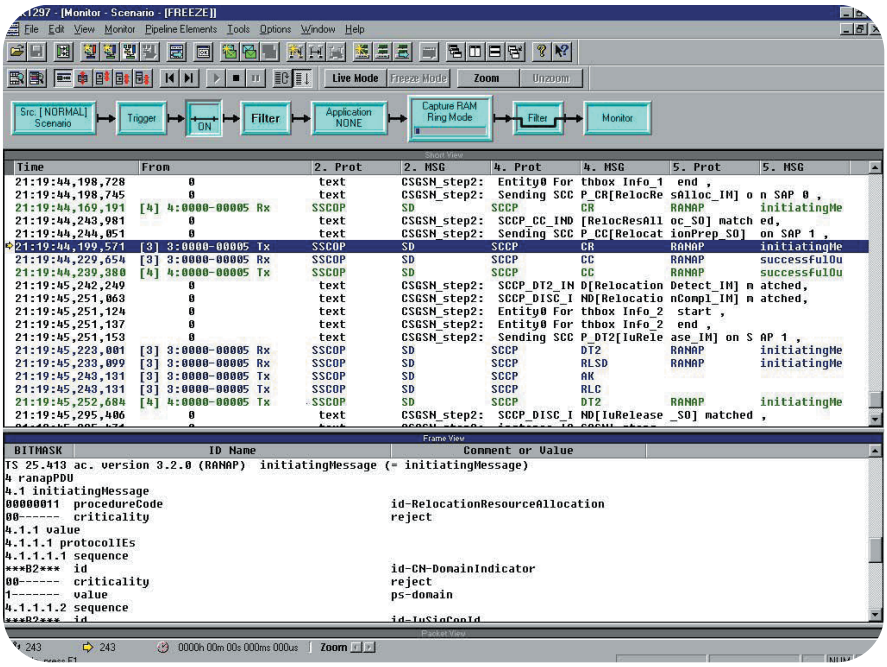
K1297-G20 Protocol Tester

▶ UMTS Software



UMTS Software

As the third-generation mobile standard, UMTS allows sophisticated services through the latest CDMA and network technologies. Extensive simulation and monitoring test tools are required more than ever, due to the advances and complexity of developing, deploying and operating these mobile networks. As a leader in the mobile measurement business, Tektronix offers solutions to meet Protocol Test challenges. Software for the K1297-G20 Protocol Tester supports functional tests in UMTS R99, R4, R5 and R6 system development and system tests for system integration. Monitoring, Simulation, and Emulation functions are provided for relevant UMTS signaling protocols and user plane protocols. Solutions are available for the most challenging test functions such as PER encoded RANAP, NBAP and RNSAP protocols.

UMTS Iu, Iub and Iur test software allows the RNC or CN at both sides of Iu interfaces, as well as RNC and Node B, to be simulated and tested. The software enables telecommunication equipment manufacturers to verify the software implementation of the RNC, CN and Node B, ensures product development quality, minimizes development time and reduces the risks for UMTS projects. Continuous protocol version upgrades are made available in order to comply with the latest 3GPP specifications. For fast trouble ticket resolution the K1297-G20 base SW offers Single-Interface Calltrace for Iub, Iu-CS and Iu-PS interfaces. A Calltrace captures all relevant messages on one interface related to a certain subscriber or to a certain transaction. A mobile operator may be interested in singling out all transactions related to a certain network problem, like congestion or temporary failures.

▶ Features & Benefits

Monitoring and Simulation/ Emulation of Signaling Protocols at the Iu, Iub, Iur, Iu-BC, Iu-PC, Nb, Mc, and Nc Interfaces Ensure Quality Implementation of Protocol Definition and Behavior

Powerful Tools for Development and Test of UMTS Network Elements Allow Earlier and Cost Effective Availability of Adjacent Network Node Functions

Simultaneous Handling of AAL2 and AAL5 Virtual Channels Allows Simultaneous Testing of Control and User Plane Protocols

More than 1800 Protocols and Variants According to 3GPP R99, R4, R5 and R6

Vendor Specific Protocol Decoding (Nortel, Nokia)

Call Generation for MOC (Mobile Originated Calls) and MTC (Mobile Terminated Calls)

Handover Tests (3G-3G HO, 3G-2G HO) and Location Service Test Capabilities

Data Generation of IP Traffic Enables QoS and End-to-End Tests

Test Scenarios with AMR Coded Voice

Supports Interface Boards ATM E1/DS1 (Rx/Tx and Rx/Rx) and ATM STM1/SONET OC3 Optical (Rx/Tx and Rx/Rx) to Cover the Needs of UMTS Networks

Seamless Access to PCM Lines Using IMA (Inverse Multiplexing Over ATM) and Fractional ATM

Test Solution for TDD LCR (Time Division Duplex, Low Chip Rate) R4

▶ Applications

Functional Testing of Protocol Implementations

System Testing of Network Nodes

Simulation of RNC, CN (SGSN/MSC), Media Gateway Controller, Media Gateway and Node B

