



4th European Tcl/Tk User Meeting

Tcl used for testing in the mobile world

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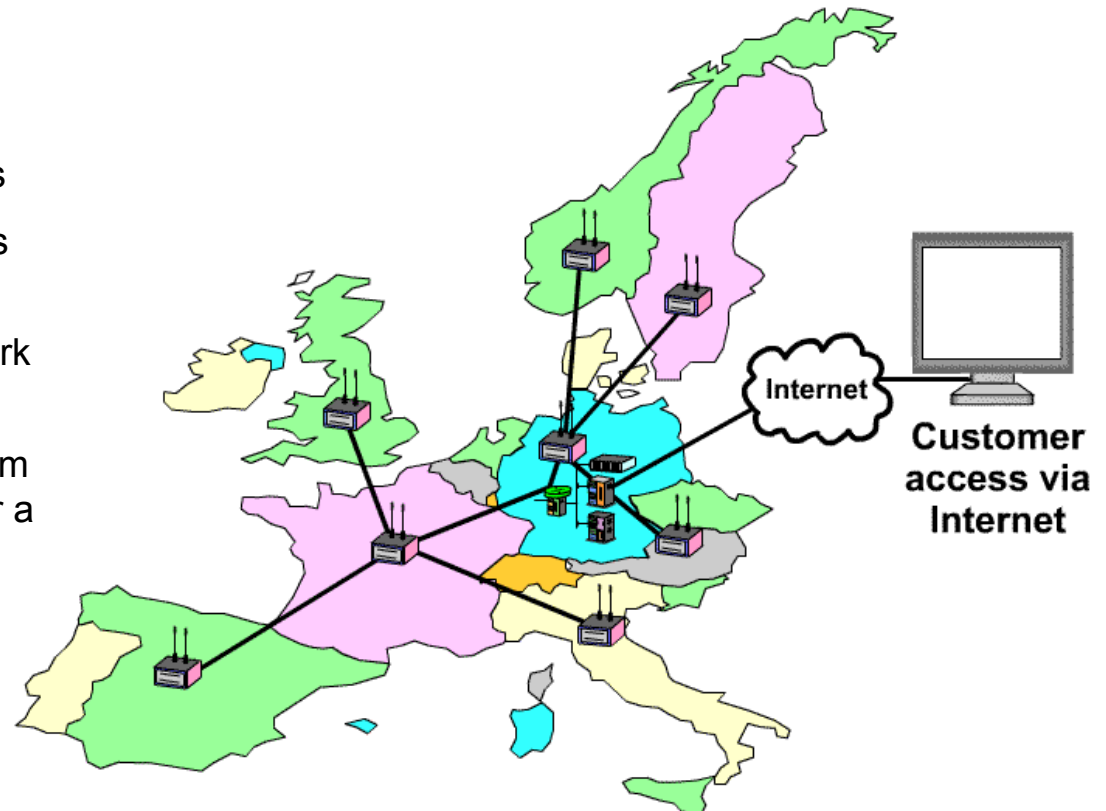
Testing is our competence

Overview

- ▶ Testing of Mobile Networks
- ▶ Introduction of SIGOS
- ▶ Architecture and Implementation of the SITE Testsystem
- ▶ Central SIMCARD Multiplexing
- ▶ Definition of Testcases using the Tcl-based Language TDL

