

Misunderstanding Digital Computer Technology in Court: A Commentary on a Case Involving the Post Office Horizon System

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Synopsis

On 3rd May 2007, the long-time Manager of the England's Lane Post Office in Hampstead, England, Mr. David Cameron, was found guilty in the Crown Court of ten counts of theft from six customer-complainants in the period July 2005 to February 2006¹. Mr. Cameron applied to the Court of Appeal for an extension of time to apply for leave to appeal against his conviction, in light of the issues now known with the Horizon system, which processed the transactions involved in Mr. Cameron's prosecution (the original deadline for filing for appeal had long passed). The judgement was published on 31st March, 2022. The Court of Appeal declined Mr. Cameron's application to appeal his conviction and provided their reasons.

We do not have access to the summing up of the trial judge in the 2007 trial in which Mr. Cameron was convicted. We attempt a rational reconstruction of the actions which led to the counts, nine of which are detailed in the Court of Appeal judgement. We base the following discussion purely on technical information publicly available, and information in the Court of Appeal judgement.

We are concerned with two main issues in this note. The first concerns the technical details of how Mr. Cameron is alleged to have performed the thefts for which he was convicted. Given the technology underlying the transactions, it is hard for two of us, as computer scientists, to see how some of the incidents may have occurred. The second issue is that the Court of Appeal judged Mr. Cameron's conviction not to be a "Horizon case". However, all the details of transactions and discrepancies, including the information about their account statements provided by witness-victims, derived from the Horizon accounting processes, which are now known not necessarily to have produced accurate transactional records. It is thus difficult for us to see a rationale behind the convictions not being a "Horizon case". The unfortunate consequence of Mr. Cameron's case not being a "Horizon case" is that his convictions stand, in contrast to the multitude of "Horizon cases" convictions, which have been quashed by Act of Parliament. We include further comment on, for example, a statistical statement by the Court of Appeal, for which we think grounds are lacking.

¹*White v Post Office Ltd* [2022] EWCA Crim 435 at [25], <https://www.bailii.org/ew/cases/EWCA/Crim/2022/435.html> accessed 2024-03-09

Technical and Organisational Background

In 2003, the Post Office introduced Post Office Card Accounts (also called POCA²). The House of Commons Select Committee on Trade and Industry described the Post Office Card Account and its demographics in 2006 as follows³

40. From April 2003, the Government began paying benefits and state pensions directly into customers' bank accounts (direct payment). The Post Office Card Account (POCA) was developed by Post Office Ltd[...] to act as a 'simple' banking vehicle whereby customers could obtain these benefits if they could not, or did not wish to, use any other kind of banking account. [Post Office Card Account]s allow holders, or a nominated helper, to take cash out, free of charge, at any Post Office branch using a plastic card. It cannot be used for any purpose other than to receive benefit payments. For example, it cannot be used to obtain cash from ATMs or to pay bills, either directly or by direct debit, and it carries no overdraft facility. It is the electronic equivalent of the old benefits order book.[..]

41. Whilst the [Post Office Card Account] offers very limited functionality, approximately forty percent of the benefit claimants converting to direct payment opened a [Post Office Card Account]. The [Post Office Card Account] helped Post Office Ltd retain some of the £400 million worth of transactions, which would otherwise have been lost when the Government changed to direct payment.[..] Around 3.7 million customers of the DWP currently have their benefit or pension paid into a [Post Office Card Account].[..]

The purpose of a card is twofold: to enable the user to perform a transaction; and to identify the card user to the digital-electronic system which performs and records the transactions (authentication). The technology used for the Post Office Card Account cards is the EMV protocol, also known as Chip & PIN. The supplier was EDS⁴. The Chip & PIN protocol uses a digital processor chip implanted in the card. The PIN is not physical: it is a four-digit number which is needed to authorise a transaction using the card. To perform a transaction, the card is inserted into a special (physical) reader which executes the EMV protocol using interaction between a computer with which the reader is continually connected, the chip, and a keypad on the reader. The reader keypad is used to enter supplementary data (for example, the £-amount of the transaction; the PIN). To authorise a transaction, a human enters the PIN associated with the card into the keypad on the reader, when prompted to do so.

It was thought until 2009 or early 2010 that Chip & PIN requires both the physical presence of the card, as well as the correct PIN being entered, in order to execute a transaction. This entailed that any theft required physical theft of a card along with knowledge of the PIN. Theft of a card often takes place through a mugging or pickpocketing on the street. Knowledge of a PIN may be gained from looking over the shoulder of a customer using a card reader, or from a paper note accompanying the card on which the cardholder has (unwisely) written the PIN, which, despite warnings not to do so, many bank customers apparently still do. In 2010 a group of researchers at Cambridge University showed how to execute EMV transactions with the physical presence of the card but without knowledge of the PIN⁵. This work was underway in 2009, and postdates the incidents discussed here by some three to four years.

