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Rapid Resolution of Trouble Tickets

▶ How to solve trouble-tickets faster with the new K15 Iub monitoring/automatic configuration and UMTS Multi Interface Call Trace applications

Trouble ticket. It is an expression that strikes fear into the hearts of network operations and maintenance (O&M) personnel everywhere. Something is amiss with a network element or interface… somewhere. Subscribers are having difficulty using a service they have paid for and may be contemplating a change in their mobile provider. It means a rush to find and repair a problem that is costing the operator its hard-earned revenue and reputation.

A trouble ticket is a matter of great urgency. Network operators know that there is a strong correlation between customer satisfaction and loyalty. In fact, some market studies show that customers who report problems and receive prompt resolution are actually more loyal than subscribers who never encounter problems. People seem to understand that no network is perfect, and believe that responsive service is the best assurance of quality.

Customer complaints are the source of at least 80% of all trouble tickets. The typical subscriber complains when he or she is unable to access voice or data services that have always worked before. These access problems are commonly caused by technical issues within the network but may be something as simple as an element that is stretched beyond its capacity. Most operators have set aggressive time goals for their O&M troubleshooting teams. When a trouble ticket appears, the O&M group is expected to solve it within "a couple of hours." But everybody on the team knows that sooner is better.

This two-hour time limit is a huge challenge, given the complexity of modern networks as the industry advances to 3G infrastructures.

The K15 "Iub monitoring/automatic configuration" application along with the "UMTS Multi Interface Call Trace" application support technicians in reducing the time needed to close a trouble-ticket. This application note describes how the K15 can help to solve a typical problem that can occur in a UMTS network.

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Problem: A particular subscriber is not able to place UMTS voice calls

A subscriber is having trouble with his UMTS mobile phone. He switches on his phone to make a call, dials the number and receives no response.

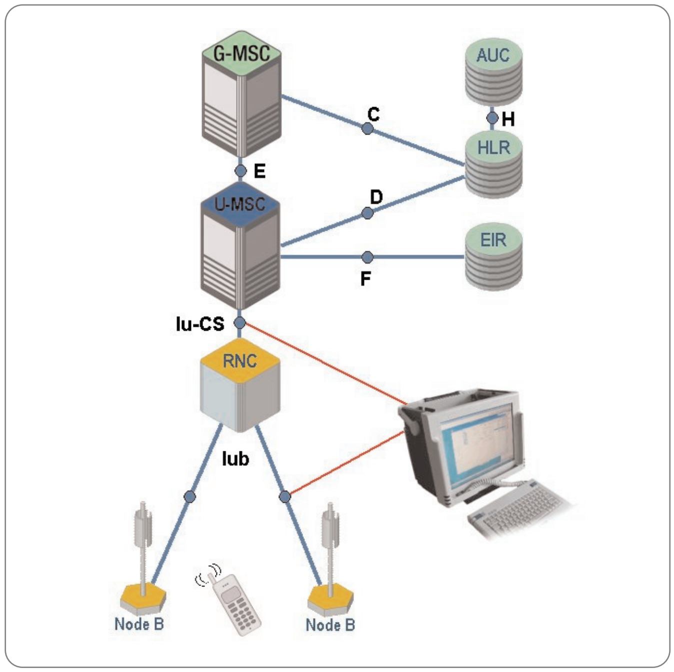
The subscriber calls his network provider and complains about the defective service. A service agent logs the complaint, noting the model of the phone and the location from which he attempted to place the call. After ensuring that the subscriber's phone is working, that the subscriber has a subscription for the requested service and that the equipment is operated correctly, the call is passed on to the operations center. The agent sends an email to the network O&M group, where it becomes a "high-priority" trouble ticket.

