, codes 5.1.1 and 5.1.2.

4.4.2 **Perform Surveys, generate exhibits and other analytical tasks.** Under section 7 ("Setting the Forensic Strategy") and section 12 (test reports, statements and presentation of evidence") requirements are stated including:

- *Highlight any parts of the process (for example, conversion of call data, mapping, surveys, etc.) that they have not personally verified as accurate. If a third party has performed these tasks and the practitioner has checked them and is confident that they are accurate, the practitioner may take ownership of the product. In this instance the practitioner needs to record who undertook the original work in accordance with Part 19 of the Criminal Procedure Rules.*
- *Suitable theory training on survey strengths and limitations, validation data and appropriate knowledge of RF technology.*
- *The data (for example, survey database) relied on are sufficient in size and quality to justify the nature and breadth of inferences drawn*
- *Their methodology, assumptions and reasoning have been considered by other practitioners and are regarded as sound, or where challenged, the concerns have been satisfactorily addressed.*
- *An assessment of the extent to which their methodology and reasoning are now accepted by their peers, together with details of any outstanding concerns.*
- Accounting for limitations in the examinations undertaken is a requirement of ILAC G19 section 4.8.1

4.4.3 **Provide opinion and generate report.** Under section 5 ("Independence, Impartiality and Integrity"), section 7 ("Setting the Forensic Strategy") and section 9 ("Competence") requirements are stated including:

- *Cell site analysis may be used to propose investigative avenues (i.e. to help form a hypothesis). If a hypothesis has been produced through a different process, cell site evidence should only be used to test whether that hypothesis is supported by the evidence; it should never be used to test whether the hypothesis supports the allegations or hypotheses being put forward in the case independently of the evidence. Care should be taken not to transpose the conditional aspects of any assertion.*
- *"The terminology used in reports shall be clearly defined and imply no bias. Phrases in reports such as 'in the vicinity of' may only be used if qualified; phrases such as 'consistent with' should not be used in reports unless all other hypotheses the findings would be consistent with are given."*
- *Development of a forensic strategy.*
  - *Assessment and interpretation skills;*
  - *formulating and testing hypotheses;*
  - *awareness of the risk of transposing conditionals; and*
  - *appropriate terminology.*
- *Suitable theory training on survey strengths and limitations, validation data and appropriate knowledge of RF technology.*
- *Awareness of cognitive bias.*
- *Expressing opinions on the facts is the role of the expert witness; this includes providing evaluative evidence. Personnel interpreting results shall have been assessed and deemed competent before reporting statements, including in the interpretation and opinions of results and findings.*
- *Forensic units shall ensure that all staff who provide expert evidence based on their practical experience and/or their professional knowledge are additionally able to provide the following.*
  - *An explanation of their methodology and reasoning.*
  - *Reference to a body of specialised literature relating to the field of expertise and the extent to which this supports or undermines their methodology and reasoning.*
  - *That the data (for example, survey database) they have relied on are:*
    - *sufficient in size and quality to justify the nature and breadth of inferences drawn;*
    - *the inferences are logically sound; and*
    - *alternative hypotheses in the investigative mode and alternative hypotheses in the evaluative mode have been properly considered.*
- *The language used in all reports whether considered factual, investigative or evaluative shall be consistent with the needs of the courts to be informative, unbiased and not misleading.*

- The use of propositions is required by ILAC G19 section 4.8.1.
- Those providing opinion must be competent to do so under ILAC G19 4.8.3

## 5. Interpretation Model

### 5.1 Assessing uncertainty in Cell Site Analysis Methods, accuracy and precision

An "opinion" may be defined as when "an explanation for data has been given or is preferred, and there are other reasonable explanations that could have been given that are not preferred". If there are a range of possible explanations then if selecting one (or a subset) of them the expert must have a view as to how likely each explanation is. At the least this view will be whether an explanation is possible, but they may go further and potentially rank the likelihood of explanations. This assessment will almost certainly be influenced by technical assessments resulting from tests; In Cell Site Analysis this will often include, but not be limited to, survey results. Knowledge of the uncertainties within the tests applied is therefore essential. Within Criminal Practice and Direction (CPD), there is a requirement that *"if the expert's opinion relies on the results of the use of any method (for instance, a test, measurement or survey), whether the opinion takes proper account of matters, such as the degree of precision or margin of uncertainty, affecting the accuracy or reliability of those results"*. This requirement is at the core of opinion evidence and must be assessed prior to presentation of the results of a method to the jury. To do so, the meaning of "precision", "Accuracy" and "reliability" and how they can be assessed must be understood. The terms of accuracy and precision may be used in other fields of forensic science including traditional sciences such as chemistry and physics but also other areas such as computer science and statistics. There may be different definitions of accuracy and precision according to each of these fields (statistics, chemistry, computing) in which the terms are employed. This can result in the concepts being difficult or inconsistently applied to Digital Forensics.