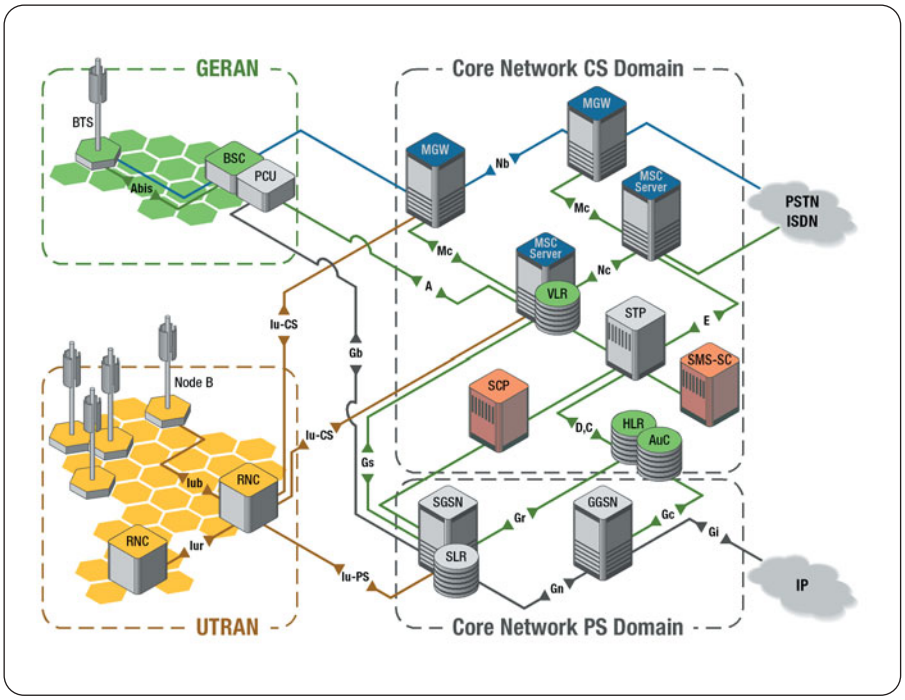
All-IP UTRAN Test Application

Calltrace for Iub, Iu-CS and Iu-PS

Iub Deciphering

Iu-PS Capacity Tests

Tektronix
Enabling Innovation



▶ ***Figure 1:*** UMTS reference model.

The software packages support the following test functions (selection):

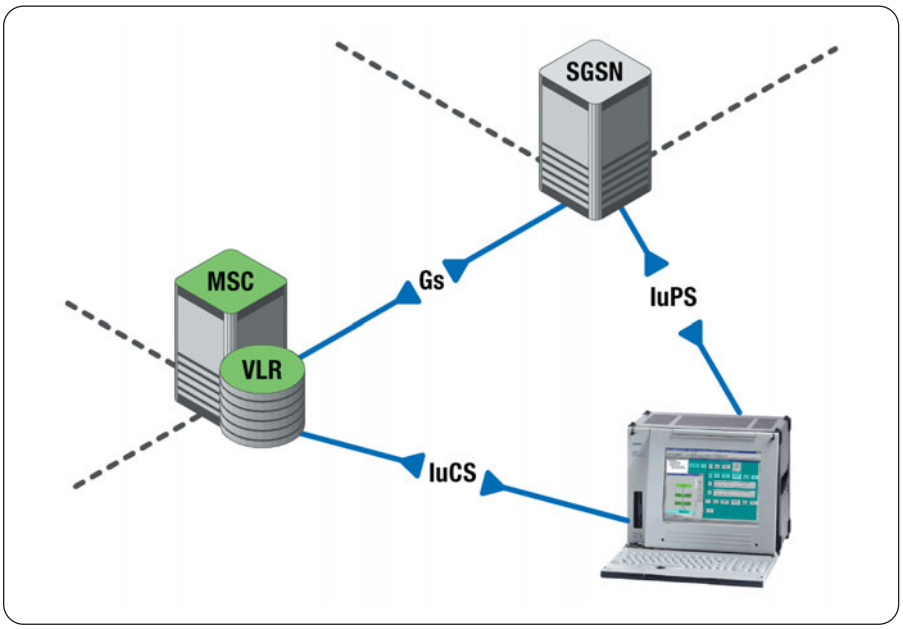
- Monitoring and simulation of Iu UP (TS25.415)
- Monitoring and simulation of Iub FP (TS25.427, TS25.435)
- Monitoring and simulation of MAC (TS25.321)
- Monitoring and simulation of RLC (TS25.322)
- Monitoring and simulation of RANAP (TS25.413)
- Monitoring and simulation of NBAP (TS25.433)
- Monitoring and simulation of RNSAP (TS25.423)
- Monitoring and simulation of SABP (TS25.419)
- Monitoring and simulation of RRC (TS25.331)
- Monitoring and simulation of MM/CC/RR/GPRSMM/SM (TS24.008)
- Monitoring and simulation of SMS (TS23.040, TS24.011)
- Monitoring and simulation of BMC (TS25.324)
- Monitoring and simulation of PCAP (TS25.453)
- Monitoring and simulation of Supplementary Services (TS24.080)
- Monitoring, simulation and emulation of M3UA and SCTP
- Monitoring, simulation, and emulation of ALCAP (Q.2630.1, Q.2630.2, and Q.2150.1/2)
- Monitoring, simulation and emulation of GTP (TS29.060)
- Monitoring, simulation and emulation of PDCP (TS 25.323)
- Monitoring and simulation of BICC
- Monitoring and emulation of RTP/RTCP
- Send and receive speech on interfaces such as UMTS Iu. Iub, Nb, GSM A, and PSTN
- Emulation of IPv6
- Mobile originated call generation for circuit and packet switched calls by simulating RNC or CN at the Iu interface
- IP packet generator and comparator on top of GTP-emulation