²The acronym POCA refers in legal circles to the Proceedings of Crime Act 2002. The Select Committee on Trade and Industry Ninth Report, quoted below, uses POCA to refer to a Post Office Card Account, as does the Post Office. We avoid the acronym "POCA" and spell it out; we also speak of "Card Accounts".

³House of Commons Select Committee on Trade and Industry Ninth report, 2006-10-30, Section 4 Post Office Card Account. Available from <https://publications.parliament.uk/pa/cm200506/cmselect/cmtrdind/1556/155607.htm> accessed 2024-03-09

⁴Finextra, "EDS teams with Tti for Post Office EMV card contract", 2002-07-17. <https://www.finextra.com/newsarticle/6198/eds-teams-with-tti-for-post-office-emv-card-contract> accessed 2024-03-09

⁵Steven J. Murdoch et al, Chip and PIN is Broken, Proceedings of the 2010 IEEE Symposium on Security and Privacy, Oakland, California, May 2010. Available from <https://www.cl.cam.ac.uk/research/security/banking/nopin/oakland10chipbroken.pdf> accessed 2024-03-09

Weaker Protocols

We have indicated that Card Accounts were based on cards with Chip & PIN technology. However, the demographic for users of Card Accounts is a group of people who do not have regular bank accounts; who are therefore not familiar with Chip & PIN from such accounts and who might therefore find using the technology challenging. They are supposed to remember a four-digit number but might not have the skill, cognitive ability, or experience to be able to do so reliably. The Select Committee report speaks of a “designated helper”. That could be a person who can do so and might even be a counter assistant at the Post Office branch at which the Card Account is registered. A counter assistant could not necessarily remember all PINs for all customers the assistant “helped”; likely these would have been written down. We might hope that such records be kept in a hopefully secure place, but this is not assured.

We are not aware of weaker protocols having been made available for Card Account holders, but it is possible that they were⁶. Such a weaker protocol would be to have supplemented the Chip & PIN protocol with older technology based on a card with a magnetic stripe (magstripe), for those customers who had some difficulty with Chip & PIN. The cybersecurity problem with magstripe is that all of the transaction-authentication data is held on the magstripe on the card. The stripe can be read by a third party to obtain this data, and then this retrieved data can be replicated on the magstripe on another card. It is unlikely that a Post Office Card Account reader which could also read magstripes would retain that authentication information and divulge it on request, but it is possible that a magstripe card user give their card to an assistant, who then passes it not only through the proper Card Account reader, but also surreptitiously through an additional device which the assistant uses to record the authentication information on the magstripe, for later replay for purposes of theft⁷.

Note that with Chip & PIN in which the PIN is shared with a third party, any transaction still requires the presence of the original card with the card’s Chip on it (and its attached near-field antenna, which extends largely invisibly through the rest of the card). However, with magstripe technology, knowledge of the information on the magstripe is all that is required to successfully perform a transaction – magstripe-based replays do not require the physical presence of the original card.

The Trial of David Cameron for Theft

On 3 May 2007, the Manager of the England’s Lane Post Office in Hampstead, Mr. David Cameron, was found guilty of ten counts of theft from six complainants in the period July 2005 to February 2006⁸. He had managed the Post Office since 1992. Nine of these ten complaints were detailed by the Court of Appeal⁹, which declined Mr. Cameron’s application to appeal his conviction and provided their reasons on 31 March 2022. As mentioned earlier, we do not have access to the summing up of the trial judge in 2007 and we base the following discussion purely on the information available from the Court of Appeal judgement cited. The nine complaints were:

1. Mrs. Fraser, on 2 August 2005, performed a Card Account transaction, she said of £100. However, records showed her account depleted by £200.
2. Mrs. Fraser, on 31 August 2005, performed a Card Account transaction, she said of £100. However, records showed her account depleted by £300.

⁶Steven J. Murdoch suggested this possibility to us, for which we are grateful to him.

⁷During the heyday of magstripe, such devices were not infrequently attached to the outside of the card-reader slot of bank ATMs by thieves, and banks warned customers not to use any machine in which any part of the card reader device protruded from the plane of the machine surface.

⁸*White v Post Office Ltd* [2022] EWCA Crim 435 at [25], <https://www.bailii.org/ew/cases/EWCA/Crim/2022/435.html> accessed 2024-03-09

⁹*White v Post Office Ltd* [2022] EWCA Crim 435 at [28] – [30], <https://www.bailii.org/ew/cases/EWCA/Crim/2022/435.html> accessed 2024-03-09

