Analysis & Advice to Customers

regarding

Answer Machine Detection

with respect to

New Ofcom Statement of Policy regarding the Persistent Misuse of Dialling Equipment

Background

In September 2008, Ofcom issued a new statement of policy regarding the Persistent Misuse of Dialling Equipment. The policy is intended to protect the public against "silent calls" (or "abandoned calls", "dropped calls" or "nuisance calls") generated as a side effect of the use of predictive diallers.

All predictive diallers need to drop live calls connected to actual people from time to time as it is an inherent risk associated with the probabilistic nature of any predictive algorithm. Ofcom accepts this fact and the regulation is aimed at limiting the annoyance caused by this anomaly. This was the purpose of the original regulations which have now been in place for quite some time and are enforced quite stringently.

For instance, it has now become common practice in the UK that all calls which the dialler needs to disconnect due to a lack of live agents needs to first play a short, non-commercial message identifying the caller as well as presenting Caller Line Identity (CLI) to all call recipients.

Most importantly, the total number of calls which the dialler abandons in a 24 hour period is not allowed to exceed 3%, as a percentage of the total number of live calls (i.e. calls made and connected to real people).

The new statement of policy has been introduced more recently in order to address another source of abandoned calls which had been overlooked previously and refers to the use of Answer Machine Detection (AMD) technology. AMD attempts to identify calls connected to an answering machine or another automated answering device and not deliver these calls unnecessarily to agents.

The attraction of AMD technology is obvious as at certain times of day for instance the percentage of calls connected to answering machines can be very high (over 50% sometimes) and eliminating these from the flow of calls delivered to agents has clear efficiency advantages.

The problem is that unlike modems, faxes, busy signals and so on, there is no certain deterministic way of identifying answering machines with 100% accuracy. Without exception, commercial

algorithms in use rely on some form of heuristic methodology based on an analysis of voice patterns (such as the length of periods of silence between speech bursts).

Therefore, all AMD algorithms will generate errors. These errors are less critical if an answering machine is wrongly identified as a live person and duly presented to an agent. Apart from a slight degradation of efficiency no great harm is caused. These type of errors are known as “false negatives”, in the sense that the dialler falsely made the decision that the call was not connected to an answering machine.

The problem that Ofcom are trying to address relates to the more serious problem of what is known as “false positives”. These are the cases when a live person is misidentified by the AMD technology to be an answering device. In such cases, not only is the call dropped, but no message is being played which typically results in a genuine “silent call”.

And here lies the crux of the problem. There is no scientifically precise way of measuring the number of “false positives” with any level of real accuracy. This is where Ofcom have not been able to come up with any meaningful ideas and the policy remains remarkably vague in this area. On one hand it requires users of AMD technology to measure this in some way yet on the other hand it fails to specify how this may be achieved.

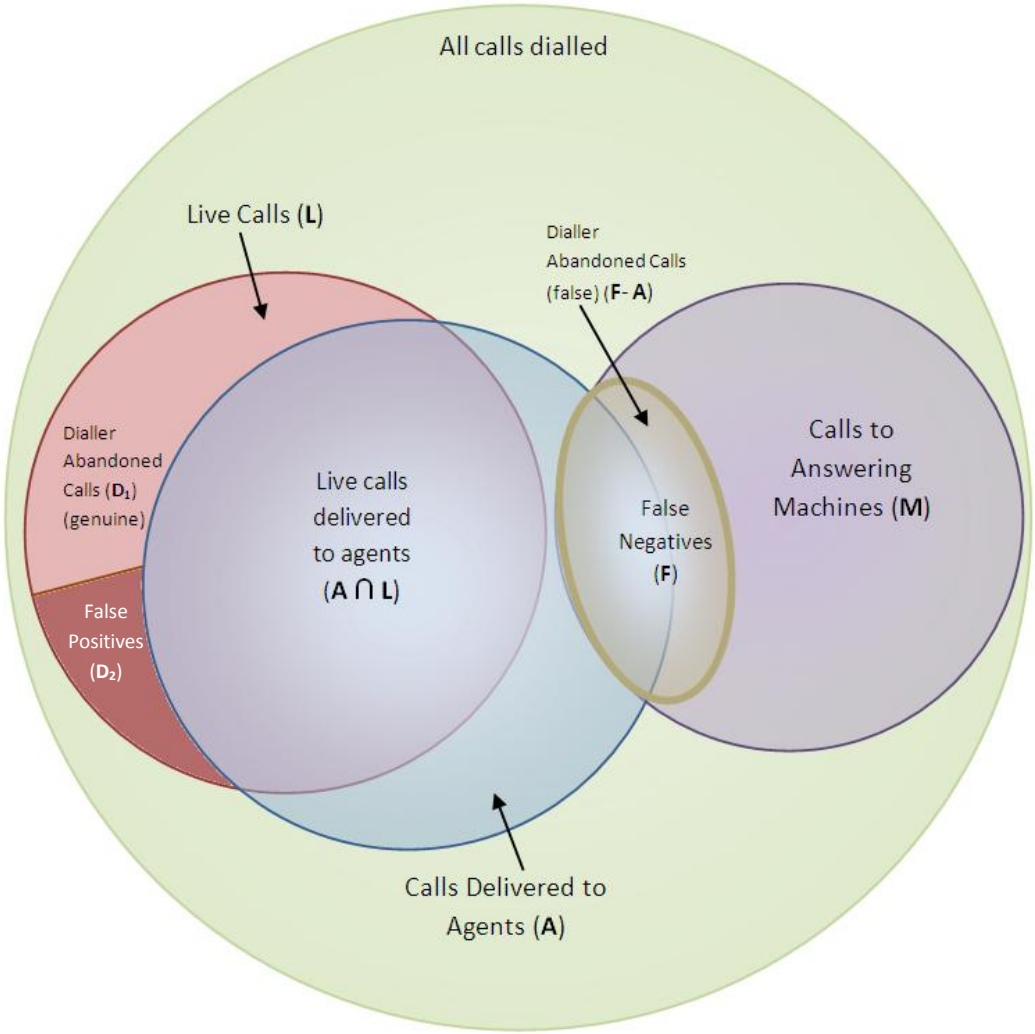
Although Noetica hasn’t developed its own AMD technology, our dialling products support AMD in conjunction with other suppliers. In soft dialling mode the Noetica dialler integrates with PBX vendors’ (such as Avaya, Aspect, etc.) AMD technology whilst in hard dialling modes it relies on AMD firmware provided by Aculab as part of the ProsodyX range of hardware.

