Application Note

In-service analysis of SDH signals

CMA 3000

TABLE OF CONTENTS

Introduction

Today network operators are faced with many challenges. Above all, they need to be profitable in a market characterized by increased competition, decreased ARPU and significant churn. Therefore it’s vital for operators to ensure peak performance of their network in order to maximize network investments.

Using in-service analysis of the traffic carried in the network will provide operators with the best possible information on the current state of the network as experienced by their customers. However, as traffic by nature is bi-directional the analysis should include both traffic being sent from A to B, as well as the responding traffic.

Large parts of the network are based on SDH technology. This in turn demands of operators to use tools with bi-directional capabilities for SDH for the in-service traffic analysis.

CMA 3000 is Anritsu’s next-generation portable, compact and user-friendly field tester. It's designed specifically for field technicians who install and maintain mobile-access and fixed-access networks, transmission networks and switching.

As CMA 3000 can be equipped with two receivers at all the supported interfaces, including SDH it’s an obvious choice for in-service, bi-directional analysis of the traffic.

1.0 Access for bi-directional analysis

To connect to an SDH line for in-service analysis you require a connection in parallel with the SDH line. There are several methods: Protected monitoring points may be available for electrical interfaces, or in some cases the SDH network elements can be configured to present signals to monitor dedicated access points.

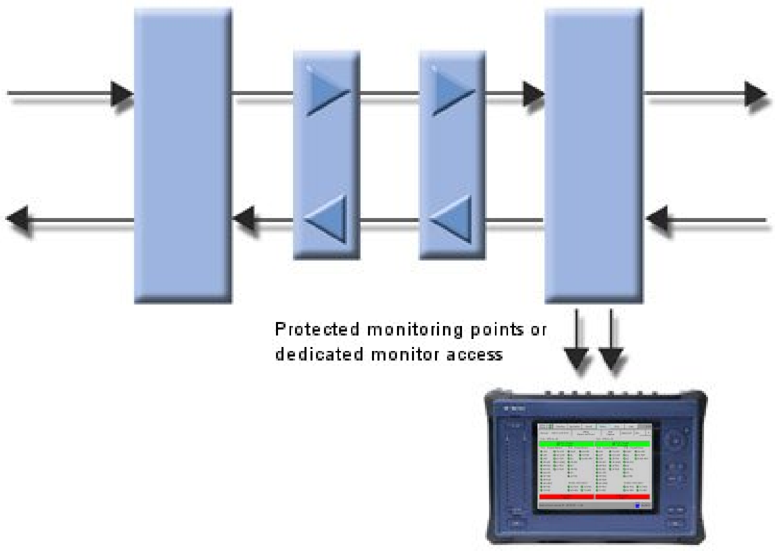

Figure 1 Bi-directional access for in-service analysis.

In case dedicated access points are not available for SDH signals on optical lines you have two other access methods available, either optical splitters or the through mode of the instrument.

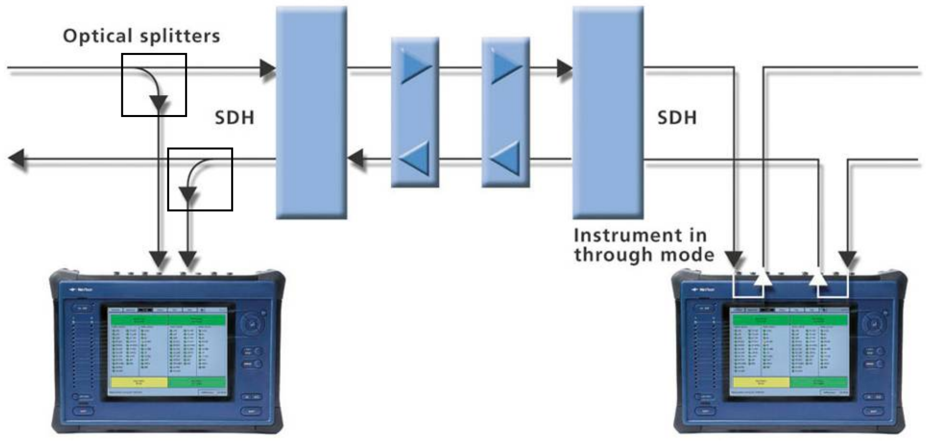

Figure 2 Optical splitters and through mode for in-service analysis access.