UMTS Reference Model

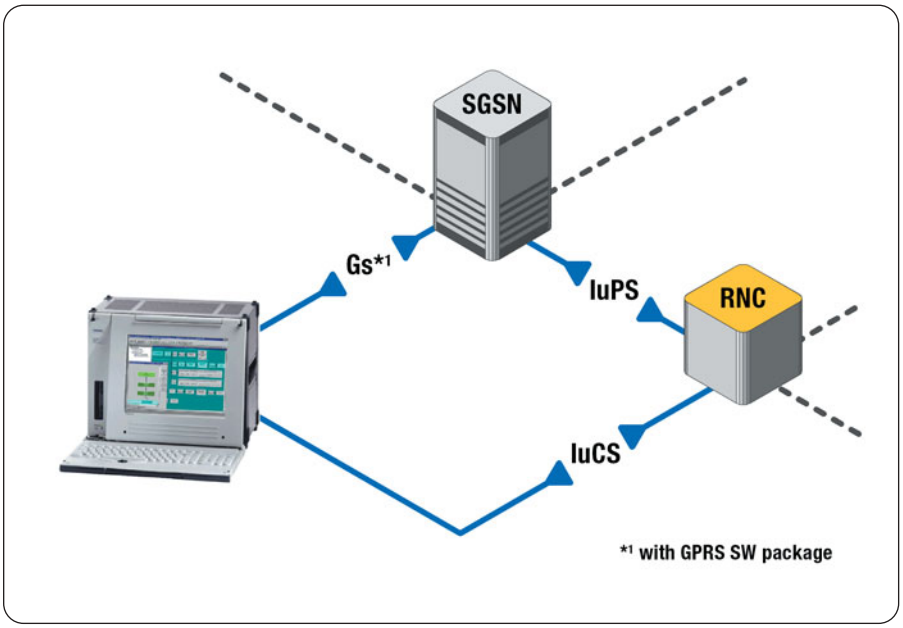
UMTS architecture can be seen as the next step beyond the 2G and 2.5G technologies (GSM and GPRS). Thus, UMTS will not replace these technologies and their network elements, but will extend the network architecture. UMTS R99 introduced new network elements, such as the Radio Network Controller (RNC) and Node B, as shown in Figure 1. These two new network elements will form three new UMTS specific interfaces:

- The Iu interface between RNC and MSC/SGSN, with the Circuit Switched (CS) and Packet Switched (PS) part
- The Iub interface between RNC and Node B
- The Iur interface between RNCs

UMTS R4 introduced new network elements such as the MSC Server and the Media Gateway (MGW), as well as new interfaces Nc, Nb and Mc, as shown in Figure 1. In addition, new functionalities have been added to already existing UMTS/GPRS protocols.



▶ ***Figure 2:*** K1297-G20 simulating a Radio Network Controller (RNC).



▶ ***Figure 3:*** K1297-G20 simulating a MSC towards RNC and SGSN.

These new elements, the interfaces between them and the great number of new protocols create a huge demand for test applications. Examples of test configurations that can be handled with the K1297-G20 UMTS solution are described below.

UMTS R5 introduced an All-IP architecture, end-to-end support for VoIP, the Stand-alone A-GPS SMLC (SAS) and new features (e.g. HSDPA) that will enable new services and reduce operating cost. The Iu-PC interface connects the SAS with the RNC. Further, support of the TD-SCDMA technology has been included in UMTS R5.

Figure 2 shows a K1297-G20, which simulates the RNC network element towards the MSC and SGSN. Depending on the test purpose, the protocol layer will be simulated or emulated. The message flow for the protocol to be simulated is usually defined in a simple way with the Message Sequence Chart (MSC) Tool offered by the K1297-G20 Base Software. Emulations, which behave according to the standards, are used for all layers below the simulated protocol layer.

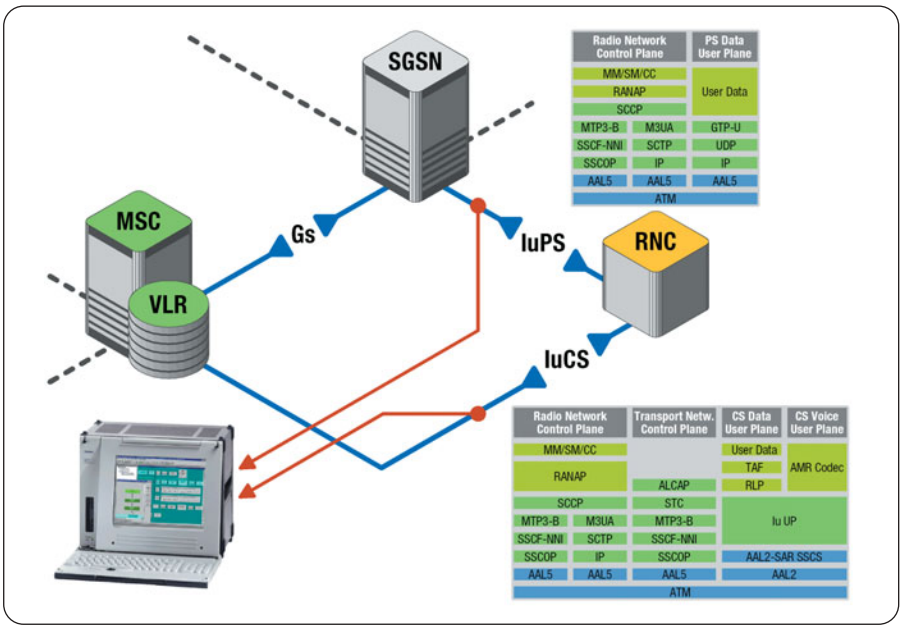
In Figure 3, the K1297-G20 simulates a MSC towards the SGSN and the RNC. This configuration requires the appropriate GPRS packages for G_s interface simulation. Applications, such as the Call Generator, help to test the basic call handling.

Monitoring UMTS interfaces adds additional test challenges. As the physical layer is often optical in nature (e.g., STM1 optical) it is not possible to hook the unit to an interface without disconnecting the lines between the network nodes unless there are special monitoring points. In addition, an optical coupler (each direction) may be necessary to allow passive monitoring. The K1297-G20 in Figure 4 monitors the complete Iu interface (Iu-CS and Iu-PS) at the same time.
Figure 5 shows a K1297-G20 monitoring the Iub and the Iur interface.