This document is an attempt to inform our customers of the risks associated with the use of these technologies and also the options open to them if they wish to continue the use of this feature.

Analysis

Before we try to explain the challenges that the new Statement of Policy presents both users and vendors of dialling equipment' it is important to try and understand the concepts at the centre of this subject.

Below is a diagram illustrating the types of calls generated by a predictive dialler with enabled AMD technology:



The diagram requires some definitions of the concepts that it illustrates. If we look at the entirety of all calls made by the dialler, we can distinguish within it two large disjoint sets of calls: live calls (i.e. calls connected to a real person) and calls connected to answering machines, denoted by the letters **L** and **M** respectively. The two sets are clearly disjoint as a call is either to a real person or an answering machine.

The aim of a good dialler and AMD algorithm is to deliver as many live calls and as few calls of any other kind as possible to agents. In an ideal world, the set of all calls delivered to agents (which we shall denote **A**) would be identical to **L** and overlap it perfectly. This would mean that there would be no abandoned calls at all and also that no calls connected to answering machines or other non productive calls (such as faxes, modems, unobtainables, etc.) would be presented to agents.

Unfortunately, this is not possible. Therefore, what is interesting from the point of view of the current discussion is an analysis of the ways in which **A** intersects **L** and **M**. As already mentioned above, calls delivered to agents by a predictive dialler can on occasion be of types other than to live persons or to answering machines. Nevertheless, for the purposes of this document we can safely ignore these as they do not affect any of the calculations presented below and are therefore not relevant to our discussion.

Hence we will assume that: **A** = (**A** ∩ **M**) **U** (**A** ∩ **L**) meaning that any call delivered to an agent by the dialler can be either a live call or a call to an answering machine and nothing else.

First of all, let us examine the difference between **L** and **A**, i.e. the live calls that are not presented to agents. Let us denote this set as **D = L – A**. Until the new Statement of Policy from Ofcom, the assumption was that all calls within **D** were of one type only: dialler dropped calls due to unavailable agents, that are simply a result of probabilistic fluctuations affecting the dialling algorithm.

Indeed, when AMD is not in use that is the case. All calls in **D** are simply over-dials with no agent available to handle them. When AMD is in use though a new type of call appears in **D**: calls to live persons (i.e. within **L**) but mistakenly not presented to agents by the dialler (i.e. not in **A**) in the erroneous belief that they were answering machines. These type of calls are known as "false positives" (i.e. falsely classified as positive identifications of answering machines).

So, if we denote the set of dialler abandoned calls $\mathbf{D_1}$ and the set of false positives by $\mathbf{D_2}$, it is clear that $\mathbf{D = D_1 \cup D_2}$, meaning that any abandoned call is either of one type or another. Clearly, if AMD is not being used this means that $\mathbf{D_2} = \emptyset$ (i.e. it is empty) and therefore $\mathbf{D = D_1}$.

Now that we understand the definition of false positives, what about the false negatives? These are calls that are aimed at agents by mistake as the AMD technology wrongly identifies an answering machine to be a live person.

To start with, the set of all "false negatives", which we shall denote **F**, clearly contains all calls to answering machines (i.e. in **M**) which are delivered to agents (i.e. in **A**), so at first glance one could jump to the conclusion that $\mathbf{F = M \cap A}$. There is however a slight refinement to this. Some false negatives may never reach an agent as they end up being dropped as part of the dialler's normal abandonment rate (due to no agent being available).

Therefore, the correct relationship is:

$$\mathbf{M \supseteq F \supseteq M \cap A} \qquad (1)$$

meaning that clearly the set of false negatives is included in the set of all calls to answering machines (by definition), but it actually contains the set of all calls to answering machines delivered to agents (**M** ∩ **A**) and it can be slightly larger than it.

As a final remark, when AMD is not used, all calls to answering machines are in essence false negatives, therefore in this case: $\mathbf{F = M}$.

The Problem

There are numerous logical inconsistencies and much imprecision in the Ofcom document. Concepts are not clearly defined and even when they are defined, the document tends to stray from the original definitions. In order to understand the problems, we need to explain the basics.

Ofcom requires users of dialling equipment to conform to a very simple rule: "*the 'abandoned call' rate shall be no more than three per cent of 'live calls'".* So in principle the formula should be very straightforward (where $\mathcal{R}$ denotes the "abandoned call rate"):

$$\mathcal{R} = \frac{|\mathbf{D}|}{|\mathbf{L}|} < 0.03 \qquad (2)$$

i.e. that the total number of abandoned calls[1] ($|\mathbf{D}|$[2]) is less than 3% of the total number of live calls (i.e. calls to real live persons).

