

Application Note



Maximizing GSM Mobile Repair Centre Throughput



Service center throughput is affected by more than just test times - it involves the entire workshop process.

Administration, data management, de-skilling of repetitive tasks, test setup times, test equipment user interfaces, test software management as well as test times on equipment can all significantly affect workshop efficiency.

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This application note outlines and quantifies the impact of the IFR 2935 and PhoneTest system on the complete workshop.

Issues surrounding the repair center process

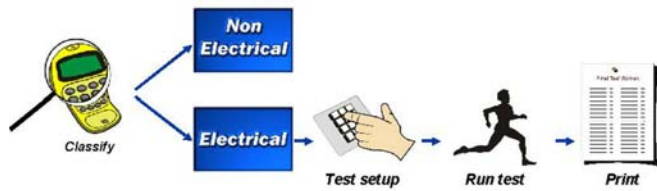
Let us briefly review the repair center process.

Booking in



At book-in, an operator enters any details associated with the job, such as Customer Name, IMEI, the customer-reported fault, and Warranty Status into the center's business system.

Pre-screen



At pre-screen, the operator sorts mobiles into those with and without electrical problems. In making the decision, the operator refers to the job ticket for the customer-reported faults. However, in a busy workshop, there is a time penalty associated with accessing any paper-based information.

If the mobile has an electrical fault, then the pre-screen operator carries out an initial test run to assist in diagnosis. The mobile is connected to a test set either via a simple RF cable, coupler or dedicated jig. The operator selects the test program (usually a "brief" one), and specifies the allowance that the test set is to make for the RF loss within the connection mechanism.

He then runs the test and waits for it to complete.

If pre-screen and repair are carried out as separate functions, the operator waits for a results printout to send, with the mobile, to the technician who will diagnose the fault and implement the repair.

Repair & Alignment



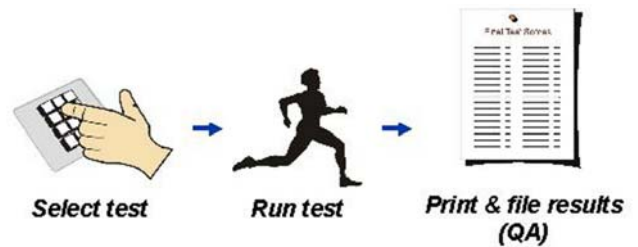
To accelerate diagnosis, a technician makes use of every available piece of information. These include the customer-reported fault, the results of previous tests, past experience of similar symptoms on similar mobiles and any 'Top 10' fault checklist that the workshop has created for itself. It is simply not practical to present all this information to a technician - even if it could fit on a busy repair bench, gathering it together takes too long.

Having made a diagnosis, the technician executes the repair. However, repair centers and/or mobile manufacturers require the repair to be documented. This involves noting, in a standardized

format, symptoms, faults found, action taken and components used.

If a mobile's RF stages have been disturbed by the repair then it has to be re-aligned. During alignment, the mobile has an RF connection to the test set, but is usually under the control of the manufacturer's software. The problem is that each of the many types of mobile has a different 10 to 15 step procedure, with each step requiring the setting of 4 or 5 test set parameters. Although the process is straightforward, the settings - which have to be precise - are repetitive, error-prone, and slow, resulting in a typical alignment taking several minutes. Mistakes are inevitable but, as some mistakes will not necessarily be detected during alignment. This can allow the phone to be misaligned, a circumstance which, at best, will not be detected until final test.

Final test

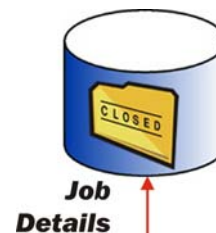


After the mobile has been repaired and aligned, most workshops subject it to a final test.

As with the pre-screening test, the operator has to select the test program and RF insertion loss, start the test and wait for it to complete. Usually, final test differs from pre-screen in that the nature of the final test is often dictated by the customer - centers that have contracts with large retail organizations are familiar with this. Another difference is that a final test tends to be long.

A third difference is that some repair centers are contracted to have an element of traceability. In this case, there is a need to have test results printed and filed.

Booking out



After the workshop stage, the mobile is booked out and shipped. The center's business system raises the warranty claim, for which it requires the 'documentation' that the repairer completed earlier on. If the documentation was done on paper, then the details need to be transcribed into the system.