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3. Mrs. Fraser, on 9 September 2005, performed a Card Account transaction, she said of £100. However, records showed her account depleted by £200.
4. Mrs. Painter, on 12 October 2005, performed a Card Account transaction. Later that same day, a second Card Account transaction was recorded for a £200 cash withdrawal. Mrs. Painter says this second transaction was unauthorised.
5. Mrs. Georgiou, on 26 August 2005, performed a Card Account transaction. Later that same day, a second Card Account transaction was recorded for a £100 cash withdrawal. Mrs. Georgiou says this second transaction was unauthorised.
6. Mrs. Georgiou, on 19 December 2005, performed a Card Account transaction. “[S]econds later”¹⁰, a second Card Account transaction was recorded for a £100 cash withdrawal. Mrs. Georgiou says this second transaction was unauthorised.
7. Mrs. Heron, on 25 July 2005, performed a Card Account transaction. Later that same day, a second Card Account transaction was recorded for a cash withdrawal. Mrs. Heron says this second transaction was unauthorised.
8. Mrs. Heron, on 1 August 2005, performed a Card Account transaction. “[V]ery shortly afterwards”¹¹, a second Card Account transaction was recorded for a cash withdrawal. Mrs. Heron says this second transaction was unauthorised.
9. Mrs. Heron, on 10 December 2005, performed a Card Account transaction. “[L]ess than a minute after”¹², a second Card Account transaction was recorded for a cash withdrawal. Mrs. Heron says this second transaction was unauthorised.

The tenth count on which Mr. Cameron was convicted is not detailed by the Court of Appeal. Of the six complainants, only four (above) are named by the Court of Appeal¹³. Of the four named witnesses (above), only two were present at the 2007 Crown Court trial.

The first three incidents were recounted by Mrs. Fraser to the Metropolitan Police, whom she approached. The Metropolitan Police forwarded the complaints to the Post Office on 19 November 2005. The fourth incident was recounted by Mrs. Painter to the Metropolitan Police, who forwarded the complaint to the Post Office on 17 January 2006. “Subsequent inquiries”¹⁴ discovered the complainants Mrs. Georgiou and Mrs. Heron.

The Possibilities

We consider the nine counts above, and what might have happened.

1. Mrs. Fraser might have misremembered her withdrawal amount. Or Mr. Cameron might have performed the transaction for her, given her £100 and pocketed the rest. Or the Horizon system might have recorded the transaction amount falsely.
2. Mrs. Fraser might have misremembered her withdrawal amount. Or Mr. Cameron might have performed the transaction for her, given her £100 and pocketed the rest. Or the Horizon system might have recorded the transaction amount falsely.

¹⁰*White v Post Office Ltd* [2022] EWCA Crim 435 at [30].

¹¹*White v Post Office Ltd* [2022] EWCA Crim 435 at [30].

¹²*White v Post Office Ltd* [2022] EWCA Crim 435 at [30].

¹³One count of the ten is missing. Supposing the complainant on that count is a different person from those named, that yields only five complainants. If there were nevertheless six, it seems to follow that Mr. Cameron was acquitted of at least one complaint.

¹⁴*White v Post Office Ltd* [2022] EWCA Crim 435 at [30].

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3. Mrs. Fraser might have misremembered her withdrawal amount. Or Mr. Cameron might have performed the transaction for her, given her £100 and pocketed the rest. Or the Horizon system might have recorded the transaction amount falsely.
4. Mrs. Painter might have left her card behind in the Post Office branch, which Mr. Cameron or another person with knowledge of the PIN then used to perform a second transaction, without Mrs. Painter being present, and that person then pocketed the results. Or Mrs. Painter was a magstripe-card user, had her authentication data recorded surreptitiously, and this data was used for the second transaction. Or the Horizon system might have recorded a phantom transaction¹⁵.
5. Mrs. Georgiou might have left her card behind in the Post Office branch, which Mr. Cameron or another person with knowledge of the PIN then used to perform a second transaction, without Mrs. Georgiou being present, and that person then pocketed the results. Or Mrs. Georgiou was a magstripe-card user, had her authentication data recorded surreptitiously, and this data was used for the second transaction. Or the Horizon system might have recorded a phantom transaction.
6. Mr. Cameron might have indicated to Mrs. Georgiou that her transaction had “failed” and asked her to repeat it, and then pocketed the results of the first transaction. Or the Horizon system might have recorded a phantom transaction.
7. Mrs. Hernon might have left her card behind in the Post Office branch, which Mr. Cameron or another person with knowledge of the PIN then used to perform a second transaction, without Mrs. Hernon being present, and that person then pocketed the results. Or Mrs. Hernon was a magstripe-card user, had her authentication data recorded surreptitiously, and this data was used for the second transaction. Or the Horizon system might have recorded a phantom transaction.
8. Mr. Cameron might have indicated to Mrs. Hernon that her transaction had “failed” and asked her to repeat it; and then pocketed the results of the first transaction. Or the Horizon system might have recorded a phantom transaction.
9. Mr. Cameron might have indicated to Mrs. Hernon that her transaction had “failed” and asked her to repeat it, and then pocketed the results of the first transaction. Or the Horizon system might have recorded a phantom transaction.