The access methods have various benefits and disadvantages:

- **Dedicated access points can be established without disrupting the signal to be monitored, but will typically require that the highest level of the SDH signal (the section overhead) is regenerated and therefore does not directly reflect what's on the monitored line**
- **Optical splitters and protected monitoring points (for electrical signals) require the signal to disrupt in case they have not already been installed already. Once established they represent a more direct view of what's happening on the monitored line compared to dedicated access points. Signal level will be reduced due to the nature of the access type. They may be left on the line after a specific measurement has been done for future investigations**

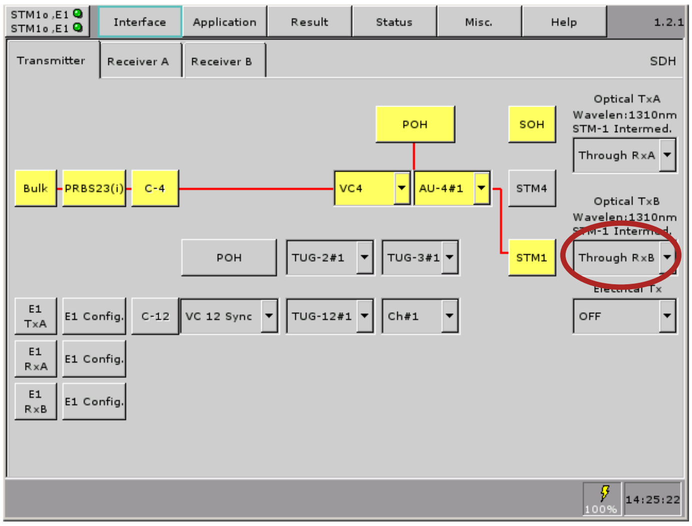

Figure 3 Setting the optical transmitters of the CMA 3000 for through-mode.

- **Utilizing the CMA 3000 through-mode feature for the access enables you to get the largest amount of information on the monitored line. However, in this case it's necessary to disrupt the signal when the instrument is set up and removed again**

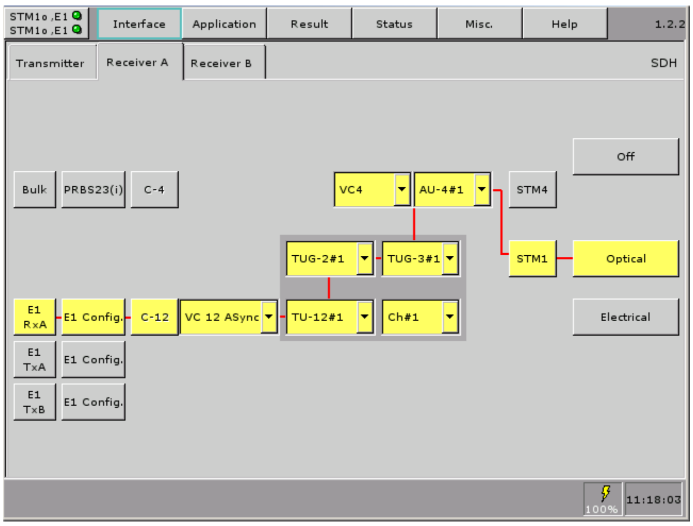

Figure 4 Setting one of the CMA 3000 optical receivers.

2.0 Results of bi-directional analysis

The advantage of the bi-directional analysis is that information of both sides of a communication line is immediately available.