The Aeroflex product

Aeroflex's solution to the issues discussed above lies not simply in a fast and stable GSM test set, but also in the software system that accompanies it. The 2935 test set is fast, stable and accurate

but it is the PhoneTest software that gives the efficiency improvements that maximize throughput.

The PhoneTest system combines:



- PhoneTest itself, in effect the user interface for the 2935, tailored to suit the role in hand.
- A workshop management option, comprising:
 - PhoneTest-Manager, Aeroflex's system for recording and archiving the entire test and repair history of every mobile.
 - PhoneTest-Exchange, providing configurable links into the user's own databases, whether for analyzing repairs, or for transferring commercial information.
 - PhoneTest-Repair, which can be configured to simplify capture of repair data.

The impact of 2935 & PhoneTest on the repair center process

To best understand the effect of PhoneTest and the 2935, let us examine how it works in a repair center. As the discussion develops, an estimate is made of the amount of time that can be saved during each process.

Pre-screen

The classification into electrical and non-electrical faults (or, indeed no fault found) rests, in part, on knowing key information such as the customer-reported fault. Rather than the operator accessing information from job tickets, PhoneTest speeds-up the process by automatically accessing the fault information and warranty status, directly from the business system.

Estimated time saving: **15 sec.**

Regarding initial test, the time taken by the operator to select the right test program and RF insertion loss can be removed by configuring PhoneTest to automate the process. This reduces operator involvement as it's simple one-button operation.

Estimated time saving: **30 sec.**

The 2935 is arguably the fastest test set aimed at repair center use. Although test speed is significant, just as important to maximizing throughput is the ability to create and fully customize test sequences so that they test only the relevant parameters. This is particularly important since pre-screen testing needs to be kept very short.

Estimated time saving: **15 sec.**

The time taken to print pre-screen test results can be completely removed simply by logging them to PhoneTest-Manager instead.

Estimated time saving: **1 min.**

Repair and alignment

There are many ways that PhoneTest can help in diagnosing the repair. The system can:

- Present the fault, as reported by the customer, direct from the business system.
- Access the results of the pre-screen test. Incidentally, the operator can also see the full test-and-repair results of any other visits that the mobile has made to the Repair Center.
- Compare the pre-screen results with the knowledge base that PhoneTest creates of previous tests and repairs on mobiles of the same type, and then automatically present the technician with probable causes based, literally, on past experience.
- Display any product-dependent guidance checklist that the Repair Center, or the manufacturer, wishes the repairer to have access to. This may be as simple as displaying the manufacturer's "Top 10" fault list. At the other extreme, PhoneTest may display the manufacturer's repair documentation, circuits and parts lists.

Estimated time saving: **2 min.**

To assist with post-repair 'paperwork', PhoneTest-Repair can be configured to allow the technician to pick, from simple product- or manufacturer-dependent lists, details such as symptoms, fault, action taken and components replaced. Given this information, combined with the Job Details on the center's business system, PhoneTest can either create a warranty claim directly or, if preferred, it can pass the details up to the business system for it to process.

Estimated time saving: **30 sec.**

At the alignment stage, PhoneTest has a special feature - 'TCH Test Mode stores' - that can be configured to reduce the literally hundreds of possible test set settings to a simple two-step process: first select the type of mobile in question, and then pick the next step in the manufacturer's process. Not only speeding-up the process, it reduces the risk of errors (some of which would be uncovered later on at final test).

Estimated time saving: **2 min 30 sec.**

Final test.

To be effective, final test needs to be comprehensive, but to reduce costs, it also needs to be simple, fast and error-free. As at pre-screen, PhoneTest can be set to automatically load the correct test sequence and insertion losses for the mobile in question.

Estimated time saving: **30 sec.**

In addition to the 2935 being fast, users can configure tests to match their own, or their customers', requirements. With multiple 2935s at one final test workstation, users can increase throughput by testing two or more mobiles simultaneously from a single PC.

Estimated time saving: **1 min 50 sec.**

Where traceability is required, as opposed to waiting for results to be printed (and then having to file them), users automatically log results centrally to the PhoneTest-Manager database.

Estimated time saving: **1 min.**

In order to see a mobile's full test-and-repair history, it is only necessary to identify the mobile to PhoneTest. This can be done by registering it on a 2935, or by entering (through the PC keyboard or using a bar code reader) the mobile's IMEI. The latter does not require a 2935 to be present; it can be done on the supervisor's PC, the QC manager's PC or any PC anywhere on the center's network.