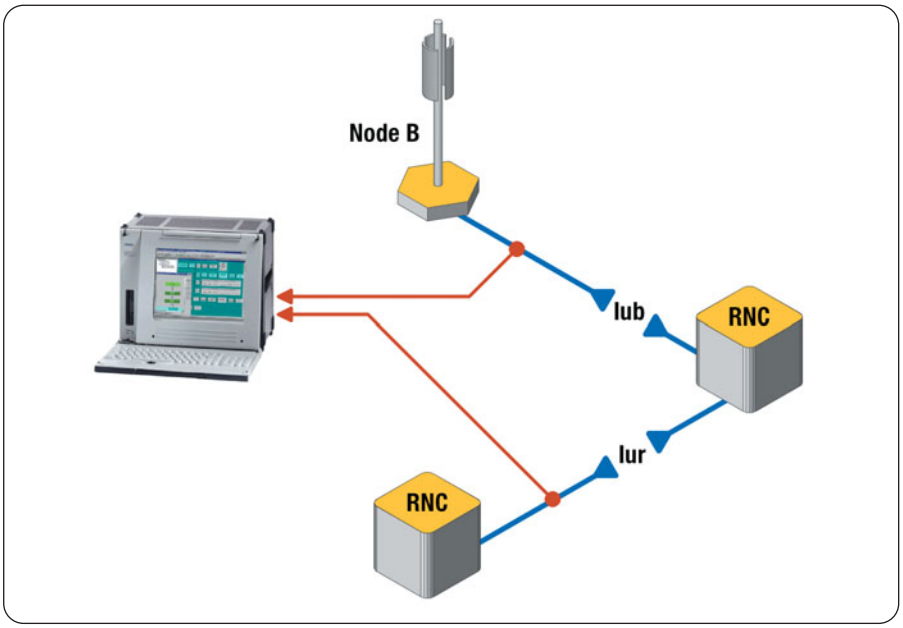
Iu-PS Capacity Tests

The SGSN in the UMTS core network is tested from both the Gi and IuPS interface by the test unit. The test unit emulates many RNCs supporting multiple UEs at IuPS. The UEs and RNCs are modeled as performing real world mobile procedures, like:

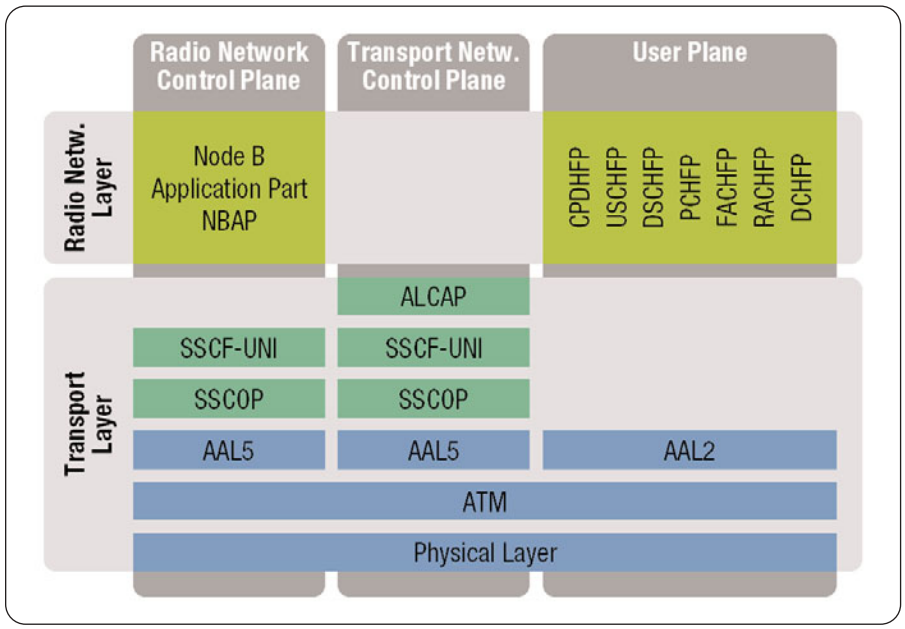
- Attach
- Detach
- PDP Context Activation
- PDP Context Deactivation
- PDP Context Modification
- Intra/Inter-SGSN RAU with simultaneous data transmission
- PTMSI Reallocation
- Paging PS
- Uplink/Downlink Data Send
- Uplink/Downlink Data Receive
- SMS Send
- SMS Receive



▶ ***Figure 4:*** K1297-G20 monitoring the Iu interface.



▶ ***Figure 5:*** K1297-G20 monitoring of Iub and Iur interface.



▶ ***Figure 6:*** lub interface protocol structure.

A K1297-G20 with one AP-4/ATM-Board is able to simulate up to 100.000 mobile subscribers. Testing the SGSN at the Gi interface is valuable because:

- ▶ It allows for sending of traffic in both directions better simulating real world up-link and down-link traffic
- ▶ Gathering payload metrics at Gi allows for analysis of the SGSN's performance in processing user plane traffic generated at IuPS
- ▶ These metrics can include total packet, good packet, lost packet and bad packet counts
- ▶ Down link traffic can be generated at Gi to test the SGSN's user plane in the reverse direction

For more detailed information refer to the Iu-PS Capacity Test Application Note 2FW-17575-0.

Dynamic allocation of AAL2 links with a K1297-G20 on the Iub interface.