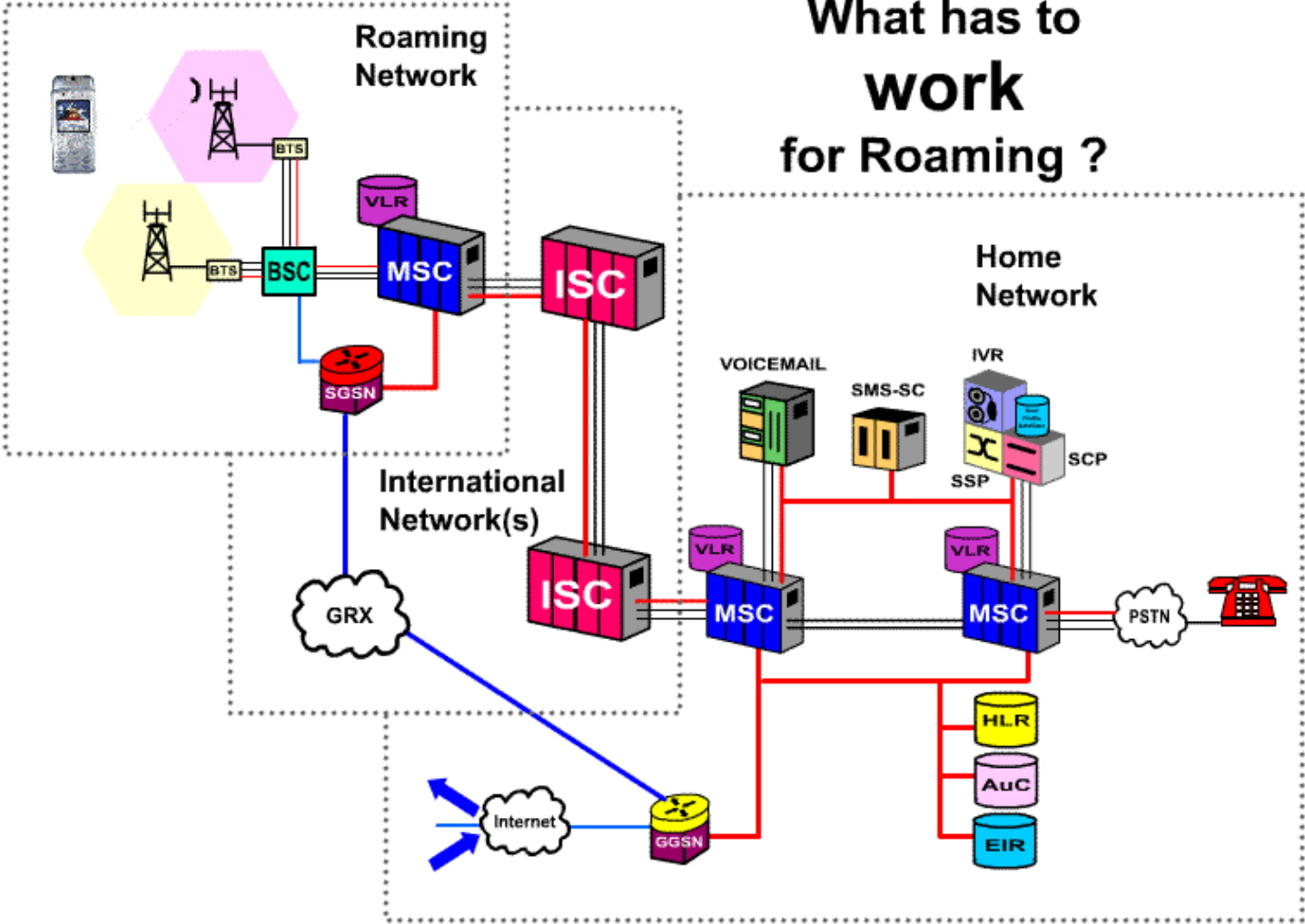
Requirements

- ▶ Simulating user behaviour using real mobiles
- ▶ Making calls between different locations
- ▶ Possibility to use all available SIM cards from each location (central SIM Mux)
- ▶ Support of (almost) all services a network operator offers to his customers
- ▶ Multiple users accessing the system from remote using a graphical user interface or a web interface
- ▶ Comfortable user support for parameterization of test cases
- ▶ Parallel execution of test cases
- ▶ All results stored in the database
- ▶ Simple and powerful test case development



testing mobile networks

What has to work for Roaming ?