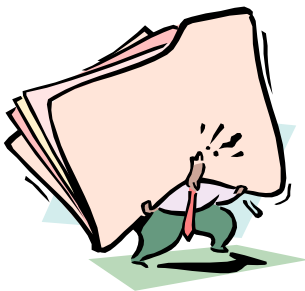
In addition, when a mobile passes final test, PhoneTest can automatically print a customized certificate for returning to the end-user. This is seen as a way of building customer satisfaction.

Book out

At booking out, the dispatch operator closes the job on the Center's business system. PhoneTest system can assist by already having:

- The business system that the mobile had already passed final test (and thus ensuring that mobiles cannot be dispatched inappropriately).
- Sent up the repair details (symptoms, faults, actions, parts, etc) so that the business system can make the warranty claim automatically.

Helping the workshop supervisor



The workshop test supervisor has a key role. Any problems, whatever the magnitude, with any mobiles, equipment or methods are referred to him for 'instant resolution'.

Included in his responsibilities is the creation of tests. As well as PhoneTest being supplied with a range of ready-to-run sequences for various depths of test and band combinations, PhoneTest's script wizard guides you through the creation of custom sequences to meet particular needs. And, as the scripts are saved as simple text files, they can be further fine-tuned with any editor.

Once scripts, stores, or any other aspect of a testset's settings are ready for release to the workshop, it wastes time to spend a typical 5 minutes per workstation in, waiting for the operator to finish their current job and installing the data. It is far quicker to simply put the information on a central server, and have every workstation access it from there. As PhoneTest is Windows based, work-

stations can be networked with virtually any technology that the user wishes. In addition, if a center has multiple sites, and the sites are already networked, centralized distribution becomes even more cost effective.

Incidentally, because 2935s are controlled from their PCs, central distribution of scripts, stores and settings is applicable even when a test set is away for calibration. When the 2935 returns, there is no risk of forgetting to update it.

As the supervisor is treated as the all-round expert for every problem imaginable, he needs as much help as he can get. In addition to conventional training and telephone support, Aeroflex can, if required, provide dial-in support direct to a specific workstation. Conversely, the supervisor can make use of simple inter-PC networking to access workstations at remote sites.

Throughput implications

The above estimates yield a total savings of a little over 10 minutes per mobile. For a repair center with a throughput of 500 mobiles per day a 10 min saving per mobile is equivalent to over 400 operator hours per week, thus giving significant scope for increasing capacity.

For a repair center with 20 test sets, whenever the supervisor updates (for example) a script, a saving of 5 min per test set means a saving on his time of 1.5 hours.

There are additional benefits:

- Optimizing the use of skilled technicians.
- Reducing errors, thus increasing both throughput and customer satisfaction.
- Traceability, without the overheads.
- Extra customer satisfaction through automatically printing custom "Pass certificates".
- If required, dial-in support.

Implementation scheme



PhoneTest does far more than simply provide a user interface to the 2935 test set. However, it is unnecessary to implement all the features discussed above, nor is it necessary to implement the final system from "day one". Consider the following typical (but by no means mandatory) scenario, any stages of which can be implemented or omitted as appropriate:

1. Start with the 2935s controlled by PhoneTest. Immediately, the user gets the benefit of a fast, stable test solution, with a simple-to-use PC-based user interface, and full flexibility in the coverage and flow of test sequences.

2. Progressively configure PhoneTest to yield the benefits of automatic test sequence and insertion loss selection, faster alignment throughput via the TCH Test Mode stores, and certificate printing. In addition, the PCs can be networked for immediate distribution of test sequences, stores and settings and, if required, use readily-available PC packages for remote access.
3. Use PhoneTest-Manager to give virtually cost-free traceability.
4. Configure PhoneTest-Exchange for accessing and, if required, updating information held on the center's business system.
5. Finally, configure PhoneTest-Repair to capture repair details (and virtually any other operator-entered information that the center requires). This information can, if necessary, be passed on via PhoneTest-Exchange to the business system for preparation of the warranty claim.