The Iub interface protocol architecture consists of two functional layers, as shown in Figure 6:

- ▶ The radio network layer defines procedures related to the operation of Node B. It consists of a radio network control plane and a radio network user plane
- ▶ The transport layer defines procedures for establishing physical connections between Node B and the RNC

In order to decode the dynamically opened Signaling Radio Bearers (Signaling RABs) from and towards the User Equipment (UE), the signaling on Iub Control Plane (NBAP) and Transport Network Control Plane (ALCAP) must be traced.
Each connected Node B requires configuring at least one pair of NBAP and ALCAP links.
An appropriate application analyzes this signaling and opens the appropriate Common and Dedicated Control Channel.
One Node B serves a certain number of cells. For each cell there is a complete set of Common Control Channels, such as PCCH, BCCH and CCCH. These channels are called Logical Channels. See Figure 7.

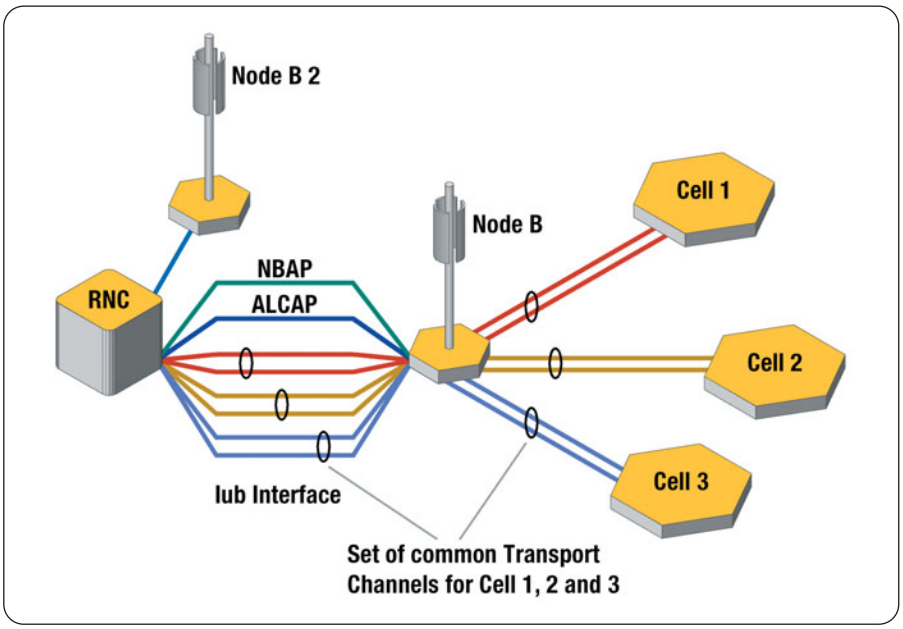
Iub Deciphering

Ciphering in UMTS is performed between UE and RNC over Air and Iub-Interface. For the structure of the Iub protocol stack refer to Figure 8.

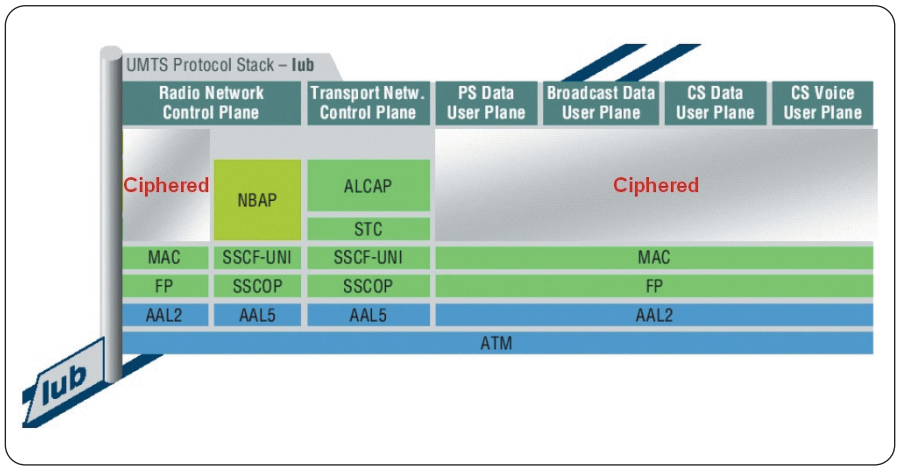
The ciphering function is performed either in the RLC sublayer or in the MAC sublayer, according to the following rules:

- If a radio bearer is using a non-transparent RLC Mode (AM, UM), ciphering is performed in the RLC sublayer
- If a radio bearer is using the transparent RLC Mode (TM), ciphering is performed in the MAC sublayer (MAC-d entity)

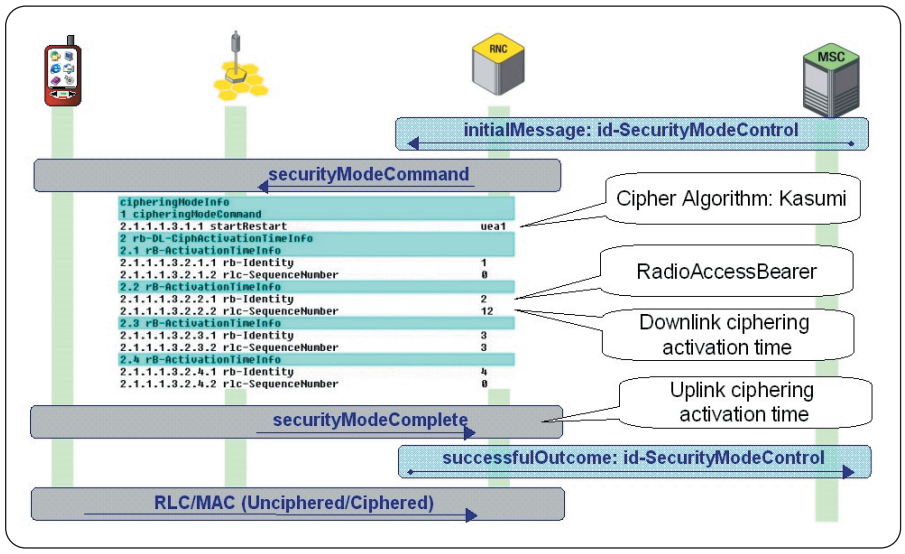
In effect, if a protocol tester without Deciphering application is used on Iub-Interface and Ciphering is activated, all RRC messages and above plus all User Data cannot be decoded anymore.