- ▶ Company founded in 1989
- ▶ 45 Employees in 2001
- ▶ Shares owned by:
 - ▶ Management 48 %
 - ▶ Employees 24 %
 - ▶ Venture Capital 28 %
- ▶ Consultancy & development for standardisation bodies (ETSI)
- ▶ Several references with GSM Operators
- ▶ Member of



- 1989** **Foundation, November 9, with 17 employees**
- 1990 Testing and integration support for the first GSM network
- 1991 Active participation in standardisation process as full member of ETSI
- 1993 SITE DSS1 for conformance test in ISDN networks
- 1994 Network Planning of a GSM Core Network
- 1995 SITE DECT for type approval test
- 1996 SITE ISUP for conformance test for C7 networks
- 1997 SITE GSM for end to end test
- 1998 SITE IN/CAMEL for conformance test
- 1999 SITE ACTT distributed automatic call through test
- 2001 SITE WAP, SITE IVR/VMS, SITE GPRS, SITE HLR
- 2002 SITE Multi Media Messaging Services

1989 - 2001 Testing and integration support for GSM and fixed networks

SIGOS expertise and solutions

We support our customers in

Planning, Implementation, Deployment, Operation

Our Know-How

12 years expertise in network & service testing

Domains of expertise

SS7, ISDN, IN including CAMEL, GSM/GPRS/UMTS,
Mobile applications with SMS & WAP, IP