Some real examples

1. A 2935 user with multiple repair centers in several countries, operating hundreds of 2935s.
 - The main requirement from the 2935 is for a fast and reliable test set. However, most benefit comes from PhoneTest's unique TCH Test Mode stores facility which, he reports, "doubles alignment throughput".
 - Workstations are networked for rapid distribution of stores and setups.
2. A repair center with one workshop, operating about fifty 2935s.
 - Organized into separate repair/align and final test stages.
 - Final test has 2 test sets per operator. If it passes, automatically prints a certificate for returning with the mobile to the end user.
 - Workstations are networked for instant, centralized update of scripts, stores and settings.
 - Uses PhoneTest-Manager to meet contractual commitment to a major retail chain to maintain traceability. Currently have three years of records on-line. If a mobile is returned, the complete history is retrieved automatically.
3. A repair center with several workshops, operating about twenty-five 2935s.
 - Existing inter-site networking means that scripts, stores and settings are immediately available everywhere within the organization.
 - All workstations log results to central PhoneTest-Manager database - provides full traceability.
 - Have configured PhoneTest-Repair for their own particular repair detail entry requirements.
 - Use PhoneTest-Exchange to automatically pass, on a selective basis, repair details and job status update to their business system database.

Appendix

IT issues within a PhoneTest system

The main text of this application note describes how PhoneTest systems range in complexity from:

- one PC running PhoneTest simply as the user interface for a 2935 testset, through to:
- tens of workstations, across multiple sites, with central result logging, full traceability, and real-time access to the corporate business system, all managed by a single supervisor from a single desk.

This appendix provides a brief overview of the IT (Information Technology) issues applicable to a PhoneTest system.

Stand-alone workstations

A single workstation comprises a 2935, a PC, and PhoneTest software. The 2935 connects to one of the PC's COM ports, using the RS232 cable supplied with the testset.

Multiple 2935s can be connected to the same PC, so long as the latter has sufficient COM ports with non-overlapping IRQs.

Interconnected workstations

Instant distribution of test sequences, stores, settings, etc, is gained simply by networking together the workstations PCs, the supervisor's PC and, optionally, a server.

PhoneTest can use any networking scheme that is supported by the PC's Windows™ operating system. PhoneTest accesses test sequences, stores, settings, etc as simple files, whose paths are configurable within PhoneTest. Therefore, it is necessary only to set-up a master directory structure physically on one PC (such as the supervisor's or, ideally, an "always on" server) and, on each workstation PC, create links to the structure via virtual drives.

Central result logging

Test and repair results can be logged either:

- to Aeroflex's unique **PhoneTest-Manager** system, or
- via **PhoneTest-Exchange**, to the user's own conventional **relational database system**,

or to both.

PhoneTest-Manager does not use a relational database. It is a hierarchical database, optimized for efficient storage and retrieval of multiple variable-length records indexed by a single key, as is required when dealing with test and repair histories of mobile phones (where the key is the mobile's IMEI). One distinct benefit of using PhoneTest-Manager is that, other than running a simple Windows-based server process on one of the PCs (preferably the database's own server), it requires no user configuration.

Conversely, for PhoneTest to log results to the user's own **relational database system**, provision of the database, configuration of its tables, fields, reporting and data presentation facilities are all under the control of the user. Although requiring greater effort in terms of initial system set-up, as everything is under the user's direct control, maximum flexibility is gained in terms of report

generation and data presentation.

Logging to PhoneTest-Manager

On the technical side, PhoneTest logs results to PhoneTest-Manager via a simple server process that, typically, runs on the central PC that hosts the database. The communication mechanism uses TCP/IP. In case of failure of either the central server or the network, PhoneTest workstations automatically buffer results locally and, when the system is re-established, log buffered results to the server.

Exchanging information with the user's own databases

Assuming that the user's own relational databases have 32-bit ODBC drivers, then PhoneTest can exchange information with them. The exchange of data (test and repair results, job details, etc) is controlled by a simple SQL (Structured Query Language) subset, using statements such as SELECT, UPDATE and INSERT.

As the user will typically be using different databases for commercial and technical data, PhoneTest can use different DSNs (Data Source Names) for the various business system and results transactions.

To help with getting a PhoneTest-Exchange system "up and running", PhoneTest includes:

- two sample Microsoft Access databases (one for results, one for job details,
- an Access 32-bit ODBC driver, and an
- SQL file

all pre-configured for:

- retrieving job details (customer name, warranty status, customer-reported fault, etc), and
- storing and retrieving full test-and-repair histories to and from a results database.

For the very latest specifications visit www.aeroflex.com

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