5.1.1 **Accuracy** can be defined as "The closeness of agreement between the mean of a set of results or an individual result and the value that is accepted as the true or correct value for the quantity measured". Accuracy is a measure of whether or not a true answer is returned in the range of results from a method (and if not, how close the result is to the true answer). In Traditional Forensics, for example, an assessment of a method for measuring the refractive index of glass, this could be equated to whether the true value was returned within the range of measurements (i.e. whether the correct answer was within the range of answers provided). In Cellsite Analysis, an example may be whether all of the legitimately serving cells were detected in the survey (or whether any known serving cells were *not* returned in a result) when reviewing a survey method for measuring cells serving at a location. If there were legitimately serving cells that were not detected by the method, this can be equated to "false negative" results. A static survey taking place at a location will only return serving cells at that point; If the question addressed is aimed at that specific point, the results would be high accuracy (but the accuracy will reduce the further from the specific point at which the measurements were taken).

5.1.2 **Precision** is defined as "Precision is synonymous with reproducibility or repeatability, whereas accuracy is about obtaining the true or correct value for the quantity measured. An incorrectly calibrated device may be capable of giving reproducibly precise readings even though data generated are not

accurate.” Precision is a measure of the uncertainty of the result, the type or range of results provided. In traditional Forensics. For example, in an assessment of a method for measuring the refractive index of glass, this could be equated to the range of measurements returned for a single true value (i.e. the uncertainty in any individual reading defined from the range of all readings). In Cellsite Analysis, for example, in a review of a survey method for assessing cells serving at a location, this could be equated to the range of cells detected serving at a location in addition to that used by the target device. If there were cells that were included by the method that did not legitimately serve the location (i.e. could not have created a call record), this can be equated to “false positive” results. A static survey taking place at a location is likely to return a subset of legitimately serving cells and is therefore low-precision (but as stated in the previous section, high accuracy)

5.1.3 **Reliability** appears to have no fixed meaning within a legal context (ref 10, ref 13) but may be broadly expected to mean “the degree to which the result of a measurement, calculation or specification can be depended on to be accurate”. In forensic terms it might be considered as a broad amalgamation of accuracy and precision; whether a result can be relied on to be correct and how repeatable it is.

5.1.4 **Assessing accuracy, precision and reliability - Validation.** Validation involves demonstrating that a method used for any form of analysis is fit for the specific purpose intended, i.e. the results can be relied on. In short, validation is the process of identifying the hazards in a method and assessing the risk associated with each hazard. The results can be used to inform uncertainty in the method, and highlight the need for additional steps to be taken to mitigate for that uncertainty. The validation process is not to demonstrate beyond doubt that a given method is perfect. There are standards concerning validation with Digital Forensics (ref 17). Within Cellsite analysis there may be differences in the manner in which validation can take place. In the validation of a reliably repeatable process – e.g. CDR normalisation, or representation of locations in mapping tools, a set of test data can be created that is known to include all of the data items which may cause issue (including volume of data and character types or formats known to cause problems). The expected “correct” answer can be defined in advance, and an assessment made as to whether the method meets the required standard. This approach cannot easily be taken for methods such as survey techniques. For this type of assessment the source data (i.e. the air interface radio environment) is outside the control of the validation exercise. In the absence of an ideal and entirely predictable mobile phone network controlled by the person performing the validation, the complete ‘true’ answer will be unknown. Thus, if there are a range of possible answers, these may be difficult or impossible to accurately define, although it may be possible to define a subset of correct answers. An assessment of repeatability (with accuracy and precision being inferred from how consistent the readings are using the method), “sanity tests” (when survey data is compared to a known cellsite to ensure it looks reasonable) and blind trials if network data is available can still be performed to inform on the accuracy and precision of the method, and some work of the nature has been peer reviewed and published (ref 1)

5.2 **Types of opinion and reasoning** Prior to an opinion being formed, it is useful to understand the types of opinion that may be presented and the thought processes by it may be reached. Understanding

these ways of thinking assists in recognising, addressing and expressing the limitations of any opinion provided.

**5.2.1 Technical Opinion.** Assessing the time uncertainty in usage of a Cell in a Vodafone GPRS record can be achieved using a defined and repeatable process; If the rules by which the record is generated are known, they can be interpreted in a repeatable way and safely used in an ensuing analysis. Some assessments within Cell Site Analysis concerning possible activity may also present only one reasonable explanation, depending on the required precision of the question. For example, if a phone used a cellsite based in central Norwich followed by a cellsite in central London some time later and the question was merely to assess whether there was movement between the general areas of these cities. The question is set in the broadest terms (i.e. the practitioner is not asked to estimate the service area of any cell used, or whether any of them encompass an area including a location of interest). In this proposition, on the scale of a single map (illustrating Norwich and London, over 180km apart), the icons for cellsites may be equivalent or even larger than many of the service areas' of the cells' used. As such there is a "common sense" conclusion that could be drawn that, if the call data has been correctly normalised, the only reasonable explanation for the data would be that the device moved between the general areas of Norwich and London. This is a form of deductive reasoning, a logical thought process that ends in a single conclusion, that being the only one reasonable. The correctness of that conclusion depends on the assumptions that underlie it (which may require technical knowledge). If there is only a single reasonable explanation for data this would not appear to be opinion evidence, so long as the assumptions on which it is based are true (i.e. the truth of the premises guarantee the truth of the conclusion). Even if no opinion is given, this may still be expert evidence if it is sufficiently technical in nature. Whether or not it is expert evidence, prior to provision of it the competence of the individual must still have been assessed to:

- i) select the method
- ii) apply the method
- iii) correctly interpret the output of the method

If there are other reasonable explanations that could have been given but one or a subset are preferred this is by definition opinion evidence. Such opinions may include whether a given cell serves an area including a specific location or an assessment of the service area of a given cell. This technical assessment is unaffected by case circumstances and relies on the skill and knowledge of the practitioner. Except in extreme circumstances (e.g. a test cell in a Faraday cage) there is no certainty in the service area of a given cell, so there may be alternative views on how to assess it or what specific technical results mean in the context of that assessment. Despite the potential availability of large quantities of survey measurements, the author is unaware at present of a reliable and/ or accepted method to produce a probability of whether a given cell is likely to serve at a given location. The assessments will therefore often be qualitative rather than quantitative and fit into one of a few categories:

- i) It is reasonable that the cell serves at the location. This could be split into two sub-categories

- a. Survey data or other information can demonstrate that the cell served on the day of the survey
- b. It is reasonable that the cell serves at the location but this is not demonstrated. Often survey data doesn't exist or doesn't demonstrate service, but there are other factors which may influence the expert that can be expressed, such as a neighbour measurements or an overlaid cell known to provide service. There is less assurance that the opinion that the cell serves is correct, but it is the belief of the expert that it is reasonable that it serves
- ii) It is not expected that the cell serves at the location, but not impossible e.g. there is weak neighbour service detected but other cells were selected as serving at the location. In the expert's view other cells would be much more likely to be selected and there is no evidence demonstrating or suggesting the cell of interest would, but it could not safely be excluded
- iii) It is not reasonable (or may be impossible) that the cell could serve at the location

These types of technical opinion usually form the basis of a wider assessment and inform other types of opinion (whether investigative or evaluative).

#### **5.2.2 Investigative Opinion**

The call data may be interpreted to provide speculative explanations or hypotheses. Investigative opinion is strongly linked to abductive reasoning, which is a process by which possible explanations for data are proposed by the expert, assessed and ideally ranked in order of probability. There will be more than one possible explanation for the data (else it would be deductive reasoning), and there is a danger that some possible explanations will not have been thought of or presented, meaning that an expert may inadvertently mislead. This is clearly opinion evidence and a focus of this form of reasoning will be the assessment and expression of uncertainty within the process. An example may be a broad commentary of the general apparent movement of a phone under consideration in a period outside specifically alleged activity, potentially aiding insight into an investigation but not directly addressing any specific allegations under consideration. There is a danger that if overly specific hypotheses are presented this may give the impression that the expert has a much clearer and defined knowledge of what took place.

#### **5.2.3 Evaluative Opinion**

The call data may be interpreted to assess whether it is more likely it would be generated under one proposition than another. As such, evaluative opinion is strongly linked to inductive reasoning, which is an assessment of whether the data considered is more or less likely given different sets of circumstances. The data may be more likely given one proposition than another; As such the assessment relies on probability. The propositions considered will normally be those presented by prosecution and/ or defence as their explanations of how the data was generated. This is clearly opinion evidence and a focus of this form of reasoning will be the assessment and expression of uncertainty within the assessment. An example of inductive reasoning within Cell Site Analysis may be an assessment of whether the call data would be expected given that the phone was at the scene (as the prosecution allege) or at the alibi location (as the Defence propose). Other examples may include

assessing whether call data would be expected if the users of devices met, or if a suspect were the user of a given device. The understanding of the practitioner on the limitations and uncertainties in the source data (CDRs, survey results and other information used to reach conclusions as to the area in which a phone would have been at the times of the call activity in the records) is critical to being able to address whether that data would be expected given a proposition.

Here we have; a framework of circumstances; a set of data; two or more propositions that often represent the positions taken by prosecution and defence at court. The opinion here will be an expression of support for one of the two propositions (or no evidence if the evidence is inconclusive). As with the deductive process, its correctness relies on the validity of the assumptions that underlie it, but different to deductive reasoning there will not be one, categoric, answer.

Competence in the use of technical methods does not in itself provide any assurance that the output can be correctly interpreted when applied to a wider proposition or question. In particular, opinion evidence (when a method is used to shed light on whether evidence is expected given specific activity) is prone to a range of additional concerns in addition to those concerning the validity of the method used. Competence in forensic interpretation (evaluative evidence) must be explicitly assessed if a practitioner is to produce opinion evidence. This would be in addition to validation exercises for a technical method.