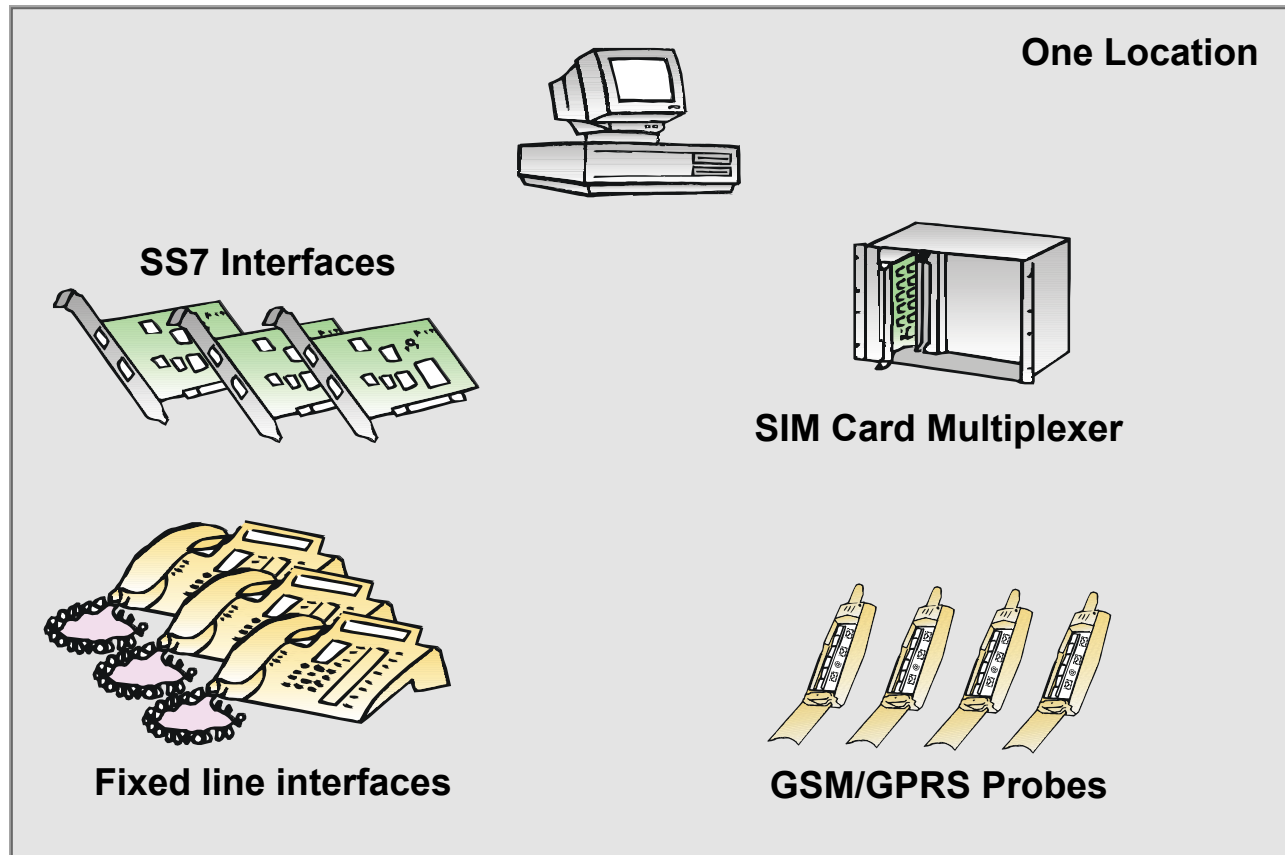
We offer

Test Solutions based on SITE Test System,
Professional Services, Customised solutions