Acting quickly, the O&M department begins the sometimes time-consuming task of troubleshooting the problem. The analysis must consider several cells in the geographical area of the misplaced call. Similarly, it must account for the Radio Network Controller (RNC) controlling the Node B elements in that same area, and lastly the analysis must evaluate the UMTS Mobile Switching Center (UMSC) that controls the RNC. Any of these elements and their interfaces might be at fault.

As a first attempt, network management tools are used to locate the problem. When this does not identify the problem, a technician is sent out in the field. The technician places a test call with a known-good mobile phone of the same make and model of the subscriber. O&M technicians at the RNC switch site attempt to track the test call on the Iub and on the Iu-CS interface using the K15 to see what kind of problem affects the network. The K15 is connected to the physical Iub and Iu-CS interfaces around the RNC. See Figure 1.

To configure a typical protocol analyzer for an Iub monitoring session, the technician must:

1. Configure Logical Links
2. Define Virtual Path Identifier/Virtual Channel Identifier (VPI/VCI) for each ATM Permanent Virtual Circuit (PVC) to be monitored on the AAL5 layer
3. Define VPI/VCI/Circuit Identifier (CID) for each ATM PVC to be monitored on the AAL2 layer

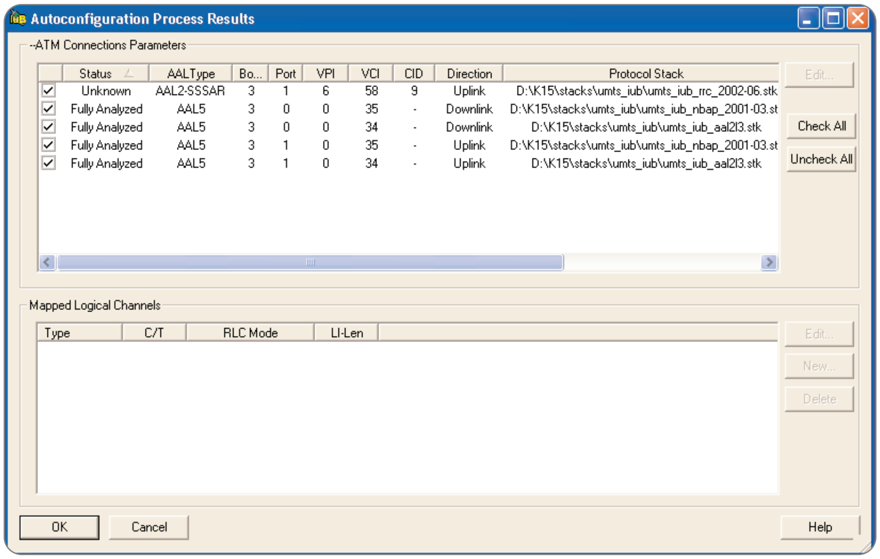


▶ ***Figure 1.*** *Setting up the K15 to monitor the Iub and the Iu-CS interfaces.*

Logical links must be configured for the two protocol entities transported over ATM AAL5, namely, Node B Application Protocol (NBAP) and Access Link Control Application Part (ALCAP).

NBAP is a radio network layer protocol that maintains control plane signaling across the Iub interface and provides a means for the Node B (base station) and the RNC to communicate.

ALCAP is a transport network layer protocol, which reacts to the radio network layer's demand to set up, maintain and release ATM PVC data bearers. For each Node B involved in the Iub monitoring session, VPI/VCI values must be determined for each ATM PVC carrying NBAP and ALCAP protocol signaling. Complexity can multiply quickly if there are several Node B elements that might be involved in the failed phone call.



▶ ***Figure 2.*** *Setting up the K15 to trace the call over the Iub and the Iu-CS interfaces.*

Logical links need to be configured for the following Common Control Channels (CCCHs) transported over ATM AAL2: RACH, FACH, PCH and BCH. For each cell controlled by the Node B involved in the Iub monitoring session, VPI/VCI/CID must be determined.