In case the instrument is connected in through-mode you can immediately inspect a number of basic parameters of the monitored signal, such as:

- **The optical level, which has to be in a range acceptable by the optical receiver in the network element. Color indications in the instrument will highlight optical levels outside specifications**
- **The frequency of the SDH signal and more importantly, any frequency difference between the two receivers. Within a normal SDH network the two lines should be synchronized to the same frequency reference. Therefore, any difference indicates an anomaly that could lead to a degradation of the transmission performance**
- **As shown in the example, frequency difference information is also available for 2 Mbps signals embedded in the SDH signal. Also, PDH signals are normally synchronized to the same frequency reference and therefore, there should be no frequency difference between the two embedded 2 Mbps signals. A frequency difference will typically result in transmission performance degradation in the form of bit slips**

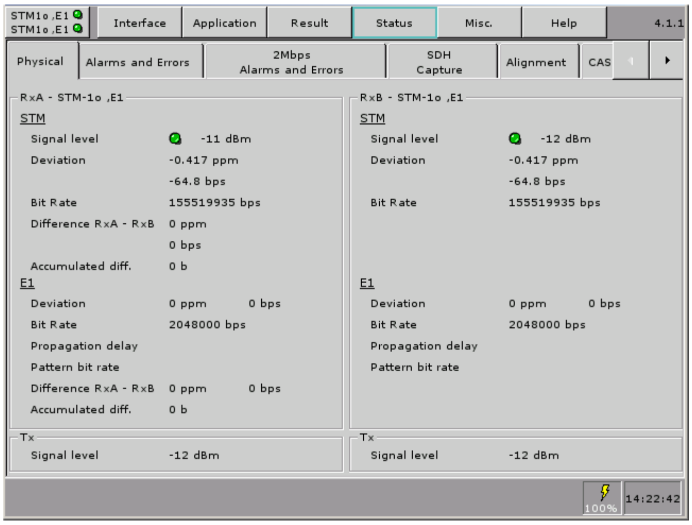

Figure 5 Physical level information in through-mode.

Bi-directional analysis also enhances the level of information you can obtain from the SDH maintenance information. The SDH signal is divided into levels: The section level, the higher order path level and the lower order path level. If a crucial condition (disrupting the traffic) occurs on one of these levels, this is signaled onwards by issuing an SDH maintenance signal: “Alarm Indication Signal” (AIS) while a “Remote Defect Indication” (RDI) is signaled on the line going back to inform the transmitter of the signal that it was lost on the way.

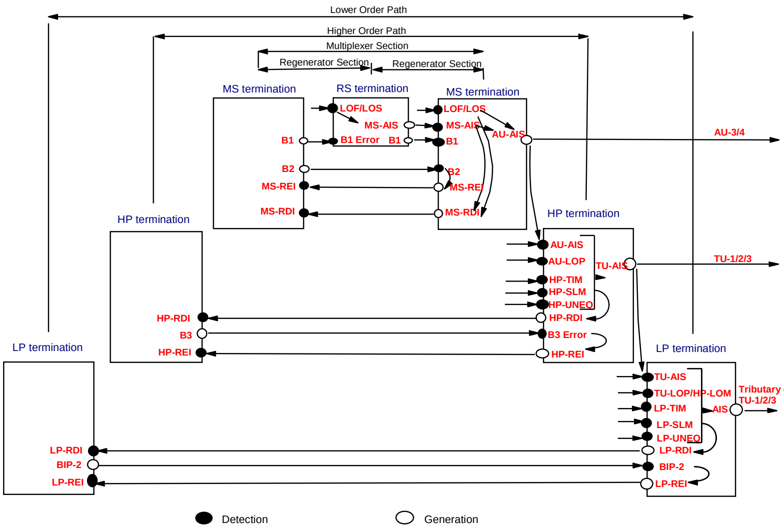

Figure 6 Interaction between SDH maintenance signals.

Likewise there are check sums at each level to detect transmission errors. In case of errors this is signaled back to the transmitter of the signal with a “Remote Error Indication” (REI). The diagram in Figure 6 shows the interaction between the SDH maintenance signals.

When you identify one of these remote indications on one side of the line during simultaneous monitoring of both sides of the line, you can immediately inspect the other side of the line for errors or major defects. If there are no errors on the other side the problem has occurred further down the line while a faulty signal implies that the signal has been distorted on the way to the point where you have connected the measurement instrument.