site system features

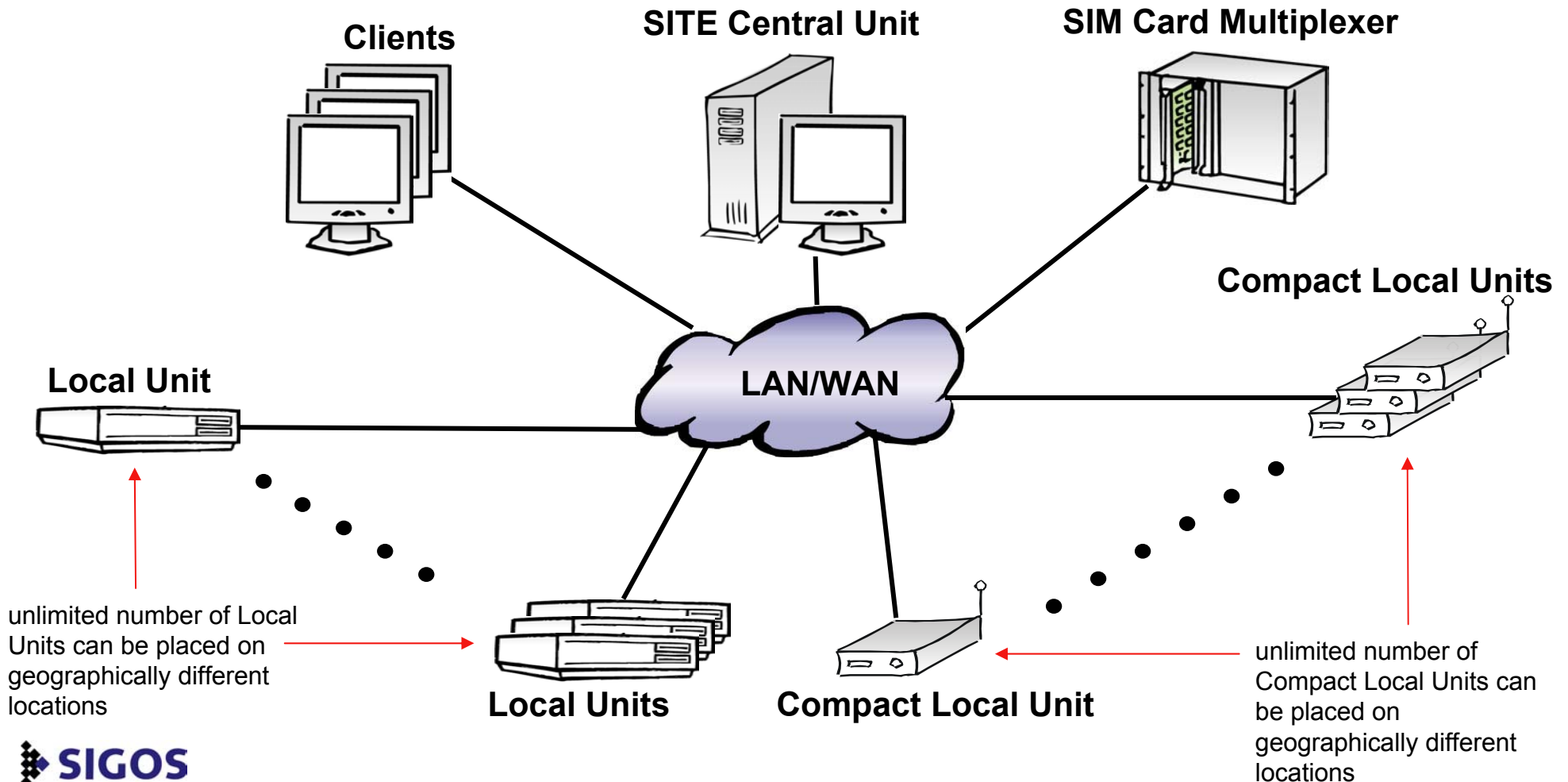
- ▶ The SITE test platform is available as
 - ▶ Stand alone test system