#### **5.2.4 The difference between Investigative Opinion and Evaluative Opinion**

Earlier in this paper there was an example of a deductive assessment concerning wide movement from the general area of Norwich to London. If this were a case example, more detailed allegation may develop and the approach taken to an assessment may change:

- First, given the observations that a call was made via a cellsite in Norwich, followed a while later by another call from a cellsite in central London, then a simple investigative explanation would be that between the two calls the phone moved from the general area of Norwich to the general area of central London.
- Later, after some investigation, the prosecution case having become more specific, for example that the defendant made the first call from his home in Norwich and the second call from outside the scene in London. The defence position may be that he made the first call from his home in Norwich and the second call from his girlfriend's flat in London. This gives two clear and precise propositions to be addressed.

Explanations formed from investigative opinion are open-ended; Propositions forming the basis of evaluative opinion are precise and framed within the circumstances and according to positions taken by prosecution and defence. The precision in the propositions comes from the proponents, not the observations.

#### **5.3 Types of question to be addressed – the Hierarchy of Propositions**

The type of question considered will affect the type of reasoning applied.



**5.3.1 Source Level.** In traditional Forensic Science, a source level proposition is one which relates a trace (e.g. a footwear mark) to a particular source (e.g. a specific shoe). There is no consideration of what activity led to the existence of the item. In Cellsite Analysis, such a proposition may be whether a given cell serves an area including a specific location, or an assessment of the service area of a given cell. As such, it is linked to deductive reasoning and technical opinion. Source level propositions may be addressed via an assessment of a purely technical nature and may require little if anything in the way of case circumstances to inform opinion. Thus, if case circumstances change, the results of source level propositions will not usually need to be reassessed.

**5.3.2 Activity Level.** An activity level proposition is one which relates to the circumstances which led to a given finding. In Cellsite Analysis, such a proposition may be that a phone moved from the home address of a suspect to the scene. As such, it is linked to both investigative and evaluative opinion. In some cases an activity level proposition directly addresses a specific proposition (as in the example above) but in other cases the proposition is indirectly linked to any specific proposition, for example addressing whether a specific individual was the user of an alleged phone. Case circumstances have a critical effect on formulating propositions and considering the probability of findings given those propositions; if the case circumstances change, a re-analysis may be required (in a way in which a source level examination would not)

**5.3.3 Offence Level.** An offence level proposition is one which relates directly to whether a specific offence occurred or whether the subject committed an offence. This level of proposition is that which the jury is required to consider, and while an expert may help a jury come to a conclusion via an analysis concerning activity or source level propositions, they must not directly address questions concerning the guilt (or otherwise) of the accused.

**5.4 Defining the questions to be addressed: Pre-assessment.** A critical aspect of forming forensic opinion is in defining the question to be addressed. There are a number of factors that need to be considered when setting the purpose of the examination. The expert must assess whether the questions set by the customer are valid or may be prejudicial, in short ensure a meaningful and impartial assessment can be made from the information received in the light of the customer request. If overly specific questions have been posed that, in the view of the practitioner, are so restricted that to answer them without additional commentary may be misleading, this shall be highlighted and a more balanced approach taken in the analysis. The overall purpose of the examination should be considered. The request for the analysis may have set questions to be addressed at a purely technical (source) level, when the true purpose is to shed light on alleged activity. An expert should, where possible, attempt to assist the court by addressing propositions at the activity level. Without this form of pre-case assessment, it is possible that an expert may assess inappropriate or misleading questions however unbiased they believe their analysis to be. This activity is a requirement of the "expert" role that is not addressed purely through the technical competence of the practitioner.

**5.5 Bayesian approach and the scale of evidence**

5.5.1 A method for assessing the evidential value of a given analysis commonly used in areas of traditional forensic science such as DNA, fibres and glass is the likelihood ratio. Bayes Theorem is a probabilistic approach in which a likelihood ratio is generated by comparison of two or more hypotheses, and this likelihood ratio can be used to update a prior probability in the light of new evidence.

5.5.2 The likelihood ratio ( $LR$ ) is derived by assessing the probability ( $p$ ) of the evidence ( $E$ ) given the prosecution hypothesis ( $H_p$ ) and dividing it by the probability of the evidence given the defence hypothesis ( $H_d$ ). The case circumstances applied to each hypothesis is the conditioning Information derived from the case circumstances ( $I$ ). Bayes theorem, when applied in this way is:

$$LR = \frac{p(E|H_p, I)}{p(E|H_d, I)}$$

5.5.3 The resultant Likelihood Ratio will be a value between 0 and infinity.

- A value of 0 means that the data would not be possible given the prosecution hypothesis. Therefore, of the two hypotheses considered, the defence hypothesis is the only reasonable explanation
- A value between 0 and 1 means that the data considered would be more likely given defence hypothesis rather than the prosecution hypothesis.
- A value of 1 means that the data considered is as likely given the prosecution hypothesis as it is given the defence hypothesis, the analysis is not of use in informing the question addressed
- A value between 1 and infinity means that the data considered would be more likely given prosecution hypothesis rather than the defence hypothesis
- A value of infinity means that the data would not be possible given the defence hypothesis. Therefore, of the two hypotheses considered, the prosecution hypothesis is the only reasonable explanation

5.5.4 The results can be expressed in a verbal scale, as adopted by the Association of Forensic Science Providers (AFSP). In areas such as DNA analysis, the probabilities can be populated with reference to population databases. In the case reported as *R v T* ([2010] EWCA Crim 2439) this model was the subject of criticism by the Court of Appeal (Criminal Division). Concerns were expressed in relation to the following issues.