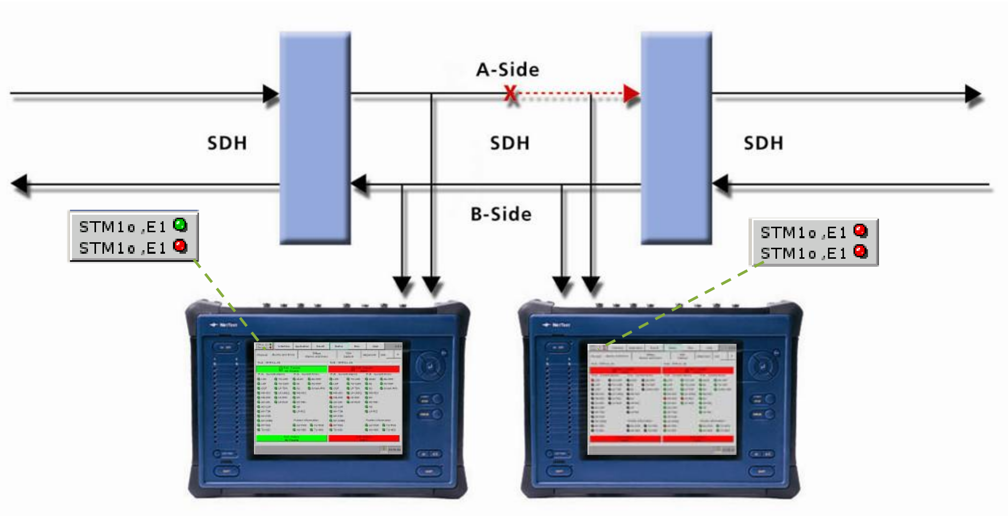

Figure 7 The CMA 3000 bi-directional in-service monitoring provides easy fault detection.

3.0 Bi-directional analysis of embedded 2 Mbps signals

The CMA 3000 can drop out a 2 Mbps signal from each of the monitored SDH signals. You can analyze in details the contents of these 2 Mbps signals and the results can be visualized on the CMA 3000 monitor. Among other things you can view the utilization of the 2 Mbps line time slots. Audio level of a selected time slot is indicated at the bottom of the display and a dedicated display provides more details on the selected time slot. As shown in Figure 8 this can be done for traditional 64 kbps time slots. Compressed GSM speech in sub-channels can also be analyzed with a CMA 3000 outfitted with GSM Abis option.

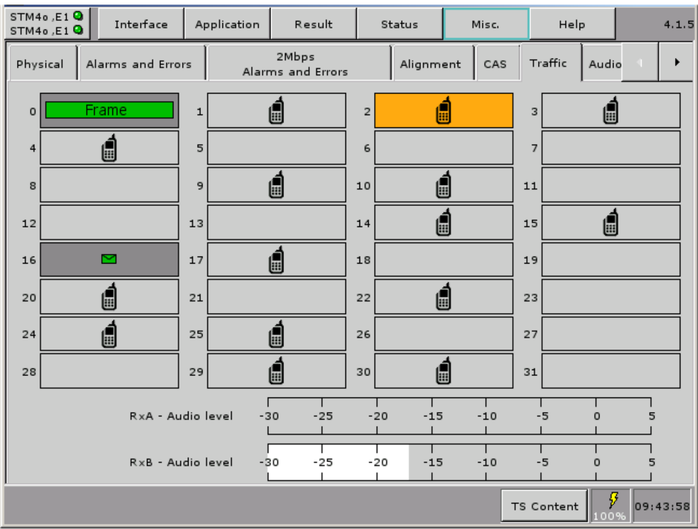

Figure 8 2 Mbps signal time slot utilization.

You can perform a longer term performance-measurement on the embedded 2 Mbps signals. If the 2 Mbps signals are framed this can be done truly in-service, i.e. without allocating part of the signal for a dedicated test signal. The test can be done by looking for errors in the 2 Mbps signals frame alignment signal (FAS), which must always have the same contents to allow receivers to synchronize to the framing structure.