- e.g.
- test lab solution
 - portable solutions
 - single location solutions



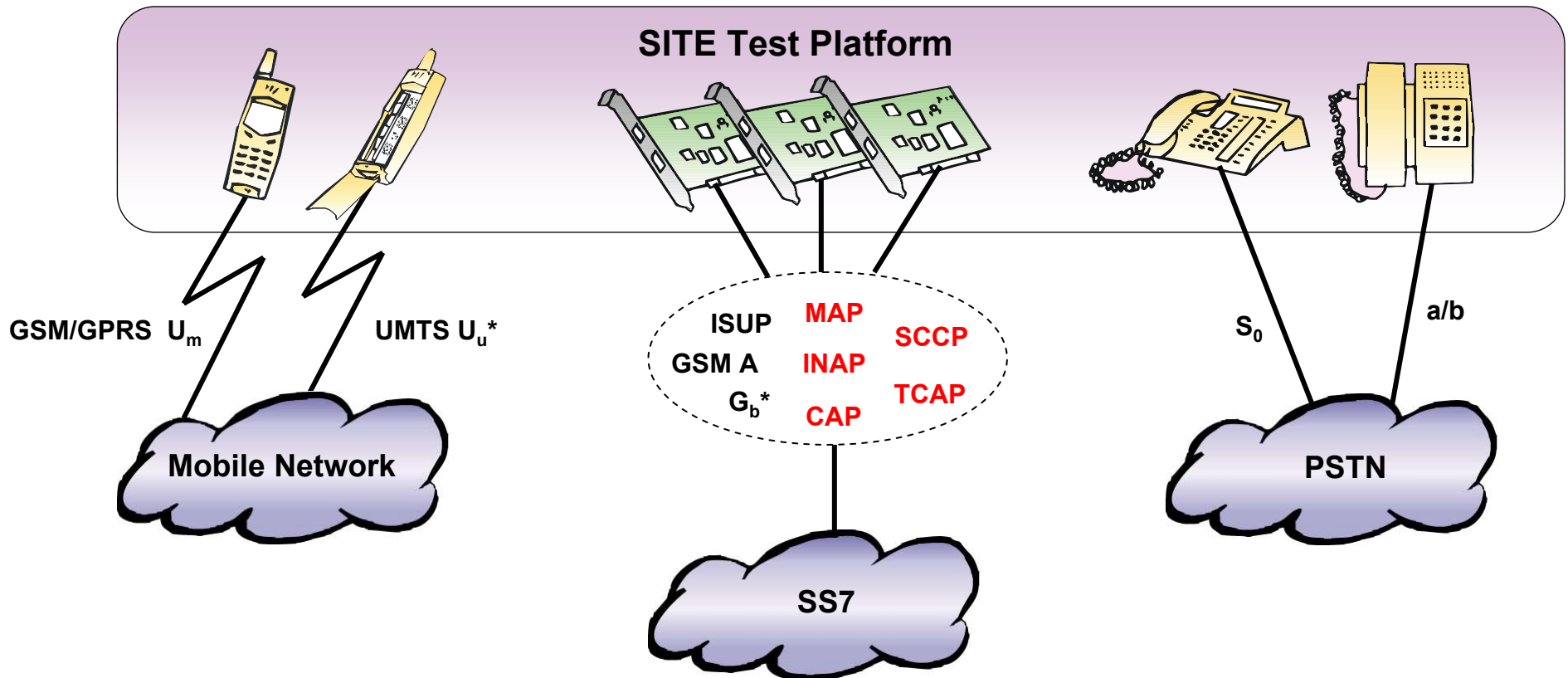
site system features

- ▶ ... or as distributed test system with one central unit and several local units all connected via LAN / WAN