The problem with this formula is that diallers (without AMD enabled[3]) can not determine which calls that they decide to abandon are to real live persons and which to answering machines as the decision to abandon the call is made before an agent has a chance to disposition the call as live or to an answering machine. Therefore the abandoned call rate as defined by Ofcom cannot be calculated with any degree of accuracy by any dialling device.

It appears that although not explicitly stated, Ofcom recognises this difficulty and therefore the formula for $\mathcal{R}$ in their document[4] is <u>different</u> from their stated policy. The basic idea behind the actual formula is that the probability of abandoning a call is the same whether used on live calls or calls to answering machines (precisely because a dialler would not be able to tell the difference between these two types of call). Therefore probabilistically, the same value of $\mathcal{R}$ would result from the following formula:

$$\mathcal{R} = \frac{|\Delta|}{|\Delta| + |\mathbf{A}|} < 0.03 \qquad (3)$$

Where:

$$\Delta = \mathbf{D} \cup (\mathbf{F} - \mathbf{A}) = \mathbf{D}_1 \cup (\mathbf{F} - \mathbf{A}) \cup \mathbf{D}_2 \qquad (4)$$

[1] According to Ofcom's definition: "An 'abandoned call' is one where a connection is made with a live individual and then terminated. "

[2] $|\mathbf{D}|$ denotes the "cardinality" of **D**, i.e. the number of elements of **D**, in this case translating to the total number of abandoned calls.

[3] Even when AMD is enabled, although a calculation may be possible it would be unreliable and only serve to complicate things unnecessarily.

[4] Ofcom states the following: The 'abandoned call' rate shall be calculated according to the following formula: abandoned calls (x)/(abandoned calls (x) + calls passed to live operator (y)) x 100/1.

As long as AMD is not being utilised, the Ofcom formula is a pretty straightforward one to calculate since the absence of false positives (i.e. $\mathbf{D_2} = \emptyset$) and the fact that all calls to answering machines are in essence false negatives (i.e. are all passed to agents: $\mathbf{F} \subseteq \mathbf{A} \Rightarrow (\mathbf{F} - \mathbf{A} = \emptyset)$) makes $\mathbf{\Delta}$ an easy number to determine as clearly

$$\mathbf{\Delta} = \mathbf{D} = \mathbf{D_1} \tag{5}$$

Most good diallers are very accurate in keeping track of this ratio and ensuring that it stays below the designated 3% as long as AMD technology is not in use.

The problem begins when the uncertainty of AMD is introduced into this calculation. It can be relatively easily proven mathematically that when AMD is in operation the official Ofcom formula fails completely. This is because if AMD is in use, the formula delivers $\mathcal{R}$ in accordance to its definition if and only if $\mathbf{D_2} = \emptyset$. This is a contradiction to the initial assumption that AMD is in use.

Here is the proof:

Definition 1 (Ofcom): The abandoned call rate $\mathcal{R}$ is defined as the proportion of abandoned calls as a percentage of all live calls. In other words:

$$\mathcal{R} = \frac{|\mathbf{D}|}{|\mathbf{L}|} \tag{6}$$

Theorem 1: $\mathcal{R}$ can be expressed according to the Ofcom formula:

$$\mathcal{R} = \frac{|\mathbf{\Delta}|}{|\mathbf{\Delta}| + |\mathbf{A}|} \tag{7}$$

if and only if $\mathbf{D_2} = \emptyset$.

Proof:

We will prove that if the two formulae are equivalent then $\mathbf{D_2} = \emptyset$.

Let's assume therefore that:

$$\frac{|\mathbf{D}|}{|\mathbf{L}|} = \frac{|\mathbf{\Delta}|}{|\mathbf{\Delta}| + |\mathbf{A}|} \tag{8}$$

We can make the following substitution (please refer to the Venn diagram earlier in this document):

$$\mathbf{L} = \mathbf{D} \cup (\mathbf{A} - \mathbf{F}) \tag{9}$$

as all live calls are either abandoned (by dialler - $\mathbf{D_1}$ or AMD – $\mathbf{D_2}$) or delivered to agents but not false negatives.

We also know that by definition (4): $\mathbf{\Delta} = \mathbf{D} \cup (\mathbf{F} - \mathbf{A})$

Therefore, making these substitutions, our original equation (8) becomes:

$$\frac{|\mathbf{D}|}{|\mathbf{D}\ \mathbf{U}\ (\mathbf{A}-\mathbf{F})|} = \frac{|\mathbf{D}\ \mathbf{U}\ (\mathbf{F}-\mathbf{A})|}{|\mathbf{D}\ \mathbf{U}\ (\mathbf{F}-\mathbf{A})| + |\mathbf{A}|} \quad (10)$$

As **D** and (**F – A**) are disjoint sets (a call cannot be a live abandoned call and a false negative), it follows that: $|\mathbf{D}\ \mathbf{U}\ (\mathbf{F}-\mathbf{A})| = |\mathbf{D}| + |\mathbf{F}-\mathbf{A}|$.

In addition, as **D** and (**A** - **F**) are also disjoint (a call cannot be abandoned and delivered to an agent) it follows that: $|\mathbf{D}\ \mathbf{U}\ (\mathbf{A}-\mathbf{F})| = |\mathbf{D}| + |\mathbf{A}-\mathbf{F}|$.