- The lack of a robust data set for use in statistical calculations.
- The lack of transparency about how the conclusions were reached.
- The risk that subjective opinions were presented as scientific fact.

5.5.5 In cellsite analysis, at the time of writing, no widely accepted statistical method is apparently available to inform the probabilities for prosecution and defence. The scale can still be used, with approximations made by the expert (e.g. "In my opinion the cell serves an area including the alibi location, but I don't expect it to serve at the scene") so long as it is quite clear how

the values have been reached, and what the supporting data is for the opinions. Like all verbal scales, there is risk that a single phrase can be misinterpreted by a jury. Explanation of how the final conclusion was reached is therefore paramount and should be part of any conclusion, be it in written form and/ or during oral evidence.

5.5.6 There are obvious advantages to following this approach within Cell Site Analysis whether or not specific probabilities are used:

- It ensures that a question that can be legitimately answered by an expert (the probability of the data given the proposition) is answered rather than one that falls outside the purview of the expert (whether the proposition itself is expected to be true)
- It requires the expert to be explicit about how they have come to their opinion and how much emphasis different pieces of information affect that opinion
- It ensures both prosecution and defence propositions (if available) are addressed.
- It enables consistency of expression of opinion between different areas of forensic science

## 5.6 **Opinion evidence in other disciplines: AFSP Standards for the formulation of evaluative forensic science expert opinion:**

5.6.1 The Case Assessment and Interpretation (CAI) model is compliant with the legislative requirements introduced in the 1990s (ref 3, ref 4, ref 5, ref 6, ref 7, ref 10, ref 13). An interpretation framework following the same principles has been adopted by the Association of Forensic Science Providers, whose membership includes many hundreds of experts in a wide range of specialities including DNA, fibres, marks, glass along with numerous other apparently disparate disciplines.

5.6.2 In short it is an approach to inductive thinking that produces balanced, logical, robust and transparent scientific and technical opinion. Some principles include consideration of both prosecution and defence propositions and an assessment and expression of the uncertainties within the analysis that affect any opinion given. A case example is provided in this paper to highlight how this impacts both on the opinion given and the management of the case itself. From the AFSP Standards for the formulation of evaluative forensic science expert opinion (ref 11):

- *"Balance — The expert should address at least one pair of propositions usually one based upon the prosecution issue and one based upon an alternative (defence issue). If a reasonable alternative cannot be identified then the expert may address only the one proposition but will make it clear that he cannot evaluate the strength of the evidence.*
- *Logic — The expert will address the probability of the evidence given the proposition and relevant background information and not the probability of the proposition given the evidence and background information.*
- *Robustness — The expert will provide opinion that is capable of scrutiny by other experts and cross-examination. He will base his opinion upon sound knowledge of the evidence type(s) and*

*use wherever possible verified databases. He will be satisfied that the results of the tests and examinations upon which he has based his opinion are themselves robust.*

- *Transparency — The expert will be able to demonstrate how he came to his conclusion. He will set out in the statement or report the basis of his opinion viz.:*
  - *Hypotheses addressed.*
  - *Test or examination results.*
  - *The background information he has used in arriving at his conclusion.*
  - *He will be able, if required, to provide the data he has used and its provenance.*

*It is the duty of an expert to help both prosecution and defence and the courts as much as possible by using his expert knowledge. Therefore he should address propositions at activity level wherever possible. An expert will not give evaluative opinion on matters outside his own area of expertise. An expert will not usually give his opinion on issues that do not require expert knowledge. However, if asked, he may do so provided it is made clear that he is not giving expert opinion."*

## **6. The CAI model applied to cell Site Analysis**

### **6.1 A casework example illustrating differences between task driven vs. CAI approaches**

**6.1.1** A case example was provided at the beginning of this paper. A CAI approach would have addressed the data differently. Please refer to figure 2, which illustrates a process map for the application of the CAI model to Cell Site Analysis. Within this figure:

**6.1.2** "Define Case Strategy". The expert reviews the request. The question to be addressed is part of the expert assessment at the beginning of the process and informs the activity that follows including the form of opinion provided. Whatever the customer request, the question that cellsite analysis may be able to help with in this case example might be defined as:

- *"The prosecution proposition is that the phone was at the scene, the defence proposition is that the phone was at the home address. In the period of the offence, did the cells used by the phone attributed to the suspect:*
  - *Serve one location but not the other? (in which case cellsite analysis may aid one side rather than the other, whether prosecution or defence)*
  - *Serve both locations? (in which case cellsite analysis does not aid either side, and if identified early may save the customer money and time)*
  - *Serve neither location? (in which case cellsite analysis may add additional insight to aid the court on possible alternative hypotheses in investigative mode)"*

**6.1.3** "Instruction or conduct of Technical Processes" is then progressed. This can be an iterative process, for example an unexpected survey result might require additional activity to shed more light on matters arising prior to final interpretation. Some of these activities can be delegated but if so the results must be checked and accepted by the expert. For example Call Data Records can be turned into Call Sequence Tables or Maps and tables may be produced; in this model usually to illustrate and help explain the context of specific opinions to the jury rather than as a generic product in themselves (i.e. the maps originate from the report rather than inform the

findings to be presented in the report). Surveys may be delegated, under instruction, with the survey plan would be tailored to the question to be addressed. In this case example, resolving whether a specific cell used in the period of the offence serves one or both of the locations of interest is both more useful and less technically complex and prone to error than attempting to highlight all possible serving cells at each location. Processing of survey data can be delegated, but use of it to inform opinion of service must be done by the expert; the survey results may aid the expert in coming to an opinion of service of specific cells, the opinion is based on more than just the survey data.

- 6.1.4 "Opinion" follows CAI principles, and may be at source, investigative or evaluative level with the findings presented in a report with supporting exhibits. Alternative propositions may be assessed, defined at the outset by the expert (possibly provided by the defendant, but not necessarily). There could be additional hypotheses generated as a result of the technical findings. Conclusions presented directly address the questions created at the start of the process and are expressed as explicit opinion, with limitations highlighted. It is clear which parts of the report are opinion, and what type of opinion is presented.
- 6.1.5 Ultimately, it should be clear what the expert has done, the opinion given balanced, meaningful, not easily misinterpreted and that of the expert giving it and the approach complies with the FSR codes and existing legislation.
- 6.1.6 As mentioned at the beginning of this paper, the case example given was an anonymised example from a real case. The resultant report using a CAI approach differed significantly from that of the prosecution expert's. Rather than trying to address "what cells serve at this location and were they used by anyone?", the CDR of the suspect was assessed and opinion of their usage in the context of the questions asked provided; the technical process was less prone to error (it is relatively easy to miss a possible serving cell in a location survey rather than assess whether a specific cell may serve at a specific location). In the "question based" approach, the cell of interest (Cell ID 12345) was found to serve both at the scene and the home address of suspect 1 and was agreed as having been erroneously excluded as a serving cell by the prosecution expert.

## **6.2 Comparison of a task-driven approach to a "CAI" approach**

- 6.2.1 A standardised and modular approach may enable tasks to potentially be progressed in isolation of each other, with delegation or automation of technical processes and possibly even some of the forensic report potentially taking place. This would almost certainly result in a cheaper, quicker product with easier workflow management.
- 6.2.2 In the task driven approach, the "instructions" were generic and could apply to any case with only changes in the detail of locations and CDRs considered. The specific aspects of the examination in which Cell Site Analysis may provide the most useful information were not assessed or addressed. The creation of maps may have been delegated or automated and could potentially be created with no input from the expert and were a product in their own right. The surveys were conducted using a standardised approach, based on the customer request rather

than to address a specific concern that the expert may have had to resolve an issue at hand. The processing and interpretation of the survey data findings also appeared to have followed a standardised approach, aimed at fulfilling the stated customer request. It isn't clear what the results meant in the context of the questions before the court. The subsequent report was a commentary primarily consisting of a combination of the call table and the survey results ("At x time cell y was used and according to survey results this cell served at a and b locations"). Alternative hypotheses were apparently generated from these technical findings and not from questions that the court may be attempting to resolve.