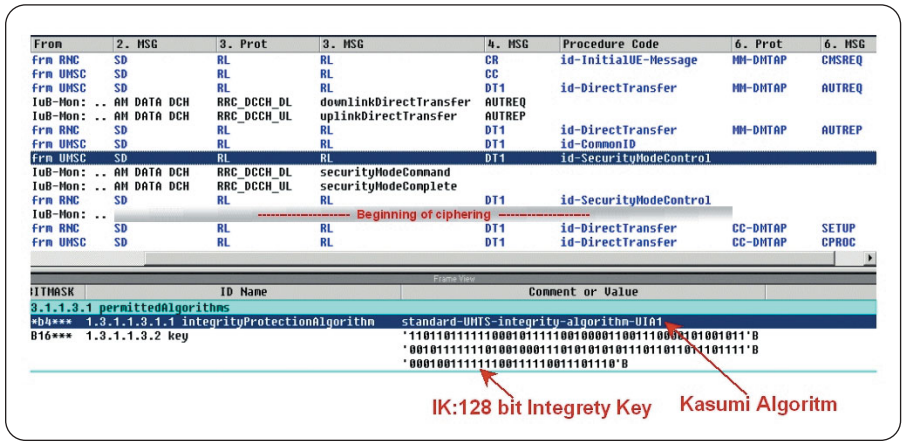
▶ ***Figure 7:*** Set of common transport channels.



▶ ***Figure 8:*** Iub protocol stack with Ciphering.



▶ ***Figure 9:*** Ciphering activation.



▶ ***Figure 10:*** Ciphering authentication and key agreement.

Ciphering will be activated after exchange of securityModeCommand and securityModeComplete (see Figure 9). The deciphering application of the K1297-G20 works in automatic and manual mode. In order to capture the ciphering key CK in automatic mode, access to the Iu Interface is required. The manual mode is designed for test labs that are able to manipulate the ciphering key CK. For this use case no access to the Iu-Interface is necessary. The Iub Deciphering application will trace up to 1000 (automatic mode) or 50 (manual mode) different connections on Iu- and Iub-Interfaces.

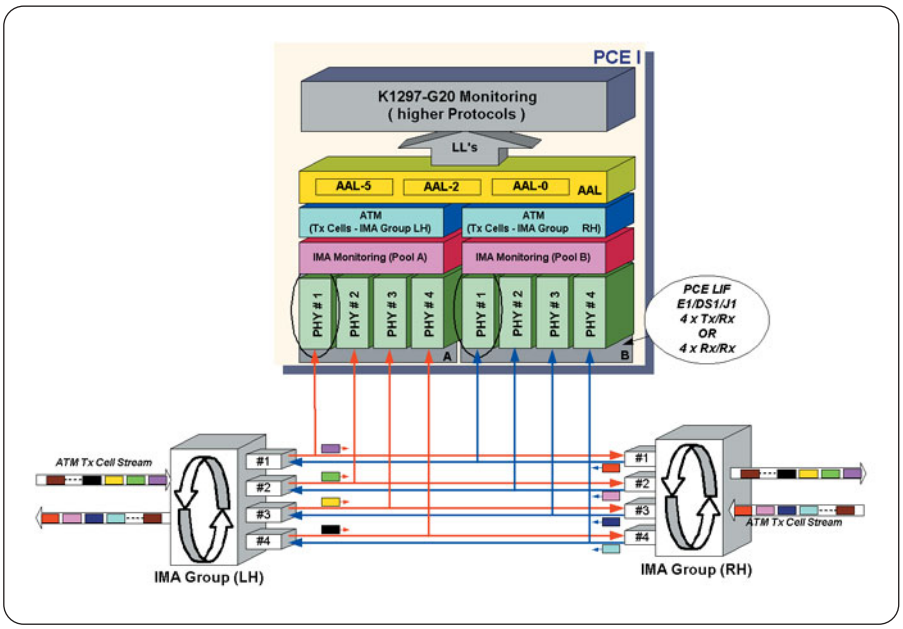
The recording shown in Figure 10 shows an authentication and call setup procedure (MOC) on Iu- (blue color) and Iub-Interface (black color). All NAS-messages after the security procedure are encrypted on Iub-Interface. Therefore without deciphering application, the SETUP, CPROG messages are decoded on Iu-Interface, but not on Iub-Interface anymore.

The K1297-G20 deciphering application works in online and offline mode and also tracks complex procedures, like Softer-Handover and Channel Type Switching.

Seamless Access to IMA

The requirements for higher bandwidth and the need to reduce investments in mobile radio network infrastructure were the driving factors for the definition of IMA. The standard was defined in the late 1990s by the ATM Forum and describes how to use links with lower bandwidth (such as E1 and DS1) to form a "virtual" link with higher bandwidth.