Also, since clearly: $|\mathbf{F}-\mathbf{A}| + |\mathbf{A}| = |\mathbf{F}\ \mathbf{U}\ \mathbf{A}|$, we can now rewrite our equation as:

$$\frac{|\mathbf{D}|}{|\mathbf{D}| + |\mathbf{A}-\mathbf{F}|} = \frac{|\mathbf{D}| + |\mathbf{F}-\mathbf{A}|}{|\mathbf{D}| + |\mathbf{F}\ \mathbf{U}\ \mathbf{A}|} \quad (11)$$

Or,

$$|\mathbf{D}|^2 + |\mathbf{D}|x|\mathbf{F}\ \mathbf{U}\ \mathbf{A}| = |\mathbf{D}|^2 + |\mathbf{D}|x(|\mathbf{A}-\mathbf{F}| + |\mathbf{F}-\mathbf{A}|) + |\mathbf{A}-\mathbf{F}|x|\mathbf{F}-\mathbf{A}| \quad (12)$$

This can be simplified to:

$$|\mathbf{D}|x(|\mathbf{F}\ \mathbf{U}\ \mathbf{A}| - (|\mathbf{A}-\mathbf{F}| + |\mathbf{F}-\mathbf{A}|)) = |\mathbf{A}-\mathbf{F}|x|\mathbf{F}-\mathbf{A}| \quad (13)$$

And further to:

$$|\mathbf{D}|x|\mathbf{A} \cap \mathbf{F}| = |\mathbf{A}-\mathbf{F}|x|\mathbf{F}-\mathbf{A}| \quad (13)$$

Finally:

$$\frac{|\mathbf{D}|}{|\mathbf{A}-\mathbf{F}|} = \frac{|\mathbf{F}-\mathbf{A}|}{|\mathbf{A} \cap \mathbf{F}|} \quad (14)$$

Adding the numerators to the denominators on both sides of the equation, we obtain:

$$\frac{|\mathbf{D}|}{|\mathbf{D}| + |\mathbf{A}-\mathbf{F}|} = \frac{|\mathbf{F}-\mathbf{A}|}{|\mathbf{F}-\mathbf{A}| + |\mathbf{A} \cap \mathbf{F}|} \quad (15)$$

Now, using (9), expressing **D** in terms of its constituent parts and since clearly $|\mathbf{F}-\mathbf{A}| + |\mathbf{A} \cap \mathbf{F}| = |\mathbf{F}|$:

$$\frac{|\mathbf{D}_1| + |\mathbf{D}_2|}{|\mathbf{L}|} = \frac{|\mathbf{F}-\mathbf{A}|}{|\mathbf{F}|} \quad (16)$$

On the other hand, we know that dialler abandoned calls (excluding false positives) are distributed evenly across live calls and false negatives (in the same way that they are distributed evenly between live calls and all answering machine calls if AMD is not in use). This is because a dialler cannot distinguish between a live call and a false negative. In other words, the proportion of dialler abandoned live calls (out of all live calls) and the proportion of dialler abandoned calls (out of all false negative calls) is equal. To express this in a formula:

$$\frac{|\mathbf{D}_1|}{|\mathbf{L}|} = \frac{|\mathbf{F} - \mathbf{A}|}{|\mathbf{F}|} \tag{17}$$

If we substitute this into (16):

$$\frac{|\mathbf{D}_2|}{|\mathbf{L}|} = 0 \tag{18}$$

And therefore $|\mathbf{D}_2| = 0$, or $\mathbf{D}_2 = \emptyset$.

This concludes the proof. □

The non-deterministic nature of AMD false positives

Now that we have established conclusively that the formula provided by Ofcom is incorrect[5] and therefore unusable for calculating abandoned call rates when AMD is in use, we need to try and find an alternative mechanism that would allow a dialler to remain compliant with the current regulations.

In order to do so, we need to return to the fundamental definition of the abandoned call rate as provided by Ofcom:

$$\mathcal{R} = \frac{|\mathbf{D}|}{|\mathbf{L}|} \tag{19}$$

Neither **D** (= $\mathbf{D_1}$ **U** $\mathbf{D_2}$) nor **L** can be calculated by a dialler in their raw form with absolute precision due mainly to the non-deterministic nature of $\mathbf{D_2}$ (false positives), which prohibits the accurate measurement of both **D** and **L**. Let's try to explain why.

Determining whether a call is a false positive or not means that the dialler needs to know precisely when a mistake has been made by the AMD algorithm. If that were to be possible, then the dialler could easily reverse the mistake and therefore no mistake would be made. This is clearly a contradiction, therefore it follows that no dialler can ever hope to be able to classify automatically any call as a false positive.

It follows that $\mathbf{D_2}$ is not measurable automatically and the best that can be hoped for is a method of approximation that would produce a reasonable estimate of it and more importantly, its size. Ofcom accepts this, but does not sanction or even recommend any practical method of approximation.

Here is the Ofcom statement verbatim:

4.16.1 the 'abandoned call' rate shall be no more than three per cent of 'live calls', calculated per campaign (i.e. across call centres) or per call centre (i.e. across campaigns) over any 24 hour period, and shall include a reasoned estimate[16] of Answer Machine Detection (AMD) false positives;

[16] Providers may wish to actually test their equipment in order to provide an actual false positives figure to Ofcom in the course of an investigation. Accuracy of AMD could be tested by comparing the differing connection rates when it is on and off or by making test calls to a range of numbers where the actual presence of an answering machine is known in advance.