In cases 1-3, the withdrawal amount should have been clearly indicated on the paper receipts printed at the time of the transaction. We take it that Mrs. Fraser did not check her receipts at the time, nor did she retain them for later reference. We also take it that Mrs. Fraser went to the police after having received a statement of account generated from the Horizon system. Had the receipts been available at the time of complaint, their contents would surely have resolved the issue of whether Horizon was falsely accounting. Had Mrs. Fraser checked her receipts upon performing the transaction, this would surely have resolved the issue of whether she had received the full amount of money she or her helper had withdrawn.

There is no information available to us about incidents 4, 5 and 7 concerning whether the witnesses had left their card behind in the branch, or whether any employee in the branch knew the associated PINs. If the complainants were Chip & PIN users, then without the physical presence of the card and knowledge of the PIN as well, at the time it was not possible to perform any transaction. We emphasise that if Mr. Cameron or anyone else (for example, his colleagues) had enacted a theft in these cases, the card had to be in the branch (when the card owner was not) and the executor had to have known the PIN.

Had the complainants been magstripe-card users, it was possible for Mr. Cameron or another assistant surreptitiously to have recorded the authentication data from the magstripe, potentially at any time the complainant

¹⁵“Phantom transactions”, transactions recorded by Horizon but which did not actually take place, were noted by Fraser J in *Bates v Post Office Ltd (No 6: Horizon Issues) (Rev 1)* [2019] EWHC 3408, at [209-214], [251], [481], [484-485], and subsection 15 of [679], discussing the “Bug Table”. <https://www.bailii.org/ew/cases/EWHC/QB/2019/3408.html>

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used the card in the branch, and to have then used this data to perform a later transaction unauthorised by the complainants. In this case, the person performing the unauthorised transaction, a case of theft, does not have to be the same person as the one who performed the surreptitious recording. It can be any person with access to that surreptitiously-recorded magstripe data (instantiated on, say, a “duplicated card”).

We take it to be important that Card Accounts are bound to branches – unauthorised transactions may thus only occur at the same branch as authorised transactions. The people with access to the transaction mechanisms are thus the SPM and employees at that specific branch, or people allowed by them to operate devices at the branch (possibly in contravention of contracts).

In incidents 6, 8 and 9, it seems possible for Mr. Cameron to have led the customers to perform a double transaction and to have pocketed the results of one of them, while claiming it had “failed”. (Note we are not hereby saying that this happened, or assigning any likelihood to this having happened. This is not a matter which commentators, such as ourselves, can adjudicate. We are assigning possibility, pure and simple.)

The editor of this journal raised the issue whether the Chip & PIN implementation in Horizon at that time could be responsible for (some of) the accounting discrepancies which led to Mr. Cameron’s conviction. The short answer is that we, the authors, do not know and it is doubtful whether we could find out. To determine such a proposition, it would usually be necessary to inspect the relevant programming code of the system. This code is proprietary, and we have no access to it. As far as we know, amongst third parties only some witnesses called by the Williams Inquiry have been able to inspect any Horizon code.

Our Initial Conclusions

From the enumerations of the possibilities above, it is possible to draw some initial conclusions.

Incidents 1-3 (Mrs. Fraser) seem to be an example of “Horizon said; she said”. It does not appear possible to resolve the incidents, given the information available in the Court of Appeal’s judgement.

Incidents 4, 5 and 7 appear to be implausible, unless either (a) the witnesses recall having left their cards behind and at some point, making their PINs known to branch employees, or (b) the witnesses were magstripe users and their magstripes had been surreptitiously recorded, and the transaction performed with this recorded data on another magstripe.

It is to us inexplicable in case (a) how Mr. Cameron can have been convicted of theft on such a count, unless it was determined that the complainant left her card behind when she left the branch, and there was additional evidence that at least one branch employee knew the PIN. In case (b), one would expect some physical evidence of a duplicate, unauthorised, card reader present at the authorised transaction, and of the card being passed through such a reader, enabling the counter assistant to record the authentication data. It is also possible that the card holder had relinquished possession of the magstripe card at some other time, and for a third party to have recorded the magstripe data at that time, for later use. As far as we know, a magstripe card user does not have to identify him- or herself when performing a transaction at the branch; a third party can have done so with a card with the duplicated magstripe.

In case (b) there would be an additional question of why the information was only used to perform one theft per Card Account holder, of a relatively small amount of money, over a period of some months. As far as we know, this kind of restraint is untypical of thievery using surreptitious magstripe readers.

It is also possible in these three incidents for Horizon to have recorded phantom transactions.

Incidents 6, 8 and 9 exhibit a *prima facie* plausible possibility of theft on the part of Mr. Cameron. (Please note that we are not hereby saying that we believe Mr. Cameron committed theft; that is not for commentators, such as ourselves, to adjudicate. As above, we are assigning possibility, pure and simple.) The fact remains that incorrect Horizon accounting could be responsible for the phenomena.

Considerations Adduced by the Court of Appeal

The Court of Appeal determined whether Mr. Cameron's convictions were a "Horizon Case". The Court had characterised "Horizon Case" in *Hamilton v Post Office Ltd* thus¹⁶:

[120] ... the general issues which affect every appellant in whose case the reliability of Horizon data was essential to the prosecution. For convenience, we shall refer to such cases by the shorthand expression "Horizon cases".