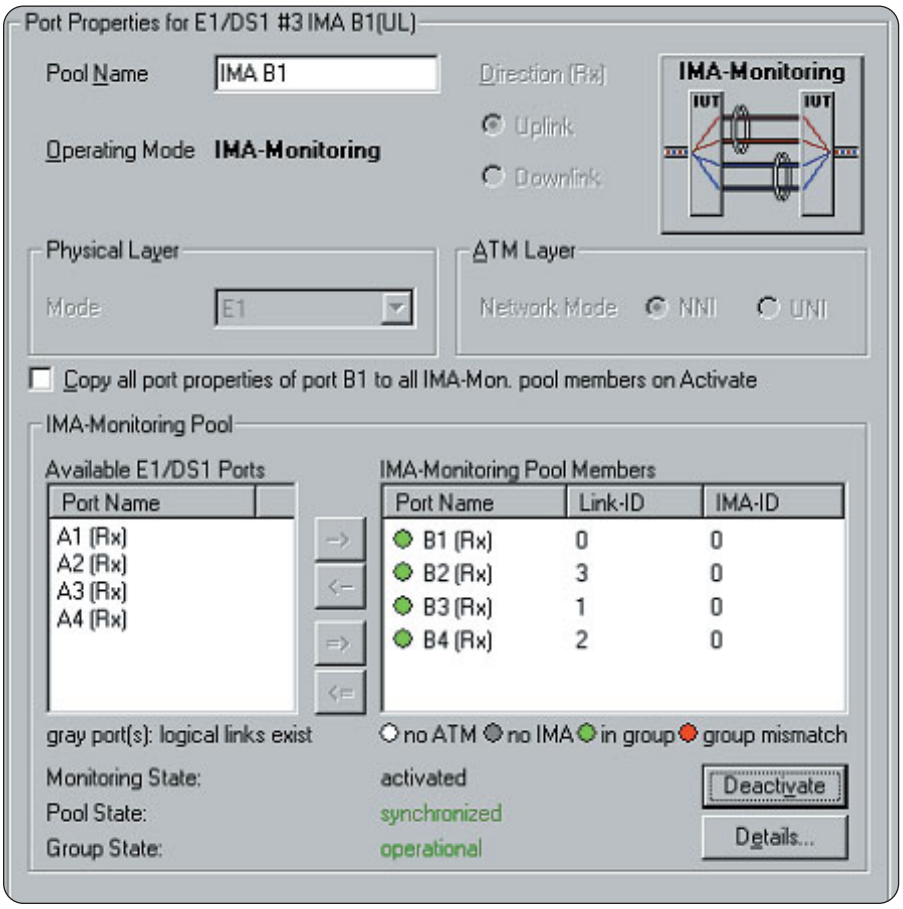
In order to save costs during the early years of 3G network deployment, operators will try and re-use as much infrastructure from existing networks as possible by using this IMA technology. Using this technology successfully requires a tool for non-intrusive monitoring, which examines all lines without utilizing additional test equipment. By combining innate protocol monitoring for the lub interface with seamless access to IMA links, Tektronix' innovative new IMA monitoring software enables users to perform upper-layer protocol analysis in addition to retrieving information (statistics, alarms, etc.) from the lower-layer IMA links. While most IMA monitoring tools actually interrupt physical lines carrying active network traffic (cutting off traffic on the link while the connection is being made), the new IMA solution is the only one to monitor passively.



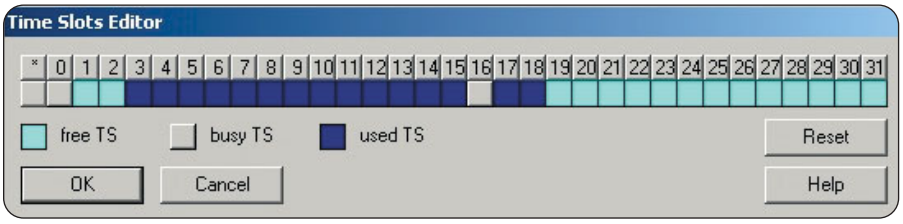
▶ ***Figure 11:*** G20 System Concept for passive IMA Monitoring.

Connection to the E1/DS1 lines of interest (those using IMA) is possible at any time without affecting live traffic. There is no need to disconnect or re-start the links being monitored. Tektronix' IMA software automatically determines whether the links that make up an IMA group are correctly connected. Links that do not belong in the group are revealed in real time. This automation dramatically simplifies the task of connecting E1/DS1 cables and reduces the risk of incorrect connections. See Figure 12.

As soon as all cables are correctly connected to the PCM lines and the configuration is set up (IMA Pool is operational) all the higher protocol layers are decoded "as usual". Applications like lub-Monitoring work as expected. In case of IMA state changes (e.g. add/remove of an IMA link), these events will be displayed as layer 1 alarms in the recording file. Furthermore there are dozens of IMA specific counters that allow a detailed analysis of the IMA protocol states.



▶ ***Figure 12:*** An IMA Pool is correctly configured and the IMA Group is operational.



▶ ***Figure 13.*** Fractional ATM time slot editor.

Fractional ATM

Fractional ATM is a technology that allows Network Operators to minimize their infrastructure costs, especially during the UMTS deployment phase when the network load is low. The UMTS UTRAN and the GSM BSS share the same physical medium and exchange User and Control information over this medium with the Core Network. The K1297-G20 time slot editor (See Figure 13) allows the assignment of an ATM Fraction in any combination. This ATM section forms the monitoring part for the UMTS Iub-Interface. The remaining time slots can be used for conventional PCM-30 monitoring, e.g., for GPRS/GSM A-Interface monitoring. Fractional ATM is part of the K1297-G20 Base SW. It supports E1 and T1 connections.

▸ Ordering Information

Please refer to the new combined platform product summary for further information. Please note that in addition to the following ordering numbers upgrades are also available.

UMTS Bundling

7KK1269-6UM11 – UTRAN Monitor K1297-G20 with basic SW and Monitoring SW bundle for Iu, Iub, and Iur.

7KK1221-6SU11 – K1297-G20 SW Bundle Mon UMTS; (Iu-CS, Iu-PS, Iub, Iur); Prerequisite: Current System Version (7KK1220-0SCxx).

7KK1221-6SV11 – K1297-G20 SW Bundle Mon Mobile; (GSM, GPRS, and UMTS); Prerequisite: Current System Version (7KK1220-0SCxx).