[5] This also throws into question the examples of abandoned call rate calculations provided by Ofcom in Paragraphs 2.14 & 2.15 of their statement of policy.

Providers could listen to a range of calls where AMD is being used. Calls where an answer machine is detected could also be passed to live operators for a limited period and this may help to quantify numbers of false positives. Alternatively, where testing is not carried out, providers may supply Ofcom with their own reasoned estimate (as a percentage of total calls identified as being answered by an answer machine) of the extent of false positives incurred where AMD is being used. Ofcom will then determine whether such an estimate is in fact reasonable, based on evidence provided to it by a provider to substantiate its estimate.

So, what does this actually say? The statement revolves around the meaning of the words "reasoned estimate" with regard to the size of $\mathbf{D_2}$ (false positives). The clarification of these words is provided in a footnote (16) and is anything but precise.

To summarise, here are the five options which Ofcom would consider as candidates for a "reasoned estimate":

1. Compare the answer machine rates when AMD is switched on and off. This would compare the actual proportion of answering machines as classified by live agents compared to the same proportion as derived from the AMD algorithm. The difference would be the AMD error rate although the presence of false negatives would make this a complex and possibly imprecise exercise. Noetica is proposing a variant of this method later in this document.

2. Make calls to a set of numbers for which the presence of and answering machine is known in advance. This is a reasonable idea, but the number of calls to be made needs to be quite large in order to produce a figure which is accurate within the levels of tolerance that would be acceptable for the purposes of the Ofcom required margin of error. However, we do see some potential in this method.

3. Listen in to calls where AMD is being used. This assumes that the dialler provides the ability to listen to calls which are not connected to an agent. Even if that was feasible, these calls would be of a duration of less than 2 seconds. Even a trained ear would have some severe difficulties in determining with any degree of certainty which of these very short calls is to a live person and which is not.

4. Pass all calls to agents for a limited period of time whether these calls have been identified by the AMD algorithm or not and then compare the agent classification with the AMD one. This is essentially a variant of option 1.

5. Equipment vendors to provide a figure to Ofcom and for Ofcom to decide whether that figure is acceptable based on the evidence provided. This is in essence a variant of Option 2.

None of these options are in Noetica's view in any way precise or can ever be accurate and are just suggestions that Ofcom have included in their statement of policy in the absence of any reasonably scientific method.

On a more general note, the problem is a philosophical one. It is equivalent to one of the most clichéd of philosophical questions[6]: "If a tree falls in the forest and there is no one there to observe

[6] Originally attributed to George Berkeley (1685 – 1753), the father of subjective idealism.

it, does it make a sound?". In our case, this translates to saying that if AMD generates a false positive call, the only way to know that is by having a human being listening to that call.

There is no automatic way of determining the existence of a false positive call, since if such a method existed it would immediately follow that false positives could be eliminated altogether. Therefore, the only way to determine if a call is a false positive is to have an agent listen to it. But in order to be able to listen to all false positive calls, agents must listen to all calls identified by the AMD technology as an answering machine. It follows that there is no point deploying AMD technology in the first place as the entire purpose of it is to avoid these calls from being passed to agents.

Therefore, the more accurate the measurement of false positives is, the less useful the AMD technology becomes. This has nothing to do with the quality of the AMD technology per se, but is simply inherent in its very nature at least until such time when a mechanism can be found to guarantee that no false positives will ever be generated (for instance by having answering machines send a digital signal to the caller identifying the device categorically).

Practical Advice to Customers

Despite our reservations with regards to the new Ofcom policy statement, we feel that as a vendor of dialling equipment Noetica needs to provide some real advice to customers with regard to the use of its products in such a way that will not fall foul of the law.

The first, simplest and probably most effective piece of advice that we can offer is:

Tip 1: ***Don't use AMD at all unless it is clear that it would deliver significant benefits.***

For instance, there is no need to use AMD for B2B campaigns or campaigns where the percentage of answering machines is low (such as evening B2C campaigns to good quality lists).

Please bear in mind that AMD has other drawbacks apart from the generation of false positives. First of all, usage of AMD technology will invariably introduce a delay (of typically at least 1.5-2 seconds) between the call being answered and it being actually connected to an agent. This is because all calls need to be screened through the AMD algorithm in order to weed out the answering machines with any degree of accuracy.

This delaying effect may be rather annoying to most people who may be tempted to hang up after the first couple of hellos, and therefore you may notice an increase in the number of calls abandoned by the very people you are trying to speak to.

It is also worth bearing in mind that the use of AMD within the new rules will have a detrimental effect on the performance and efficiency of the predictive dialler itself. As false positives need to be taken into account as abandoned calls (more about this later), the threshold of dialler abandoned calls (dropped calls) will be automatically lowered.

This means that you will experience longer wait times between calls and less talk time per hour. As the main (and probably only) attraction of the use of AMD is to reduce agent non-productive time, there is a balancing point where the use of AMD negates the benefits of predictive dialling altogether, so although you are avoiding some answering machines, you are essentially working in power dialling mode, losing all the benefits that a predictive dialler could bring. It may very well be that the new Ofcom regime, although not explicitly stating this is simply sounding the death knell of AMD altogether.

If you are undeterred by the arguments above and feel that AMD is indeed of benefit to some specific campaigns, or if your customers may be forcing you to use this technology, then you will need to take some precautions. Noetica is introducing some new features within the Synthesys™ product range to help you do so. Please read on.