- 6.2.3 The role of the expert is not clear in this process. It could be seen as presenting to the court the test results. If this were the case it is not immediately obvious which parts of the report are opinion and whether that opinion is the expert's (e.g. it may be a computer algorithm's view on whether a cell served at a given location without any detailed review by the expert). Without uncertainties and limitations of the technical results (and how those uncertainties affect the inferences drawn) being assessed and expressed the results may be misleading. In short it is not clear what the expert has done, and hence whether the opinion given balanced, meaningful, easily misinterpreted or even that of the expert giving it. If the expert has acted in this manner, the approach adopted does not appear to comply with the FSR codes or existing legislation, and it is not clear whether a jury can safely use information resulting from it.
- 6.2.4 Within this case example there were no issues surrounding integrity, technical skills (the maps and tables were accurate) or technical knowledge of the expert (i.e. understanding of network operation and RF propagation). There were a wide range of issues familiar to those arising in the 1970s, well before the invention of Cell Site Analysis. All survey methods have limitations, yet the data has been presented in such a way as it appears true and complete. There was use of non-standard techniques, with use of a Scanner data as the sole method for assessing serving cells, the data presented with no caveats; scanners used in this way are and always have been a controversial method within the industry. There is no mention of the expected accuracy, precision and reliability of results resulting from it assessed and expressed – these are overt requirements of CPD and the FSR Codes and the technique was known to have failed validation in other organisations. In addition to the concerns about the technology used, the manner in which it was used was also open to criticism as it was used while static; there is published material demonstrating that static methods are prone to false exclusions and thus of low precision (ref 1). The report only addressed the Police side of the story even though there was an obvious alternative proposition available – the home address of suspect 1. This was a known location prior to the prosecution analysis, and survey results for that location were presented by the expert. An alternative location – the home address of suspect 2 *was* mentioned, but this was apparently stimulated as the result of the (now known to be incomplete) survey results, not as part of case assessment. The Language used is problematic, with phrases such as "*cells in the Newtown area*" which may be misleading. A "cell" is the area over which a given Cell ID provides

service and the cell will emanate from network radio equipment based on a cellsite. It is common – almost expected – that a given cell will serve outside the area in which the cellsite is based (from personal knowledge there are some cells based in Newtown that serve in rural areas to the north of Birmingham, many kilometres from that area). Statements such as *"The data is consistent with the mobile telephone attributed to Suspect 1 having been at or in the area of the scene and/or the home address of suspect 2 between 21:43hrs and 23:37hrs"* are misleading. The cell used will serve an area and if only one cell is used in the period (such as in this case) the expert doesn't know where in that service area the phone was. It is reasonable that the cell may have served "outside the area of" Birmingham, let alone "outside the area of" the locations of interest within the smaller area of Newtown, yet this does not appear to be the case in the commentary. The collective issues above resulted in a statement that at face value supported the case for the prosecution.

6.2.5 Ultimately, the CAI propositions were essentially "in the period of the offence, did the cells used by the phone attributed to the suspect serve areas including the scene (prosecution position) or the home address (defence position)". There were three possible outcomes, namely, did the cells:

- 1 "Serve one location but not the other? (i.e. aid either the prosecution or defence case)". The conclusion was ambiguous in the prosecution report; While the data was stated as "Consistent with" the prosecution proposition, there was no mention of any defence proposition and the survey data presented implied that a cell used at a critical time did not serve at defence location. Even if not the intent of the expert, it is reasonable that a juror might believe the findings were in this category
- 2 "Serve both locations?" (A "null" result, cellsite analysis does not aid either prosecution or defence). The data would be equally likely given the truth of both propositions and, as such, the analysis provides no assistance in helping decide which of the two propositions is true. This was overtly stated using the CAI approach and agreed by the prosecution expert prior to presentation of their evidence to the court
- 3 "Serve neither location, implying activity different to that proposed by both Prosecution and Defence?". Neither expert believed that the phone could not have been in the area of the scene or alibi location at the times of calls

6.2.6 Assessing and expressing uncertainty is at the heart of expert evidence. The task driven approach illustrated above relied on comments such as "consistent with" when presenting the technical findings. This phraseology has been criticised by the UK Courts as sounding significant but in reality meaning little (R v. Puaca [2005] EWCA Crim 3001) and is also widely criticised in academic papers (some of which have already been discussed) including some specifically aimed at digital evidence (ref 18).

6.2.7 The findings, which essentially amounted to "Cell Site Analysis can't help resolve this" were agreed prior to any witness box exercise; the commentary and opinions expressed by the

prosecution expert in oral evidence were those in the Defence report. If the prosecution report had been reviewed as part of an appeal, however, (i.e. the findings already presented to the jury had been those in the original report, the suspect was convicted as a result, and then that conviction appealed) there were obvious parallels to issues raised in R v Preece as the expert didn't appear to:

- Address, or falsely excluded, an obvious and legitimate Defence proposition
- Have or present a valid understanding of whether the technique used could discriminate between the prosecution and defence propositions.

6.2.8 In addition to the Preece appeal case example, there were a range of parallels with other problems from traditional forensic science in the 1970's and 1980's which legislation and the Codes were issued to address. While there were many wider concerns, the difference in outcome between the task driven and CAI approaches in this case boiled down to two critical areas.

- i) Taking the purpose of the examination as only answering questions directly posed by the customer without considering declared (or obvious but undeclared) alternative propositions, whether asked to do so by the customer or not.
- ii) Adopting a core process which didn't assess or express the limitations of the methods used within that process, for example equating a single test result with a final evaluative opinion ("the following cells were detected as serving at this location" being potentially equated with "these cells serve at this location, and there are no others")

6.2.9 The CAI approach did not suffer these issues but was almost certainly more time consuming. It is also less flexible as delegation is more difficult and it is potentially less easy to automate and more difficult to capacity-manage when there are many cases to progress. From a workflow perspective, there is less ability to increase productivity and recoverability by transferring "expert" tasks to cheaper resources, and as a result of all these factors the product will be less commercially competitive than those products resulting from purely task-driven processes. The CAI method is, however, transparent, balanced, robust, scientifically legitimate and compliant with legislation and the FSR codes. As a result, conclusions resulting from it are Lower Risk and admissible.