UMTS Application

7PK1221-6UJ11 – IMA Monitoring Package.

7PK1221-6WF11 – UMTS Iub Deciphering Package.

7KK1223-5UZ11 – UMTS Iu-PS Capacity Test Extension Package.

UMTS Monitoring/Simulation/ Emulation Protocol Packages for K1297-G20

7PK1221-7UN11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Package; Iu-BC: SABP (TS25.419); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TP11.

7PK1221-7MS11 – K1297-G20 Protocol SW Mon/Sim/Emu Mobile SMS Package; SMS (TS 24.011, TS23.040, GSM 03.40, GSM 04.11 and IS637 CDMA); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7MG11 or -7MC11 or -7MM11 or -7GB11 or -7UZ11.

7PK1221-7UE11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iub/Iur User Plane Package; BMC (TS25.324); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TA.

7PK1221-7UL11 – K1297-G20 Protocol SW Mon/Sim UMTS Iu PC Package; PCAP (Positioning Calculation Application Part, TS 25.453); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TC.

7PK1221-7UQ11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Package; Supplementary Services (TS24.080); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7UY11.

7PK1221-7UR11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Package; RRC (TS25.331); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TA11.

7PK1221-7UT11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iu, Iub, Iur Package; AAL2 Layer 3 (Q.2630.1), STC (Q.2150.1, Q.2150.2); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TB11.

7PK1221-7UU11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iub/Iur User Plane Package; PDCP (TS25.323); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TA11.

7PK1221-7UV11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iub Package; NBAP (TS25.433); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TB11.

7PK1221-7UW11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iur Package; RNSAP (TS25.423); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TC11.

7PK1221-7UX11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iu CS User Plane Package; Iu UP (TS25.415); Prerequisite: Current System Version (7KK1220-0SCxx) and 7KK1220-0SL and 7PK1221-7UT.

7PK1221-7UY11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Package; Iu, Iub, Iur Control Plane: MM/CC/SM/GMM/RR (TS24.008); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7UZ11 or 7PK1221-7UR11.

7PK1221-7UZ11 – K1297-G20 Protocol SW Mon/Sim/Emu UMTS Iu-CS/PS Control Plane Package; RANAP (TS25.413); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TC11.

7PK1221-7GN11 – K1297-G20 Protocol SW Mon/Sim/Emu 2.5G and 3G Mobile G_n, G_p, G_a, Iu-PS Package; GTP (GSM09.60; TS29.060); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TP11.

7KK1226-9GA11 – K1297-G20 Traffic Generation 2.5G and 3G Mobile G_n, G_b, G_n, Iu-PS; IP Packet generator and comparator; IP-Gate; Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TP11.

7KK1226-9GJ11 – K1297-G20 Traffic Generation 2.5G and 3G Mobile G_n, G_b, G_n, Iu-PS; IPv6 Packet generator and comparator; IPv6-Gate; Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TP11.

7PK1221-7MP11 – K1297-G20 Protocol SW Mon/Sim/Emu 2G, 2.5G and 3G Mobile CAP Package; incl. CAP Phase III (TS29.078); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TC11.

7PK1221-7GX11 – K1297-G20 Protocol SW Mon/Sim/Emu GPRS Gb-IP Package; incl. NS (3GPP TS 48.016); Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7GB11.

7KK1225-7ND11 – K1297-G20 Manufacturer's Specifications Protocol Mon/Sim/Emu Iub; DATANG specific NBAP (TS25.433), NBAP/SIB, RRC; Prereq.: Current System Version (7KK1220-0SCxx) and 7PK1221-7TB.

IP Monitoring/Simulation/ Emulation Protocol Packages for K1297-G20

7PK1221-7JS11– K1297-G20 Protocol SW Mon/Sim/Emu IPS7 Package; M3UA, SCTP; Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TP11.

Transport Monitoring/ Simulation/Emulation Protocol Packages for K1297-G20

7PK1221-7TA11 – K1297-G20 Protocol SW Mon/Sim/Emu Transport ATM AAL2 Package; UP FP (TS25.427, TS25.435), MAC (TS25.321), RLC (TS25.322); Prerequisite: Current System Version (7KK1220-0SCxx) and ATM HW: 7KK1200-3Cxxx, ≥8 links license.

7PK1221-7TB11 – K1297-G20 Protocol SW Mon/Sim/Emu Transport Broadband Package; incl. SSCOP (Q.2110), SSCF-UNI (Q.2130), SSCF-NNI (Q.2140), MTPL3b (Q.2210); Prerequisite: Current System Version (7KK1220-0SCxx) and ATM hardware; ≥8 link license.

7PK1221-7TC11 – K1297-G20 Protocol SW Mon/Sim/Emu Transport SCCP Package; incl. SCCP/SCMG; TCAP; OMAP; Prerequisite: Current System Version (7KK1220-0SCxx) and 7PK1221-7TN11 or 7PK1221-7TB11 or 7PK1221-7JS11.

7PK1221-7TP11 – K1297-G20 Protocol SW Mon/Sim/Emu Transport Packet Data Package; incl. X.25, LAP B, FR, IPv4, ARP/RARP, TCP and UDP, ICMP, IEEE802.3 MAC; Prerequisite: Current System Version (7KK1220-0SCxx) and Ethernet or ATM or PRIME Board.

7PK1221-7TJ11 – K1297-G20 Protocol SW Emu Transport Packet Data Package; incl. IPv6, ICMP (RFC2461, 2462, 2463); Prerequisite: Current System Version (7KK1220-0SCxx) and 7KK1221-7TP and Ethernet or ATM or PRIME Board.

K1297-G20 Protocol Tester

▶ UMTS Software

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Last Update March 01, 2004

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07/04 HB/WWW 2FW-15356-6

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