Where does all this information come from? VPI and VCI values are usually obtained by querying the network elements from a central management console in a special client session. The session provides graphical tools to interact with the network element but often these tools are less than elegant. Alternatively, some networks have devoted substantial resources to streamlining their service processes, making critical VPI and VCI information easily available. Most have not. There are no consistently applied industry-wide rules by which VPI/VCI values are assigned; and where a particular vendor might attempt to follow a set of rules, they may not be well documented. CID values are even more elusive: there is no way to identify CID values through commands from the management console, because CID values are assigned dynamically.

One way to quickly gather information on which VPI/VCI values are used by the NBAP and ALCAP and on what VPI/VCI/CID values are used by the Common Control Channel is to simply re-start the Node B and look at the content of the initialization messages. However, what is wrong with this technique? It interrupts service to subscribers – the one thing no network can afford to do unnecessarily.

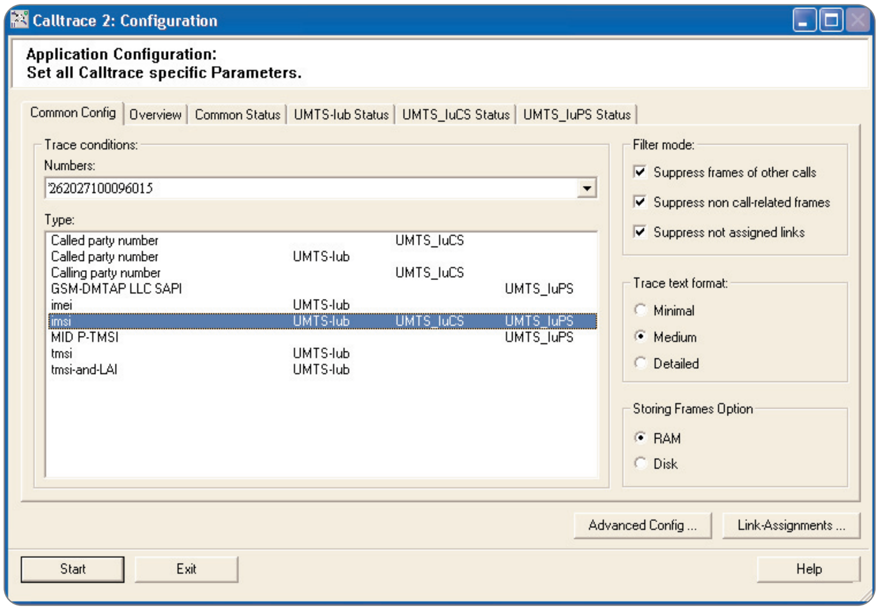
All of the foregoing steps pertain to setting up for Iub monitoring. There is a separate and similar procedure for Iu-CS monitoring. Again it is necessary to determine the VPI/VCI information. Logical links must be configured for the Radio Access Network Application Part (RANAP) protocol entity transported over AAL5.

Using the K15 Iub Automatic Configuration application, the configuration task is now completely automated. Thanks to this application only a few minutes instead of hours are required to set-up the test session.

This expert software automatically configures all the logical links required to monitor NBAP, ALCAP for each Node B under observation and RACH, FACH, PCH for each cell under observation, as shown in Figure 2.

With the K15 connected and configured (either manually or automatically), the next step for the technicians at the RNC site is to analyze the flow of the test call placed by the field technician.

The test call is structured into a set of procedures that traverse multiple network elements and interfaces. Tracing protocol messages associated with a specific subscriber is extremely difficult using conventional protocol analysis tools. The method of identifying the subscriber differs within each procedure and each network interface. Moreover, these variables change constantly and are reallocated frequently.



▶ ***Figure 3.*** *International Mobile Subscriber Identity.*

Most existing protocol monitors analyze the flow of protocol messages related to the call just on a single interface.

