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Competitive Network Benchmarking

Quality Assurance Procedure

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Introduction

EnVision Wireless, Inc. completes wireless competitive network benchmarking surveys for clients throughout the world. These surveys provide a view of each wireless network from the subscriber's perspective by comparing networks from the standpoint of coverage, performance, and capacity.

This document outlines the quality assurance processes used by EnVision to ensure timely and accurate results for all network quality surveys. EnVision's quality assurance process for network quality surveys contains eight distinct steps.

1. Project Planning - the test plan agreement, drive route creation, resource scheduling, equipment shipping, travel arrangements, allocation of spare parts and equipment configuration.
2. In-Market Setup - handset registration, manual call placement, setting up and programming the test equipment, and equipment operability verification.
3. Drive Test Clearance - includes the collection of the initial test file as well as the analysis of the file.
4. Data Collection - the activities that occur during the actual data collection including physical equipment inspection, real-time equipment monitoring, individual file notes, in-field data verification, daily data analysis, post collection test files and equipment teardown.
5. Data Post Processing - data cleaning, file merging, preliminary data review, individual call failure analysis, geographic plots, chart, table and report creation.
6. Report Review - the preliminary and final review of the deliverable reports.
7. Report Production - production of the deliverable CDs and hardcopy reports.
8. Shipment and Data Archival - shipment of the deliverables and the archival of the survey data.

The following sections provide specific details as to the actions required by EnVision's engineering staff to ensure high quality network surveys.

Project Planning

The first step in EnVision's quality assurance process is the creation of the project plan. While a project's scope is typically detailed during the sales process, several actions must take place to ensure a smooth handoff between the customers, EnVision's sales personnel and EnVision's project management team.

In order to ensure the highest level of customer satisfaction, EnVision and its client must agree on a project's test plan prior to the start of work. A typical test plan will outline the following parameters:

- ▶ Market(s) to be measured
- ▶ Equipment to be used
- ▶ Call duration
- ▶ Idle time between calls
- ▶ Call placement window
- ▶ Call type (mobile to land, land to mobile or both)
- ▶ Operators to be measured
- ▶ Drive route requirements
- ▶ Proprietary or non-proprietary results
- ▶ Parameters to collect
- ▶ Location of Fixed Voice Quality Module
- ▶ EnVision project manager contact information
- ▶ EnVision field engineer contact information
- ▶ Client main point of contact information
- ▶ Project schedule requirements

Scheduling for a project is completed based on the availability of equipment and personnel as well as client requirements. All personnel assigned to a project are made aware of which specific equipment will be used for the project as well as the project's test plan requirements.

Spare parts are provided to the field engineer based on the project's requirements. Having these spare parts in the field reduces downtime when failures occur. Typical spare part allocations will include phone cables, batteries, antennas and phones. Should a failure occur in the field for which a spare part is not on hand, EnVision's support engineer will arrange for replacement parts to be shipped to the field.

The equipment is configured based on the requirements of the test plan. Scanners are installed based on the mix of technologies required. All equipment is thoroughly tested and inspected prior to shipment to the field.

In-Market Setup

Once the field engineer and the equipment have arrived in the market, the in-market setup phase can commence. During this phase, the field engineer will register all handsets on the service provider networks to be tested, place manual calls with all phones, setup and program equipment and verify equipment operability.

EnVision's field engineer will verify that each phone can successfully place and receive calls manually. In addition, a manual call will be placed to the VQM with each handset in order to assure proper operation of the VQM. If a handset cannot place or receive calls, EnVision's field engineer will arrange for a replacement from the service provider.

EnVision's field engineer will physically connect all handsets to the equipment and configure the controlling software. The setup of the data collection software is a critical step in the overall quality assurance process. The field engineer will create a Test Plan File in the collection software that specifies the exact measurements to be collected (log mask) along with the call profile information.

EnVision's field engineer will verify that the test equipment is operating correctly, that GPS is configured properly, and that all phones are placing calls as specified in the data collection software.

Drive Test Clearance

Both the field engineer and the support engineer complete the Drive Test Clearance phase. The primary purpose of this step is to obtain authorization to proceed with the data collection. Authorization is given to proceed only upon agreement between the field engineer and the support engineer that all equipment is operating correctly, the parameters of the test plan have been programmed and that all required data is being collected by the equipment.

The field engineer will complete a test file by placing calls on all handsets while the vehicle is stationary as well as while the vehicle is moving along a pre-defined test route. Stationary testing is completed in a location where all networks have sufficient coverage. The drive route used for the mobile testing is defined in a manner to be representative of the entire survey area. Once a sufficient number of calls have been placed on all handsets, the test file is terminated and forwarded to the support engineer assigned to the survey.