Tip 2: Use a reasonable estimate of False Positives for every AMD enabled campaign.

Noetica is in the process[7] of adding a new setting to outbound predictive campaigns, namely the estimated False Positive Rate (**FPR**) for the campaign. Noetica will also provide customers with a

[7] All new Synthesys™ features presented here will be generally available during Q3, 2009 (as part of the initial general release of Synthesys™ Version 4.1 or a subsequent service pack).

default figure for this parameter which is the result of testing we are currently carrying out in our labs.

We will also try to present this figure to Ofcom with a comprehensive explanation of our testing procedure (we are using a method similar to the one presented in Tip 3, below), in the hope that Ofcom would accept this as the typical figure for the Noetica hardware based (Aculab) dialler, according to Option 5 for what would constitute a "reasoned estimate" as described in the previous chapter.

For the soft dialler option our customers are advised to obtain **FPR** figures from their PBX manufacturer (such as Avaya, Aspect, etc.) and then use that figure as the campaign setting in Synthesys™.

Tip 3: Measure FPR regularly for each campaign.

Synthesys™ users will be able to carry out their own testing (as per the options 1-4 as described above) and then use their own findings to enter an **FPR** figure in Synthesys™ as part of the campaign setup. Noetica will be also providing tools within the product to facilitate carrying out such tests and here is a description of how this will work.

In order to allow our customers to protect themselves against any legal challenge we need to clearly state how **FPR** is defined and in what way it is used internally by Synthesys™ to calculate the all important abandoned call rate $\mathcal{R}$.

Since AMD false positives are in essence "live calls" (i.e. calls to live persons), **FPR** is defined to be the proportion of AMD false positives as a percentage of the total live calls made. According to our notation (please refer to the Venn diagram at the beginning of this document):

$$\mathbf{FPR}^{8} = \frac{|\mathbf{D_2}|}{|\mathbf{L}|} \tag{20}$$

Synthesys™ will offer a new mode of running a predictive outbound campaign: **"FPR detection mode"**[9]. When running in this mode, agents will be presented with all calls to answering machines, in effect no different from running with AMD turned off.

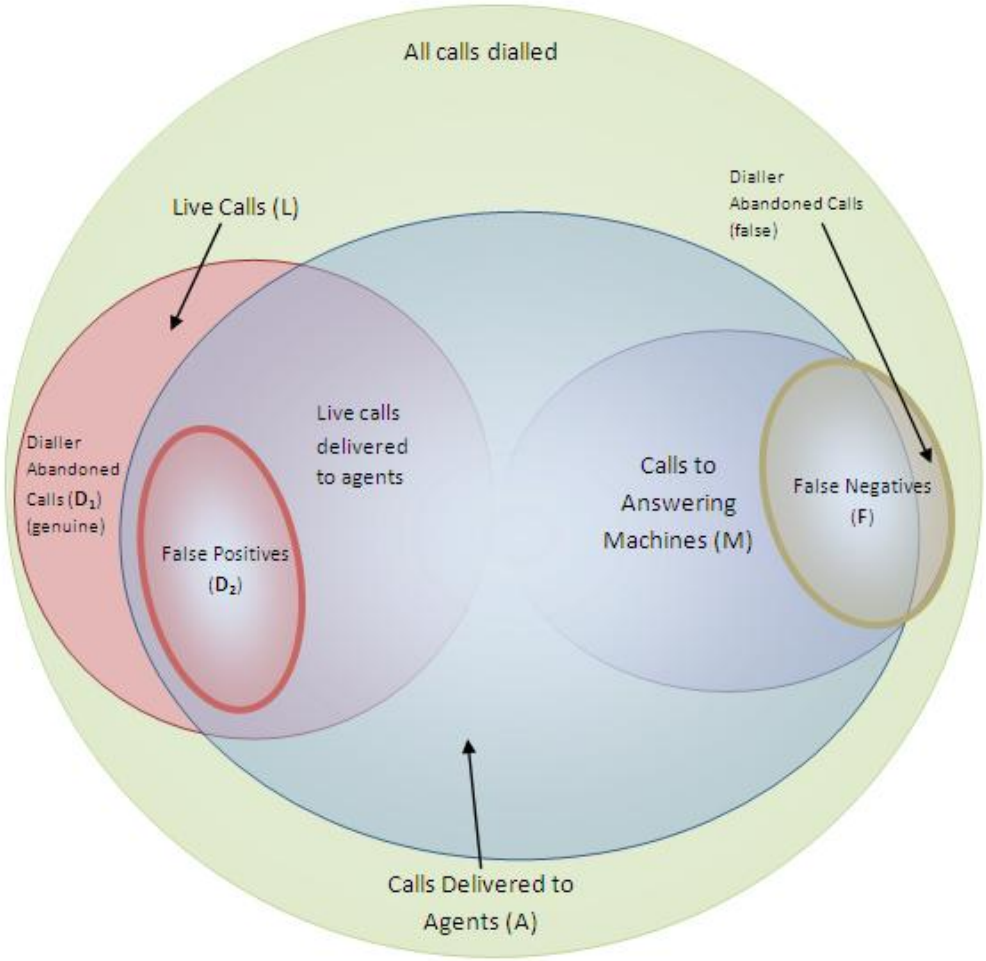
The difference of this mode is that AMD is actually in operation (so that the dialler is informed of AMD call classification) but not in effect, in the sense that although a call may have been identified by AMD to be an answering machine, the dialler will not abandon it, but pass it to an agent regardless of its AMD classification.