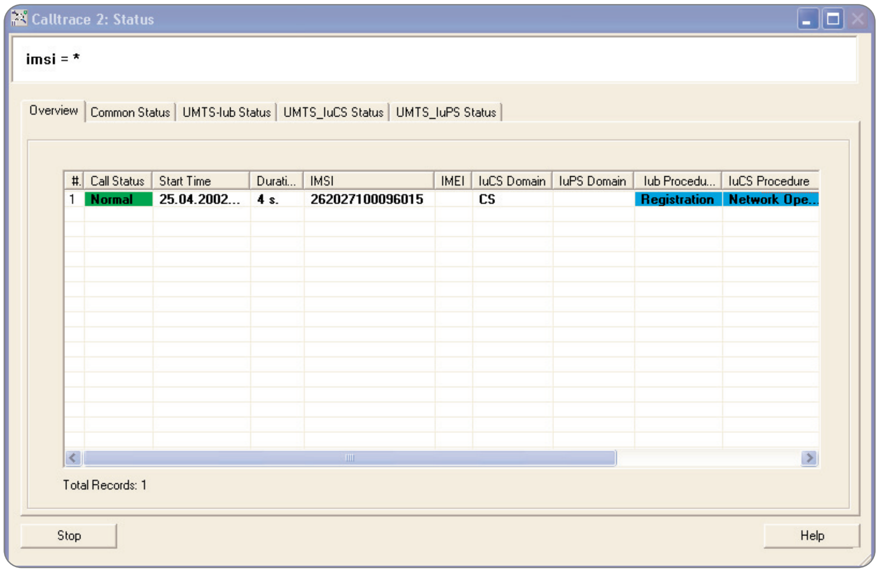
Using a sophisticated algorithm based on the correlation of key parameters contained in several protocol messages, the K15 features expert call trace software, which takes data from the Iub and the Iu-CS interfaces and automatically identifies and groups together all the transactions generated by the same subscriber. The information taken from these connections is evaluated in a side-by-side comparison. In a sense, the call data is acquired from many sources in a parallel fashion. This multi-interface analysis allows users to identify the interface and the network element responsible for the failure of a call placed by a specific subscriber.

Simply by entering the International Mobile Subscriber Identity (IMSI) of the subscriber, the technician at the monitoring site (the RNC) triggers the application, as shown in Figure 3.

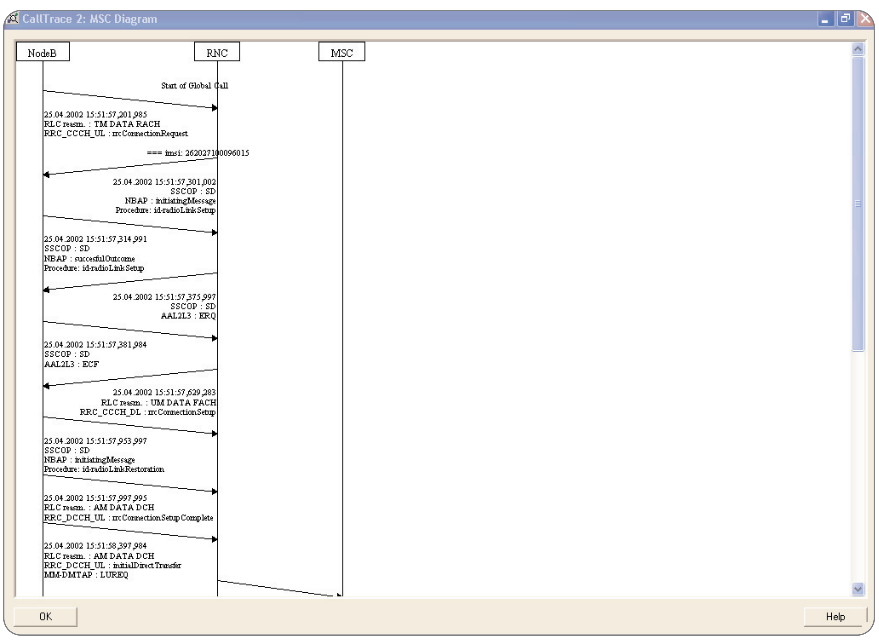
The IMSI is an individual identifier assigned to each mobile subscriber in a UMTS network.