[121] ... In each of those cases, there was no independent evidence of an actual shortfall, and it was essential to the prosecution case that the Horizon data was reliable.

[123] ... But in the "Horizon cases", there was no evidence of a shortfall other than the Horizon data. If the Horizon data was not reliable, there was no basis for the prosecution.

([123] ... *Hamilton v Post Office Ltd* was also cited in [7] *White v Post Office Ltd* in explaining what is meant by "Horizon case".) In *O'Donnell v Post Office Ltd*, the Court of Appeal referred to "Horizon cases" thus¹⁷:

[4] ... In *Hamilton* and subsequent cases, the court used the shorthand term "Horizon case" to refer to a case in which the reliability of Horizon data was essential to the prosecution, and in which there was no independent evidence of an actual loss from the account at the branch Post Office concerned, as opposed to a Horizon-generated shortage.

There are thus two characteristics of a "Horizon case":

1. The reliability of data deriving from the Horizon system was essential to the prosecution;
2. There was no evidence independent of Horizon for the accounting discrepancies which were the subject of the accusations against the defendants.

According to Criterion 2 of "Horizon case", the Court of Appeal placed weight upon determining whether there was "independent evidence" of the accounting discrepancies which were the subject of the nine (of ten) charges it listed against Mr. Cameron. Holroyde LJ explained¹⁸:

[9] ... In the cases which have come before the court thus far, the unexplained shortfall has invariably been a shortfall in the branch account rather than in any account relating to an individual customer of the post office. Where there is other evidence of the shortfall, which is therefore not an unexplained shortfall (for example, because there is evidence pointing clearly to theft by the SPM concerned) the position is very different. There might of course be other arguable grounds of appeal; but the case cannot be treated as a Horizon case,

[11] ... In the present context, this means that an applicant seeking an extension of time to apply for leave to appeal against conviction must (amongst other things) put forward an arguable basis on which the court could properly find it to be a Horizon case.

The Court of Appeal determined that Criterion 1 of "Horizon case" was not fulfilled in the case of Mr. Cameron:

[45] ... Ms O'Raghallaigh [on behalf of Mr. Cameron] submitted that it was not, in the circumstances, surprising that neither Mr Cameron nor his solicitors raised problems with Horizon at the time given that it was not for many years afterwards that such problems came to light. The difficulty with this submission, however, is that, although Horizon data obviously formed part of the prosecution evidence, it was not essential to the case which the prosecution levelled against Mr Cameron.

¹⁶*Hamilton v Post Office Ltd* [2021] EWCA Crim 577 at [123]. <https://www.bailii.org/ew/cases/EWCA/Crim/2021/577.html>

¹⁷*Joanne O'Donnell v Post Office Ltd* [2023] EWCA Crim 979, <https://www.judiciary.uk/judgments/odonnell-v-post-office-limited/>

¹⁸*White v Post Office Ltd* [2022] EWCA Crim 435

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[47] ... Mr Cameron is now seeking to raise an issue concerning the reliability of Horizon which was simply not an issue, or believed by him to be an issue, at the time that he stood trial.

It also determined that there was independent evidence of the accounting in the incidents at issue:

[46] ... On the contrary, although Horizon evidence was relied upon, in truth, the prosecution case was brought on the basis of the accounts given by Mrs Fraser, Mrs Painter, Mrs Georgiou and Miss Heron.

Observations on These Determinations

There are two aspects raised by the Court of Appeal to the “Horizon case” Criterion 1: not only whether Horizon data was essential to the prosecution, but whether Mr. Cameron believed it was at his Crown Court trial in 2007.

We deal with the second aspect first. Would it have been at all unsurprising that Mr. Cameron did not explicitly adduce Horizon unreliability in his defence at Crown Court? (We note that he claims he did, and the Court of Appeal rejected this claim¹⁹.) At the time of trial, in 2007, the Post Office had a record, with rare exceptions, of successfully prosecuting SPMs who disputed the reliability of Horizon accounting data used in accusing them of various offences. It would not surprise us had Mr. Cameron’s lawyers advised him in 2007 that he had no chance of succeeding with any argument about Horizon unreliability. Indeed, it seems to us, in 2024, that few, if any, succeeded in establishing Horizon unreliability of any sort in court until 2019²⁰, five years after Post Office prosecutions had stopped and twelve years after Mr. Cameron’s Crown Court trial. We therefore respectfully disagree with the conclusion the Court of Appeal drew at paragraph 47, above.

Criteria 1 and 2 of “Horizon case” seem to us to be linked in the case of Mr. Cameron. In each and every one of the nine counts we have considered, as we have shown above, the incident could be explained through the occurrence of a known failure mode of the Horizon accounting systems²¹ without any human miscreance. The veridicality of Horizon accounting data over the period is thus essential to any determination whether the incidents took place as described by the prosecution, namely as occurrences of theft by Mr. Cameron. In other words: the reliability of Horizon accounting is essential to any judgement that Mr. Cameron committed theft.