It is not recommended that users run in this mode for a period longer than necessary in order to measure FPR, as working in this mode has all the disadvantages of AMD (as described above) without any of the benefits.

[8] For the sake of clarity, this is not actually a percentage. To get a percentage figure, simply multiply by 100.

[9] Unfortunately, this can only possibly be provided for the hardware (Aculab ProsodyX) based dialler. In the case of the software dialler, all AMD calls (which are detected by the PBX's call progress detection mechanism) are abandoned before they reach the dialler. Therefore in the case of the software dialler, a figure for FPR must be obtained from the PBX manufacturer or measured in some other way.

Below is a diagram illustrating the distribution of calls when running in FPR detection mode:



Whilst running in this mode, the dialler can measure with total precision the number of false positives, $\mathbf{D_2}$. These are simply calls identified as answering machines by the AMD system yet dispositioned as live calls by agents. As all AMD identified calls to answering machines are passed to agents in this mode, the number of false positives can be determined with complete precision.

There is a slight complication with respect to determining the precise size of **L**, as (referring to the diagram above) it consists of all live calls delivered to agents (i.e. **A – M**) plus all live abandoned calls (i.e. $\mathbf{D_1}$):

$$\mathbf{L} = (\mathbf{A} - \mathbf{M}) \cup \mathbf{D_1} \tag{21}$$

The problem is that there are also false negative abandoned calls which the dialler cannot distinguish from the live ones, therefore $\mathbf{D_1}$ can not be established precisely. What the dialler can establish precisely is the set of all calls that it abandons altogether, which is:

$$\mathfrak{D} = \mathbf{D_1} \cup (\mathbf{F} - \mathbf{A}) \tag{22}$$

On the other hand, precisely because the dialler cannot distinguish between a live call or a false negative, the probability of abandoning a live call is the same as the probability of abandoning a false negative. Therefore, we can write:

$$\frac{|\mathbf{D}_1|}{|\mathcal{D}|} = \frac{|\mathbf{A} - \mathbf{M}|}{|\mathbf{A} \cap \mathbf{F}| + |\mathbf{A} - \mathbf{M}|} \tag{23}$$

i.e. the proportion of live abandoned calls out of all abandoned calls is the same as the proportion of live calls delivered to agents out of all live and false negatives delivered to the same agents. This allows us to express $|\mathbf{D}_1|$ in terms of known quantities. If we substitute this into (21), we can now express $|\mathbf{L}|$ in terms of measurable entities:

$$|\mathbf{L}| = |\mathbf{A} - \mathbf{M}| + \frac{|\mathcal{D}| \times |\mathbf{A} - \mathbf{M}|}{|\mathbf{A} \cap \mathbf{F}| + |\mathbf{A} - \mathbf{M}|} \tag{24}$$

If we simplify this slightly and then substitute into the formula (20) for **FPR**, we get:

$$\mathbf{FPR} = \frac{|\mathbf{D}_2| \times (|\mathbf{A} \cap \mathbf{F}| + |\mathbf{A} - \mathbf{M}|)}{(1+|\mathcal{D}|) \times |\mathbf{A} - \mathbf{M}|} \tag{25}$$

Both $\mathbf{A} \cap \mathbf{F}$ (the false negatives delivered to agents) and $\mathbf{A} - \mathbf{M}$ (the live calls delivered to agents) can be easily determined by the dialler and therefore their ratio **r** (we could call this the Delivered False Negative Rate) can also be easily calculated and expressed as:

$$\mathbf{r} = \frac{|\mathbf{A} \cap \mathbf{F}|}{|\mathbf{A} - \mathbf{M}|} \tag{26}$$

Hence the formula for **FPR** can now be more succinctly expressed as:

$$\mathbf{FPR} = |\mathbf{D}_2| \times \frac{1+\mathbf{r}}{1+|\mathcal{D}|} \tag{27}$$

This is the formula that the Synthesys™ dialler will use in order to provide a suggested value for **FPR** when running in **FPR** detection mode.

Tip 4: Ensure that agents are as accurate as possible when classifying calls

As we will see below, the abandoned call rate is extremely sensitive to the value of **FPR**. In turn, the value of **FPR** is highly sensitive to the precise classification of calls by agents as live or answering machine.

Therefore, when running in FPR mode, you must ensure that all agents are briefed to classify calls with the highest level of care and attention as even a small number of errors can have dramatic effects on the performance of the dialler when moving from FPR detection mode to normal AMD operation.

As a general rule, when an agent is in doubt it makes sense to classify the call as an answering machine rather than a live call. Only classify a call as a live call when there is no doubt that a live person is actually present at the other end of the line.

A usable formula for calculating the Abandoned Call Rate with AMD

Assuming that **FPR** is given, a formula can be found for the dialler to calculate the Abandoned Call Rate accurately. Let's start from the basic definition of $\mathcal{R}$:

$$\mathcal{R} = \frac{|\mathbf{D}|}{|\mathbf{L}|} \tag{28}$$

As we already know, $\mathbf{D} = \mathbf{D_1} \cup \mathbf{D_2}$

Despite the fact that $\mathbf{D_1}$ (=dialler abandoned live calls) is not determinable within the dialler, the set of all dialler abandoned calls: $\mathcal{D} = \mathbf{D_1 \cup (F - A)}$ (i.e. live abandoned calls and abandoned false negatives) is known and easy to measure.