Given the test caller's IMSI, the K15 begins to trace the call on the monitored interfaces.

The simultaneous multi-interface monitoring approach is a powerful troubleshooting aid. It enables users to see all of the possible error contributors at once. If, for example, a message is sent through the Iub interface to the RNC but is not observed passing through the Iu-CS interface (both can be viewed on the monitoring system), then the RNC is implicated as a source of problems. Multi-interface monitoring goes hand-in-hand with automatic configuration features. One connection at the Iub interface and one connection at the Iu-CS interface allow identification of the root cause of problems affecting subscriber transactions.



▶ ***Figure 4.*** *Real-Time display in Overview Window.*



▶ ***Figure 5.*** *Radio link setup.*

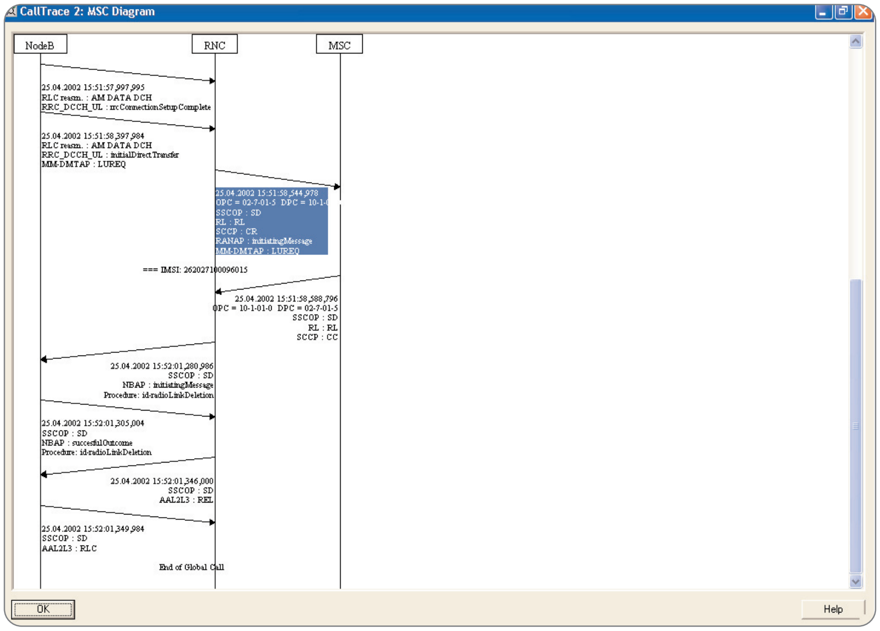
Finding the cause of the problem

As soon as they are detected, the procedures related to the test call are shown in real time within an overview window. See Figure 4.