To consider the incidents again one by one, identifying where the accounting discrepancy occurs:

1. Mrs. Fraser says she withdrew £100. Horizon accounting says she withdrew £200. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Fraser remembers.
2. Mrs. Fraser says she withdrew £100. Horizon accounting says she withdrew £300. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Fraser remembers..
3. Mrs. Fraser says she withdrew £100. Horizon accounting says she withdrew £200. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Fraser remembers.
4. Mrs. Painter says a transaction involving her card was not authorised by her. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Painter remembers.
5. Mrs. Georgiou says a transaction involving her card was not authorised by her. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Georgiou remembers.
6. Mrs. Georgiou says a transaction involving her card was not authorised by her. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Georgiou remembers.

¹⁹*White v Post Office Ltd* [2022] EWCA Crim 435 at [43].

²⁰We know of none previous to *Bates v Post Office Ltd (No 6: Horizon Issues) (Rev 1)* [2019] EWHC 3408, <https://www.bailii.org/ew/cases/EWHC/QB/2019/3408.html>.

²¹We are here specifically speaking of the period 2005-6 covered by the complaints. Horizon has changed since then, and we are making no statement concerning current reliability.

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7. Mrs. Herson says a transaction involving her card was not authorised by her. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Herson remembers.
8. Mrs. Herson says a transaction involving her card was not authorised by her. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Herson remembers.
9. Mrs. Herson says a transaction involving her card was not authorised by her. The discrepancy occurs between the Horizon record of the transaction and what Mrs. Herson remembers.

In each case, the occurrence of an “incident” is dependent on (a) what Horizon accounting data says, and (b) the witness’s claim that this Horizon transaction data does not represent what in fact went on at the time. In some cases, the witness disputes the sum; in others, the witness disputes the authorisation for the transaction. Let us call such an incident, in which there is a discrepancy between Horizon accounting data and what witnesses remember, a “Horizon incident”.

The Court of Appeal invoked the witness statements as “independent evidence” of the incidents having taken place²². But the witnesses were moved to come forward because of a discrepancy between the information they received from Horizon accounting about the state of their accounts and their recollection of what went on at those times and places. We therefore cannot agree that this evidence is independent of Horizon accounting; indeed, it seems clearly based upon Horizon accounting.

The complaints from Mrs. Fraser and Mrs. Painter were surely made because of information they had received at a later date from Horizon accounting that, in the case of Mrs. Fraser, stated that different sums of money had been withdrawn than what she remembers receiving, and, in the case of Mrs. Painter, a transaction had allegedly taken place that she does not remember having participated in. The other incidents which surfaced with Mrs. Georgiou and Mrs. Herson are equally dependent upon information received from Horizon accounting. Most obviously, a claim that one did not engage in a specific transaction raises a disputable issue only when there exists evidence that indicates that the transaction was enacted; such evidence in these incidents is necessarily derived from Horizon accounting.

It thus seems to us that Criterion 2 of a “Horizon case” is fulfilled.

Concerning Criterion 1, we might agree (or not) that Horizon data was or was not essential to the actual prosecution case made against Mr. Cameron in the Crown Court. But this seems to us not to be the crucial issue. The crucial issue is whether the incidents for which Mr. Cameron was being prosecuted took place as alleged; whether they were “Horizon incidents” in the sense we have proposed above. It seems to us that Horizon accounting data is essential to determining “Horizon incidents”. We cannot see on what basis, other than what the Horizon system reported to the complainants, it could be established that these incidents occurred as alleged.

We suggest, therefore, that preferable criteria for determining cases involving Horizon which are subject to reasonable doubt would be:

1. That a Horizon incident apparently occurred; and that
2. There was no evidence independent of Horizon data for the accounting discrepancies which were the subject of the accusations against the defendant(s).

As we have argued, the nine incidents above on which Mr. Cameron was convicted fulfil these criteria.

²²*White v Post Office Ltd* [2022] EWCA Crim 435 at [46]

Discrepancies Within Horizon Accounting Data

Concerning Criterion 2, the Court of Appeal considered the effect such incidents, had they occurred, might have had on branch accounting data, and concluded that there were some effects²³. We believe that there would have been no such obvious effects, for the following reasons.

If Mrs. Fraser had been party to a transaction in which £300 was withdrawn, and only received £100, then either the branch account *with reliable accounting* would be £200 in surplus at the end of the day, or someone “pocketed” the surplus. That someone could have been Mr. Cameron at the time, or it could have been someone else reconciling cash-in-hand at the end of the day, noticing there was a surplus, and pocketing it, knowing it could not be traced and books would still balance within expected error limits.