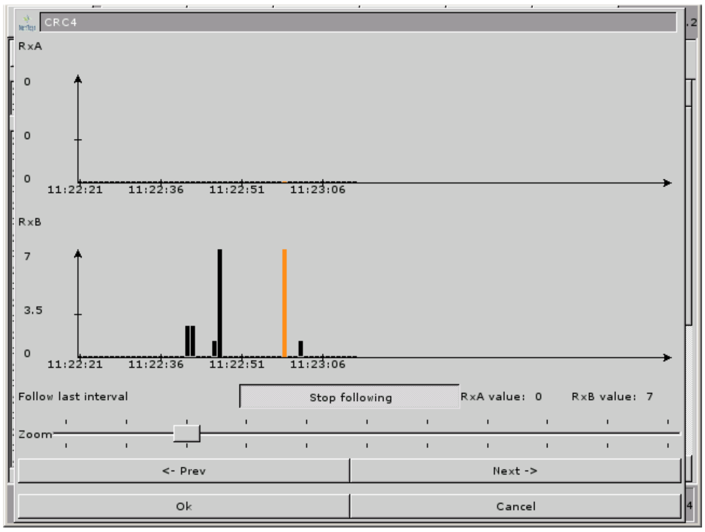

Figure 9 With the CMA 3000 histograms you get a rapid overview of a measurement.

This, however, only allows detection or errors in the FAS itself, not in the carried traffic. Therefore some 2 Mbps systems have added a CRC-4 check sum of the 2 Mbps signal to support detection of errors in the traffic. Measuring CRC-4 errors gives very good information on the degradation in transmission quality of the carried traffic. The bi-directional measurement allows you to relate errors to what happened on the other 2 Mbps line at the same time. The CMA 3000 histogram features provides an easy time-wise overview of the measurement results.

4.0 In-service analysis of SDH network elements

In case a network element is under suspicion for introducing errors into the carried traffic you can use a CMA 3000 connected to both sides on a network element to analyze the behavior of the network element as illustrated in Figure 10.

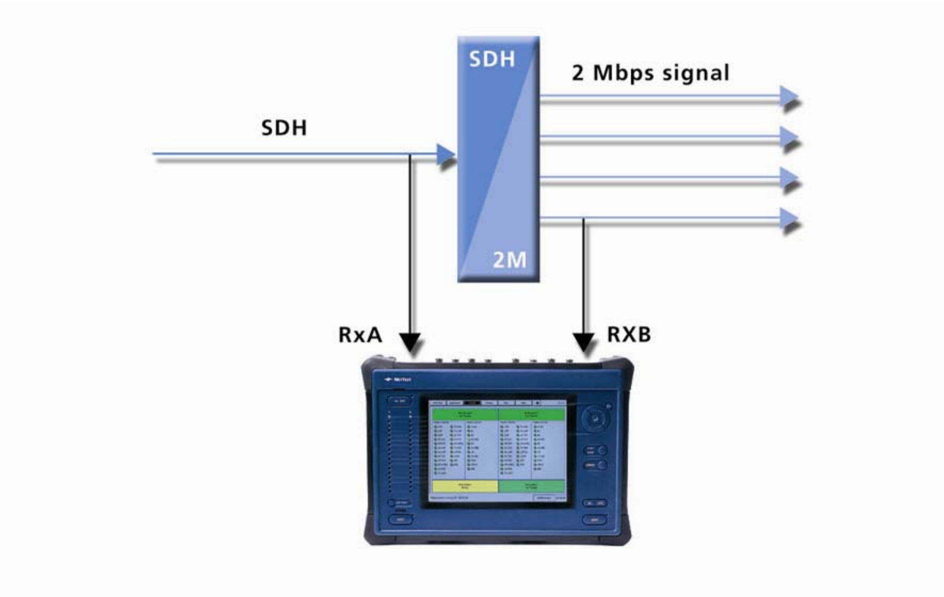

Figure 10 In-service analysis of an SDH network element.

You can analyze the network element behavior by examining errors in the FAS and the CRC-4 check sum (if available) of an embedded 2 Mbps signal in the SDH signal and compare it to what comes out of the network element as a 2 Mbps signal. A similar analysis can be made with SDH signals on both sides of the network element.

Figure 11 In-service analysis indicating problems in the investigated SDH network element.