6.2.10 Delegation of tasks can still take place using CAI; the model is primarily a mode of thinking on how to address a question but also informs case management. To follow the framework, however, the expert must be heavily involved from the outset and at all critical stages of an examination, defining the detail of questions to be addressed, the selection of tests to be applied (but not necessarily the conduct of those tests), the detail of the analysis as well as the obvious task of generating a report containing opinion. If there is delegation, the expert must explicitly instruct the necessary tasks and have a valid understanding of the uncertainties concerning the results from them (which in turn requires knowledge of the validation of the methods used).

6.2.11 Peer review is a cornerstone of the scientific method and, while disclosure rules enable a report to be reviewed by an expert instructed by the other side, disclosure should not be considered



the primary form of quality control (and indeed failed in the miscarriage of justice detailed above). Checking of work by a second competent individual is a requirement under current UKAS accreditation, and checking of opinion is part of that mandate. Those providing opinion must be competent to do so under ILAC G19 4.8.3, as must those checking it

6.2.12 In short, the task driven process seeks to answer a different question than the CAI process.

- The task driven process directly addresses the submitted questions (whether or not they are balanced) and provides results of technical tests related to the submitted questions. The tests can be directed and performed in isolation of any expert and results may or may not be presented as fact evidence
- The CAI process evaluates the Call Data in the light of specific propositions, attempting to address those issues with greatest probative value. Overt opinion is provided on whether the data would be expected given the scenario(s) presented.

6.2.13 The use of propositions is required by ILAC G19 section 4.8.1. There is also guidance concerning “reasonable rules of enquiry” published by the UK Crown Prosecution Service (CPS) (ref 19), which recommends prosecutors should work closely with investigators, disclosure officers, experts and defence to ensure that all reasonable lines of enquiry are followed and that digital material is properly assessed for relevance, revelation and disclosure.

## **7. Summary, conclusions and recommendations**

7.1 Issues concerning forensic inference exist in all areas of forensic science, and cell site analysis is no exception. There were a number of problems involving the provision of scientific or technical expert opinion arising in the 1970’s and 1980’s. As a result modes of working within the field of Forensic Science were developed to avoid repeating those shortcomings, including the development of the Case Assessment and Interpretation Model. A standard following these principles is adopted by the Association of Forensic Science Providers and a similar approach has been taken by the European Network of Forensic Science Institutes (whose membership includes experts from a wide range of different sciences including DNA, fibres, marks, glass along with numerous other apparently disparate disciplines). The guiding principles are Balance, Logic, Robustness and Transparency, and the approach complies with legislative and regulatory requirements. Although well known within the sphere of traditional forensic science, this model has not been widely adopted (or appears to be well known) either within Cell Site Analysis or in the wider field of Digital Forensics.

7.2 There are many ways in which Cell Site Analysis might be conducted, but ultimately, any report or statement must be compliant with the FSR codes and existing Legislation. There are some modes of working which do not appear to be compliant. Specific concerns include that the question to be addressed should not be to unquestioningly “provide evidence that supports our position” by producing maps and survey results in support of only one proposition without any attempt to review whether alternative questions might also reasonably be addressed. In the view of the author, the question should be to address wider technical questions for which the

knowledge and skills of the expert may aid the court most: “would the data be expected given this proposition and what are the limitations of that finding”, or “would the data be more likely given one proposition over an alternative” or “can Cell Site Analysis shed any light on possible hypotheses that may have occurred?”

- 7.3 The understanding of the practitioner on the limitations and uncertainties in the source data (CDRs, survey results and other information used to reach conclusions as to the area in which a phone may have been at the times of the call activity in the records) is critical to being able to address whether that data would be expected given a proposition or what other hypotheses might have generated it. Assessment and expression of the limitations of the methods used to reach conclusions is therefore a core precept of providing any opinion.
- 7.4 In short, while the technical tasks may be very similar between different approaches to forming opinion, the practitioner’s view of their role may be different resulting in the results of those tasks also being different
- An approach in which a set of questions are defined by the customer and then addressed as a series of technical exercises may be that of an expert, a person who is very knowledgeable about, or skilful in, a particular area.
  - A question driven, approach using an interpretation model is that of an expert witness, a person who is very knowledgeable about, or skilful in, a particular area and understands how to apply that knowledge in the context of a question before the court to provide legislatively compliant, reliable, logical, transparent and unbiased opinion
- 7.5 These issues are identified and addressed in existing standards. It is recommended that the “Association of Forensic Science Providers. Standards for the formulation of evaluative forensic science expert opinion” should be adopted within Cell Site Analysis whether the organisation or individual providing the evidence is a member of the AFSP or not.

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