What were those “expected error limits”? An audit was carried out at the branch on 20 February 2006 and a discrepancy of £240.23 was determined²⁴. On each of the separate days about which witnesses had complained of unauthorised transactions (or discrepant sums in the case of Mrs. Fraser), the amounts at issue were of a similar order of magnitude to the discrepancy incurred in that one day’s business at the branch as demonstrated by the audit.

Notwithstanding the apparent statement from Mr. Cameron that daily cash/transaction discrepancies were on the order of £20 or so²⁵, it seems *prima facie* likely that the audit amount on 20 February 2006 is representative of the actual shortfalls/excesses of a day’s business at the England’s Lane Post Office. Supposing this is so, this data suggests that it would have been possible for an employee to have engaged in theft at the branch by, say, pocketing £50 once a week from the till. To do this, there would be no need to interact with customers, let alone to perform unauthorised transactions using their identification credentials, or anything else which might lead customers to complain to the police or the Post Office. Mr. Cameron was found guilty of theft of £2,200 over a period of 8 months, from July 2005 to February 2006²⁶. Pocketing £50 a week from the branch for each of 30 weeks would have resulted in £1,500 stolen over a comparable period of time. Doing so twice a week would have resulted in £3,000.

Because the daily branch accounting tolerates discrepancies of the amounts said to be at issue in each of the complaints, it is not clear if any reliable conclusion can be drawn even from accurate branch accounts (such as those obtained through audit) on each of the days on which an incident subject to a complaint occurred. Furthermore, it is known that Horizon branch-accounting data is unreliable²⁷; even if a discrepancy of the order of magnitude of one of the incidents showed up in Horizon’s cash-in-hand data for any of the given days, it cannot be concluded that this amount is an accurate portrayal of the cash that was in fact “in hand” at the branch on that date.

In each and every one of these incidents, a known Horizon failure mode could have been causally responsible for the incident. In an accurate double-entry accounting system, this money would show up in some other place in the system, but because Horizon is known not to be an accurate double-entry system, it might also not have done so, and the amount been absorbed into daily discrepancy reports. We do not see how it is possible to draw any conclusion from the data provided by Horizon as to whether the disputed transactions actually occurred.

Our Conclusions Concerning Conviction

We cannot see how it can be “beyond reasonable doubt” that Mr. Cameron stole from Mrs. Fraser (incidents 1-3). Mrs. Fraser remembered, months after the fact, that she had only withdrawn £100 three times. Horizon accounts

²³*White v Post Office Ltd* [2022] EWCA Crim 435 at [52]

²⁴*White v Post Office Ltd* [2022] EWCA Crim 435 at [32]

²⁵*White v Post Office Ltd* [2022] EWCA Crim 435 at [43]

²⁶*White v Post Office Ltd* [2022] EWCA Crim 435 at [25]

²⁷We are here specifically speaking of the period 2005-6 covered by the complaints. Horizon has changed since then, and we are making no statement concerning current reliability.

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apparently showed that she had withdrawn £700. Maybe she misremembered. We do not know if Mrs. Fraser gave evidence at the trial. If she did not give evidence, she would not have been subject to cross-examination²⁸.

We cannot see how it is “beyond reasonable doubt” that Mr. Cameron stole from Mrs. Painter, Mrs. Georgiou and Mrs. Hernon in incidents 4, 5 and 7. The transactions could have been phantom. If the transactions were not phantom, the executor must have been in physical possession of the cards of these three ladies, as well as their PINs, in the branch office, at the time of execution. The executor could have been anyone with physical possession of the card and knowledge of the PIN and access to the card reader. Or it could have been that some or all of the complainants were magstripe-card users and had had their authentication data surreptitiously read and then replayed. In each case, there are necessary physical accompaniments (presence or absence of a card without its owner; presence of a magstripe reader and a card duplicator) that do not appear to have been taken into account at all by the Court of Appeal. However, if these necessary physical accompaniments had been examined in evidence at the trial and found to be present in any of the incidents, we would have expected these determinations to have been adduced by the Court of Appeal as Horizon-independent evidence of intent to commit theft.

We are thus at a loss to explain why the jury convicted in incidents 1-5 and 7. We are also at a loss to explain why the Court of Appeal did not allow Mr. Cameron’s appeal of his conviction on these incidents 1-5 and 7

Further Observations

We note that the Court of Appeal judgement distinguished between “Horizon case” (in their sense) and other cases²⁹, and determined that, according to this characterisation, none of the counts on which Mr. Cameron was prosecuted count as “Horizon cases” (in their sense). However, as we have noted, the occurrence of all of the incidents on which Mr. Cameron was convicted is dependent on Horizon accounting data as it was in 2005-6, which is known to be unreliable. None of the incidents have anything at all to do with branch accounting, but branch accounting was adduced as part of the Court of Appeal’s reasoning³⁰

It concerns us that what we have termed the “Law Commission presumption”³¹ seems to be occurring here in the Court of Appeal’s judgement. The presumption can be summed up as follows:

“In England and Wales, courts consider computers, as a matter of law, to have been working correctly unless there is evidence to the contrary. It follows that evidence produced by computers is treated as reliable unless other evidence suggests otherwise: this is a rebuttable presumption. In principle, there is a low threshold for rebutting the presumption that computer evidence is reliable. If such a challenge succeeds, the burden of proof lies with the party relying upon such a document to prove it, thus proving its source’s integrity and reliability. In a criminal trial, that burden is to the criminal standard.”³²

²⁸*White v Post Office Ltd* [2022] EWCA Crim 435 at [41]

²⁹*White v Post Office Ltd* [2022] EWCA Crim 435 at [5]

³⁰*White v Post Office Ltd* [2022] EWCA Crim 435 at [52]

³¹Peter Bernard Ladkin, Bev Littlewood, Harold Thimbleby and Martyn Thomas CBE, ‘The Law Commission presumption concerning the dependability of computer evidence’, 17 *Digital Evidence and Electronic Signature Law Review* (2020) 1-14, <https://journals.sas.ac.uk/deeslr/article/view/5143>

³²Stephen Mason, ‘The presumption that computers are reliable’, *Counsel*, July 2024, 34-36; see also James Christie, The Law Commission and section 69 of the Police and Criminal Evidence Act 1984, 20 *Digital Evidence and Electronic Signature Law Review* (2023) 62 – 95, <https://journals.sas.ac.uk/deeslr/article/view/5642> ; James Christie, ‘The Post Office Horizon IT scandal and the presumption of the dependability of computer evidence’, 17 *Digital Evidence and Electronic Signature Law Review* (2020) 49-70, <https://journals.sas.ac.uk/deeslr/article/view/5226> ; Peter Bernard Ladkin, ‘Robustness of software’ 17 *Digital Evidence and Electronic Signature Law Review* (2020) 15-24, <https://journals.sas.ac.uk/deeslr/article/view/5171> and chapter 5 ‘The presumption that computers are ‘reliable’’ in Stephen Mason and Daniel Seng, editors, *Electronic Evidence and Electronic Signatures* (5th edition, Institute of Advanced Legal Studies for the SAS Humanities Digital Library, School of Advanced Study, University of London, 2021), <https://uolpress.co.uk/book/electronic-evidence-and-electronic-signatures/> .

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The appeal cases deriving from referrals from the Criminal Cases Review Commission (CCRC) on the basis of *Bates v Post Office Ltd (No 6: Horizon Issues) (Rev 1)*³³, and dubbed “Horizon cases” by the Court of Appeal, concerned branch accounts and SPMs; these counts against Mr. Cameron did not do so. But there appears to be no determination that Horizon performed accurately in any of the incidents concerning Mr. Cameron, and it is possible to causally account for any of the incidents without any errant behaviour of the human participants, namely for Horizon to have performed its record-keeping inaccurately. In light of *Bates v Post Office Ltd (No 6: Horizon Issues) (Rev 1)*³⁴ it surely cannot be presumed, in any circumstances of which we are currently aware, that Horizon accounting is accurate unless otherwise shown not to be so. It does not seem to us to be beyond reasonable doubt that Horizon accounting was accurate in any one of the nine counts we have considered. It follows directly from this observation that it is not beyond reasonable doubt that Mr. Cameron indulged in theft in any of the incidents recounted.

The Court of Appeal judgement also speaks of a “remarkable coincidence”³⁵ that these witnesses, characterised as “elderly women”, were the subject of incidents involving Mr. Cameron. Two of us use statistical reasoning in daily professional life. We cannot see such “remarkable coincidence”. The Post Office Card Account demographic is of people with no bank account who feel more comfortable with limited cash-withdrawal facilities offered by Post Office Card Accounts. Maybe so-called “elderly women” are highly represented in this demographic? We do not know. But, if so, it would be expected (in the statistical sense of the word) that a random sample of Post Office Card Account holders would be such people, and there would be no “coincidence” to note. The Court of Appeal does not analyse the demographic, so there is no saying one way or the other.

Furthermore, two complainants came forward of their own account. There were apparently four others involved in questionable transactions who only came to light in “subsequent inquiries”. That, if anything, suggests there might be a ratio of two “silent sufferers”³⁶ to each one who initiates a complaint. Concerning how many other Post Office branches have complaints been initiated? If any, were they all just single complaints, or was there another branch besides England’s Lane for which there were more? How many “silent sufferers” might there be altogether? We see nothing in the available small numbers, or the large uncertainties surrounding such numbers, to suggest to us any “remarkable coincidence” in the England’s Lane numbers.

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³³*Bates v Post Office Ltd (No 6: Horizon Issues) Rev 1* [2019] EWHC 3408

³⁴*Bates v Post Office Ltd (No 6: Horizon Issues) Rev 1* [2019] EWHC 3408

³⁵*White v Post Office Ltd* [2022] EWCA Crim 435 at [55]

³⁶by which we mean people who think something about their Card Account statement of account is wrong, but who have not on their own initiative complained to the police or the PO about it.

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