The support engineer will examine the test file to verify that all handsets are operating correctly, navigational data is being logged, the call profile has been setup correctly and that all log masks have been setup correctly. Any anomalies are communicated immediately to the field engineer.

Once the field engineer and the support engineer agree that all equipment is operating according to the test plan, clearance to proceed with data collection is given.

Data Collection

The Data Collection phase is a daily feedback loop between the field engineer and the support engineer. After each day of data collection, the support engineer reviews the data to make sure that all equipment is operating correctly. This process ensures that, in the event of an anomaly, a maximum of one day's data is contaminated or lost.

Each day prior to the start of data collection, the field engineer will physically inspect all handsets, cables, antennas, batteries and connections. In the event that a defective part is observed, the field engineer will replace the part using the available inventory of spares. Lastly, software parameters are verified to be consistent with the test plan.

During data collection, the field engineer continuously inspects the system for anomalies. The field engineer is trained to observe the call statistics in real time for abnormally high rates of call failures that could be indicative of equipment failure. The field engineer will also monitor various engineering parameters for each technology so correlations can be drawn between coverage and interference issues in the networks being tested. Finally, the engineer will monitor the navigation system to ensure that positional information is being logged correctly.

For each data file that is recorded, the field engineer will prepare notes that will be used by the support engineer and the post processing team during the analysis of the collected data. The specific information recorded includes file names, start and end times, start and end mileage, consecutive call failures, bad files, equipment failures and other anomalies.

Upon completion of each day's collection activities, the field engineer will analyze the data collected to verify data integrity. All files from the day are merged and call statistics produced. The field engineer is trained on data ranges to expect for various technologies. In addition, the field engineer will verify that all files contain valid navigational information. Upon completion of this step, the field engineer will forward the data to the support engineer for further analysis.

Each day the support engineer will review the data collected on the previous day. The support engineer will examine each file while referring to the notes prepared by the field engineer. Each call failure that is recorded is examined in detail to determine its validity. Various graphs are created for the call failures to determine additional anomalies. The post-processing engineer marks all data that is determined to be anomalous for further review. The support engineer will contact the field engineer upon completion of the data review to communicate any issues identified. A copy of each day's call statistics is provided to the customer.

Upon completion of all drive testing, the field engineer will record a test file. The purpose of this file is to verify that the equipment and the handsets display similar performance at both the beginning and the end of testing. Upon completion of this test file, the field engineer forwards the file to the support engineer for review.

Upon confirmation from the support engineer that all data has been collected properly, the field engineer will disassemble the test equipment and prepare for delivery to the next market.

Data Post Processing

The Data Post Processing stage begins upon completion of all drive testing. This phase of the project results in a draft version of the survey's deliverable report.

Each day's data is examined separately along with the test engineers notes. All files are converted and mapped. Preliminary graphs and tables are created to show the results of call statistics and call failures. Any problems identified as equipment failure are removed from the data files before further processing.

Once the data has been cleaned using the data collector's notes, all files for the survey are merged into one master file containing all sets of data for all carriers measured. This master file allows for more efficient processing.

Call statistics are then tabulated and compared to historical data to determine macro level data concerns. Abnormally high percentages of call failures tend to indicate equipment failure. If abnormally high percentages of call failures are determined, further analysis is completed to determine the cause.

Distribution charts are generated for engineering parameters from similar technology service providers. In addition, tables of call statistics are created to display the overall performance of each network. This information is used to create the final network rankings for the survey.

Once all charts, graphs, tables and geographic plots have been created, they are compiled to produce a preliminary draft of the survey report.

Report Review

The draft report created in the Post Processing step is reviewed for quality assurance. All unresolved anomalies are researched to conclusion and documented in the report. The output of this step is the release of the report to the production team.

EnVision's lead engineers review all reports to validate all engineering observations, check formatting, verify reported results and identify any remaining data concerns. Any changes necessary are made and a final review draft is created.

EnVision's lead engineers will review the final draft to verify all changes have been made. Upon verification, the report is released to production.

Report Production

All customer deliverables are prepared in quantity as required according to the terms of the contract.

The final report is burned to CD in Adobe .pdf format along with all geographic plots. Hyperlinks are provided in the .pdf for ease in report review.

All reports are printed and bound professionally. Printed copies are spot checked for printing errors.

Shipment and Data Archival

The final step in EnVision's Quality Assurance Process is the Shipment and Data Archival stage.

All deliverables are packaged and shipped according to the instructions provided in the customer's purchase order.

An internal copy of the CD and deliverable report are produced and maintained in EnVision's library.

All data is archived onto CD and stored in the library along with the internal copies of the deliverables.