5.0 Signaling analysis

Another application of the CMA 3000 bi-directional feature is to use the SDH interfaces to access the signaling links. Most of the existing telecommunication systems are based on 2 Mbps lines in which traffic channels (typically with a 64 kbps bandwidth) can be allocated for network signaling information. The signaling allows the switches in the network to communicate together and with the end user equipment, e.g. in the form of fixed-line or mobile phones. Very often the 2 Mbps lines are embedded in SDH transport systems. When analysis of the signaling is required it may be more convenient to access it through an SDH interface rather than identifying the relevant 2 Mbps line. To do so the CMA 3000 bi-directional capability combined with its wide range of protocol decode options offers a simple and straight-forward solution.

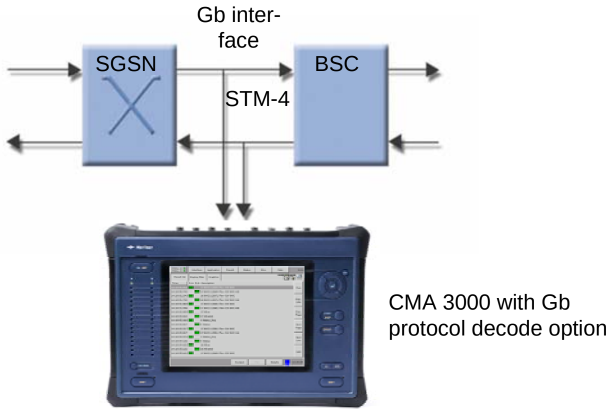

Figure 12 Access to a GPRS Gb interface in 2 Mbps lines embedded in an STM-4.

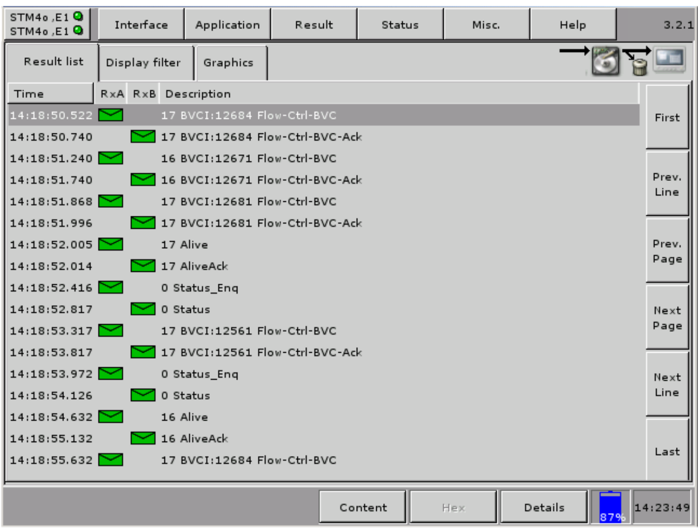

Figure 13 Bi-directional Gb protocol analysis in a 2 Mbps system, embedded in an STM-4 signal.

The CMA 3000 protocol decode options include:

- **Mobile access:**
  - International and vendor specific GSM Abis protocols
  - Vendor specific GPRS Abis interface PCU protocols
  - GPRS/EDGE Gb interface and frame relay protocols
  - A-interface protocol
  - Gs interface protocol
- **Mobile core:**
  - o MAP protocol
- **Fixed line, core:**
  - o International SS7 (ITU-T White Book, ETSI protocols)
  - o A wide range of national SS7 protocols
- **Fixed line, access:**
  - o ETSI ISDN (Q.931), National ISDN versions, QSIG, V5.x, DASS-2/DPNSS protocols

Anritsu Corporation
5-1-1 Onna, Atsugi-shi, Kanagawa, 243-8555 Japan
Phone: +81-46-223-1111
Fax: +81-46-296-1264

• **U.S.A.**
Anritsu Company
1155 East Collins Blvd., Suite 100, Richardson,
TX 75081, U.S.A.
Toll Free: 1-800-267-4878
Phone: +1-972-644-1777
Fax: +1-972-671-1877

• **Canada**
Anritsu Electronics Ltd.
700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