It is clear that since the dialler cannot differentiate between live calls and false negatives, the probability of abandoning a live call is equal to the probability of abandoning a false negative. Therefore we can safely assume that the proportion of live dialler abandoned calls (out of all abandoned calls) is the same as the proportion of agent delivered live calls (out of all calls delivered to agents, i.e live calls and false negatives):

$$\frac{|\mathbf{D}_1|}{|\mathcal{D}|} = \frac{|\mathbf{A} - \mathbf{F}|}{|\mathbf{A}|} \tag{29}$$

Therefore:

$$|\mathbf{D}_1| = \frac{|\mathbf{A} - \mathbf{F}|}{|\mathbf{A}|} \times |\mathcal{D}| \tag{30}$$

From the definition of **FPR**, we also know that:

$$|\mathbf{D}_2| = \mathbf{FPR} \times |\mathbf{L}| \tag{31}$$

On the other hand:

$$\mathbf{L} = \mathbf{D}_1 \cup \mathbf{D}_2 \cup (\mathbf{A} - \mathbf{F}) \tag{32}$$

Since all three sets in the union above are clearly disjoint, we can write:

$$|\mathbf{L}| = |\mathbf{D}_1| + |\mathbf{D}_2| + |\mathbf{A} - \mathbf{F}| \tag{33}$$

Substituting $\mathbf{D}_1$ from (30) and $\mathbf{D}_2$ according to (31) yields the following equation:

$$|\mathbf{L}| = \frac{|\mathbf{A} - \mathbf{F}|}{|\mathbf{A}|} \times |\mathcal{D}| + \mathbf{FPR} \times |\mathbf{L}| + |\mathbf{A} - \mathbf{L}| \tag{34}$$

Which can be easily simplified to:

$$|\mathbf{L}| = \frac{|\mathbf{A} - \mathbf{F}| \times (|\mathcal{D}| + |\mathbf{A}|)}{|\mathbf{A}| \times (1 - \mathbf{FPR})} \tag{35}$$

Finally, substituting (30), (31) & (35) into the formula for $\mathcal{R}$ results in:

$$\mathcal{R} = \frac{\frac{|\mathbf{A} - \mathbf{F}|}{|\mathbf{A}|} \times |\mathfrak{D}| + \mathbf{FPR} \times \frac{|\mathbf{A} - \mathbf{F}| \times (|\mathfrak{D}| + |\mathbf{A}|)}{|\mathbf{A}| \times (1 - \mathbf{FPR})}}{\frac{|\mathbf{A} - \mathbf{F}| \times (|\mathfrak{D}| + |\mathbf{A}|)}{|\mathbf{A}| \times (1 - \mathbf{FPR})}} \tag{36}$$

A relatively trivial algebraic manipulation delivers the following formula for $\mathcal{R}$ when AMD is in use:

$$\mathcal{R} = \frac{|\mathfrak{D}| + (\mathbf{FPR} \times |\mathbf{A}|)}{|\mathfrak{D}| + |\mathbf{A}|} \tag{37}$$

As **FPR** is an heuristically provided parameter and both $\mathfrak{D}$ & **A** can be determined easily by any dialler (as the dialler knows the calls that it drops and the calls that it delivers to agents), this formula is usable by the dialler.

Noetica equipment testing for Ofcom

One of the options that Ofcom is proposing in the statement of policy reads as follows (verbatim):

"*... providers may supply Ofcom with their own reasoned estimate (as a percentage of total calls identified as being answered by an answer machine) of the extent of false positives incurred where AMD is being used. Ofcom will then determine whether such an estimate is in fact reasonable, based on evidence provided to it by a provider to substantiate its estimate."*

Noetica is planning to run statistically representative tests in order to provide a "reasoned estimate" to Ofcom. It is unclear at this point why Ofcom require the number of false positive "as a percentage of total calls identified as being answered by an answer machine". We feel that this is an illogical request and here is why.

The following is an experiment that Noetica wishes to undertake as a method of establishing a clear measure of false positives (**FPR**, in our notation). Since false positives are calls to live people, we are only interested in calling telephone numbers known in advance to be manned by live people. Under these conditions, each call identified by the AMD technology as an answering machine would automatically be a false positive.

Therefore, in this scenario, the extent of false positives "as a percentage of total calls identified as being answered by an answer machine" will always be 100%. This is clearly not true for any normal use of any dialler, therefore clearly a nonsense.

One may therefore try to create a situation as near as possible to real life and mix answering machines in with live calls. The question that arises immediately is what proportion of answering machines to what proportion of known live recipients?

One could therefore "reasonably" mix 1 live call with 1 million calls to known answering machines. Regardless of the outcome of the detection of the 1 single live call, the extent of false positives "as a percentage of total calls identified as being answered by an answer machine" will clearly be 0% within any reasonable margin of error. This is also clearly flawed.

We conclude that measuring false positives "as a percentage of total calls identified as being answered by an answer machine" is not a reasonable measure as it is possible to manipulate any experiment in order to arrive at any desired result.

Therefore, we would propose that Ofcom accept **FPR** as a true measure of the propensity of a system to generate AMD false positives. After all what matters is how many real people is the dialler going to misidentify as a percentage of all real people called.

Noetica is in the process of testing its dialling equipment in order to produce a reasoned and scientifically rigorous estimate for an **FPR** which would be typical for its equipment. Noetica would then seek Ofcom approval for providing this figure to its customers as a recommended setting for **FPR** within their campaigns.

As long as the that setting is adhered to and not lowered without good reason our customers would always be protected from any legal challenges raising from possible persistent misuse of dialling equipment from and AMD perspective at least.