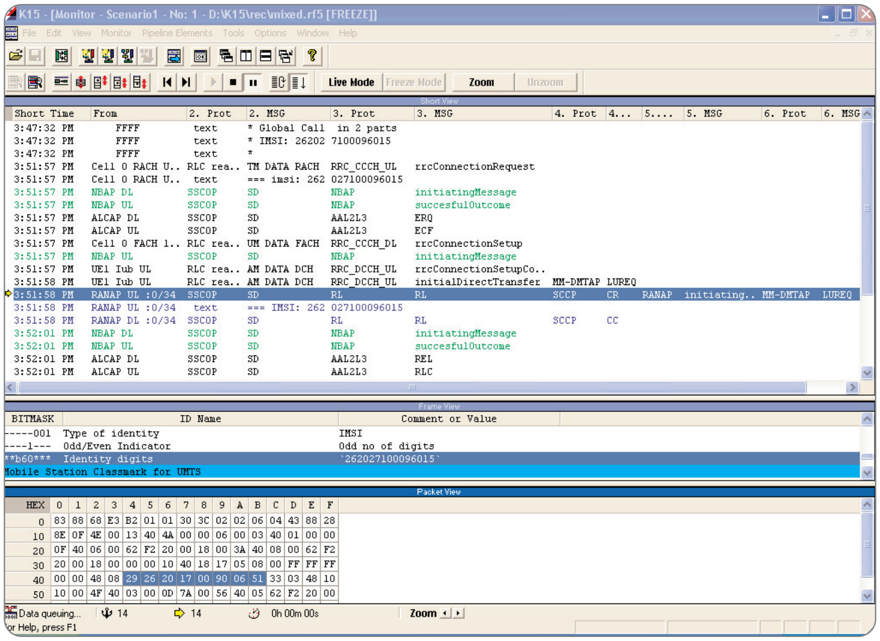
By clicking on each single line in the overview window a series of message sequence charts best explains the events that led to the customer complaint.

Figure 5 outlines the initial setup of the radio link. This is shown in simplified form, with only the messages that pertain to this discussion. All of the protocol activity in this step occurs between the Node B and the RNC; subsequent elements are not yet aware of the transaction.

The K15 captures information about the NBAP an ALCAP protocol exchanges, resolving activities for the Node B as a whole. Drilling down to the individual caller level, it can also gather data about the Random Access Channel RACH connection request, as well as the Dedicated Channel (DCH) uplink and downlink synchronization. Everything works as it should during this first instant of communication between the caller and the network.



▶ ***Figure 6.*** *Location Update Request is sent to the UMSC and HLR. RNC receives no response from the UMSC and cancels the call.*



▶ ***Figure 7.*** *K15 Monitoring Window.*

Figure 6 depicts the next round of protocol activity, which begins after the radio link between the mobile station and the Node B is set up. The Forward Access Channel (FACH) is assigned, and the mobile station submits a location update request (LUREQ) to the network via the Iub interface. As shown in the chart, this step succeeds. The LUREQ continues (after some processing) through the Iu-CS interface to the UMSC. So far, we have established that the Node B and the RNC are working correctly.

And then something happens to the LUREQ. The request does not receive a successful answer from the UMSC. Either the UMSC was blocked or the HLR that serves the network was not working correctly. The RNC de-allocates the radio layer (“RadiolinkDeletion”) and transport resources, and releases the other protocol entities as shown in Figure 7.

Further examination of the core network elements might reveal a malfunctioning UMSC or Home Location Register (HLR); in this case, the latter is more likely.

Conclusion

The technical nature of the problem is not the most important point here. What matters is that the protocol analyzer was able to trace the problem through multiple interfaces in minutes rather than hours – without interrupting mobile services. The tool's combination of multi-point connection, automated setup, and automated call tracing enabled the O&M engineers to correct the problem and document it for their quality control database.

The trouble ticket is resolved. From the subscriber perspective the operator has provided prompt, satisfactory service.

From the network operator's perspective, the time saved in resolving the trouble ticket is worth its weight in wireless revenues.

Glossary: UMTS Acronyms

ALCAP: Access Link Control Application Part

BCH: Broadcast Channel

CCCH: Common Control Channel

DCH: Dedicated Channel

EIR: Equipment Identification Register

FACH: Forward Access Channel

HLR: Home Location Register

IMSI: International Mobile Subscriber Identity

LUREQ: Location Update Request

LUP: Location Update

MCC: Mobile Country Code

MSIN: Mobile Station Identification Number

MNC: Mobile Network Code

NBAP: Node B Application Protocol

PVC: Permanent Virtual Circuit

RACH: Random Access Channel

RANAP: Radio Access Network Application Part

RNC: Radio Network Controller

UMSC: UMTS Mobile Switching Center

VCI: Virtual Circuit Identifier

VPI: Virtual Path Identifier

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