• **Brazil**
Anritsu Electrônica Ltda.
Praça Amadeu Amaral, 27 - 1 Andar
01327-010 – Bela Vista - São Paulo - SP - Brasil
Phone: +55-11-3283-2511
Fax: +55-11-3288-6940

• **Mexico**
Anritsu Company, S.A. de C.V.
Av. Ejército Nacional No. 579 Piso 9, Col. Granada
11520 México, D.F., México
Phone: +52-55-1101-2370
Fax: +52-55-5254-3147

• **U.K.**
Anritsu EMEA Ltd.
200 Capability Green, Luton, Bedfordshire LU1 3LU, U.K.
Phone: +44-1582-433200
Fax: +44-1582-731303

• **France**
Anritsu S.A.
12 avenue du Québec, Batiment Iris 1-Silic 612
91140 VILLEBON SUR YVETTE, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

• **Germany**
Anritsu GmbH
Nemetschek Haus, Konrad-Zuse-Platz 1
81829 München, Germany
Phone: +49-89-442308-0
Fax: +49-89-442308-55

• **Italy**
Anritsu S.r.l.
Via Elio Vittorini, 129, 00144 Roma, Italy
Phone: +39-6-509-9711
Fax: +39-6-502-2425

• **Sweden**
Anritsu AB
Borgarfjordsgatan 13A, 164 40 KISTA, Sweden
Phone: +46-8-534-707-00
Fax: +46-8-534-707-30

• **Finland**
Anritsu AB
Teknobulevardi 3-5, FI-01530 VANTAA, Finland
Phone: +358-20-741-8100
Fax: +358-20-741-8111

• **Denmark**
Anritsu A/S
(Service Assurance)
Anritsu AB Denmark
(Test & Measurement except Service Assurance)
Kay Fiskers Plads 9, 2300 Copenhagen S, Denmark
Phone: +45-72112200
Fax: +45-72112210

• **Russia**
Anritsu EMEA Ltd.
Representation Office in Russia
Tverskaya str. 16/2, bld. 1, 7th floor.
Russia, 125009, Moscow
Phone: +7-495-363-1694
Fax: +7-495-935-8962

• **United Arab Emirates**
Anritsu EMEA Ltd.
Dubai Liaison Office
PO Box 500413 - Dubai Internet City
Al Thuraya Building, Tower 1, Suit 701, 7th Floor
Dubai, United Arab Emirates
Phone: +971-4-3670352
Fax: +971-4-3688460

• **Singapore**
Anritsu Pte Ltd.
60 Alexandra Terrace, #02-08, The Comtech (Lobby A)
Singapore 118502
Phone: +65-6282-2400
Fax: +65-6282-2533

• **India**
Anritsu Pte. Ltd.
India Branch Office
3rd Floor, Shri Lakshminarayan Niwas, #2726, 80 ft Road,
HAL 3rd Stage, Bangalore - 560 075, India
Phone: +91-80-4058-1300
Fax: +91-80-4058-1301

• **P.R. China (Hong Kong)**
Anritsu Company Ltd.
Units 4 & 5, 28th Floor, Greenfield Tower, Concordia Plaza,
No. 1 Science Museum Road, Tsim Sha Tsui East,
Kowloon, Hong Kong
Phone: +852-2301-4980
Fax: +852-2301-3545

• **P.R. China (Beijing)**
Anritsu Company Ltd.
Beijing Representative Office
Room 2008, Beijing Fortune Building,
No. 5, Dong-San-Huan Bei Road,
Chao-Yang District, Beijing 10004, P.R. China
Phone: +86-10-6590-9230
Fax: +86-10-6590-9235

• **Korea**
Anritsu Corporation, Ltd.
8F Hyunjuk Building, 832-41, Yeoksam Dong,
Kangnam-ku, Seoul, 135-080, Korea
Phone: +82-2-553-6603
Fax: +82-2-553-6604

• **Australia**
Anritsu Pty. Ltd.
Unit 21/270 Ferntree Gully Road, Notting Hill,
Victoria 3168 Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

• **Taiwan**
Anritsu Company Inc.
7F, No. 316, Sec. 1, Neihu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817