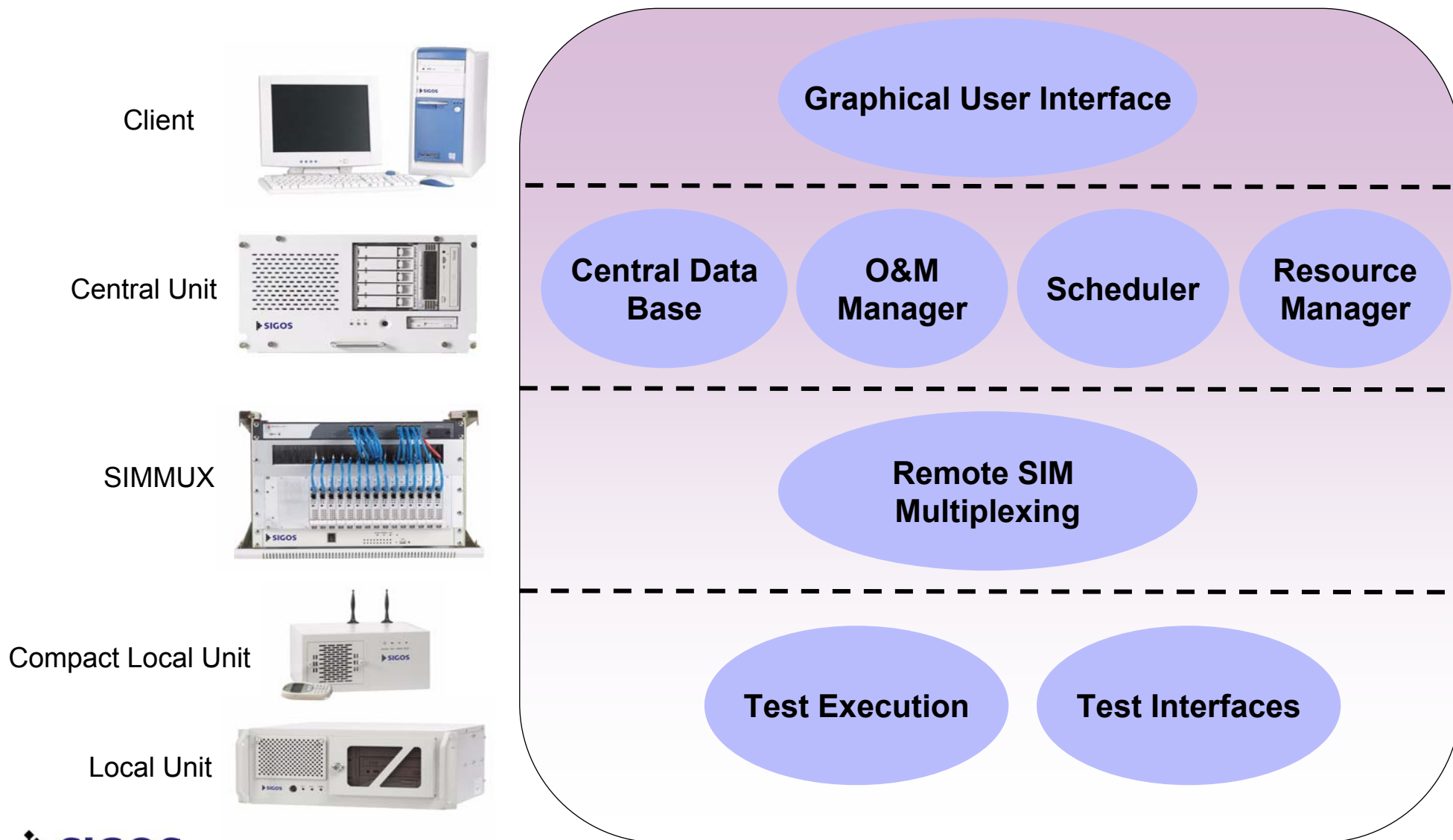
site system features

- ▶ Interfaces of the SITE test platform - test interfaces



* planned 3./4.Q 2003

site processes





server - central data base

- ▶ Central data base contains
 - ▶ All information required for test execution
 - ▶ Test cases and scenarios
 - ▶ Test results
 - ▶ Information about the SITE hardware status
 - ▶ Information about system alarms
- ▶ MySQL Data Base

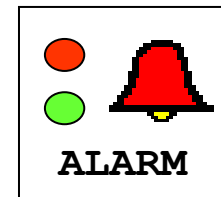
The screenshot shows the 'SITE Database' application window. The 'Tables' list on the left includes: simTab, sysconfigTab, sysvarTab, tcRecordTab, tcTraceExtTab, tcTraceTab, tdGroupTab, and testDefTab. The 'Attributes of Table sysconfigTab' window shows columns: name, value, type, defaultValue, and description. Below, the 'sysconfigTab' table is displayed with 71 matches. The table has the following columns: name, value, type, defaultValue, and description.

name	value	type	defaultValue	description
guiIntervalRecordDlg	2	INTEGER	5	Interval in seconds for updating opened re
guiIntervalTraceWin	2	INTEGER	2	Interval in seconds for updating SITE trac
LocalCurrency	EUR	char(30)	EUR	Currency code for national currency, only
localMCC	262	char(30)	000	Mobile Country Code value of the local PLM
localMNC	02	char(30)	00	Mobile Network Code of the local PLMN, see
localPLMN	D2-Vodafone	char(30)	unknown	Full name of the PLMN where the central un
localPLMNCountry	Germany	char(30)	unknown	Country to which the PLMN belongs. In oder
localPLMNCountryCode	49	char(30)	00	Country code of PLMN as defined in ITU-T E
localPLMNshortName	D2	char(30)	unknown	Short name of the PLMN, e.g DE for D2-Voda
localTrunkPrefixInternational	00	char(30)	00	digits that have to be dialed for outgoing
localTrunkPrefixNational	0	char(30)	0	digits that have to be dialed for outgoing
onAlarmFilter	1	char(30)	1	SQL expression over trapTab attributes. If
onCheckLUS	TRUE	ENUM('FALSE','TRUE		if not set to FALSE, LUS will be checked b
onCUDatabaseFileSizeThreshold	0	INTEGER	0	Value for observation of the largest datab
onCUDiskUsageThreshold	75	INTEGER	75	Value for observation of disc usage on cen
onCUIHighLoadThreshold	0	INTEGER	0	Value for observation of load on central u
onCUIOpenFilesThreshold	0	INTEGER	0	Value for observation of the number of ope
onInterval	10	INTEGER	10	Interval between the checks for all hosts
onLUIDiskUsageThreshold	75	INTEGER	75	Value for observation of disc usage on loc
onLUIHighLoadThreshold	0	INTEGER	0	Value for observation of load on local uni
onLUIOpenFilesThreshold	0	INTEGER	0	Value for observation of the number of ope
onNetworkTimeout	10	INTEGER	10	timeout in seconds for establishment of a
onPortNumberMNCP	51501	INTEGER	51501	port number used by the OM agent for the va
onPortNumberSIMMUX	51500	INTEGER	51500	port number used for the SIM Multiplexer (
onPortNumberSNMP	165	INTEGER	165	port number of SNMP
onTrapHost		char(30)		Host name for traps
onTrapPort	162	INTEGER	162	Port number for traps
prepaidAccountServer	+4917222922	char(30)	+4917222922	Number of account server for prepaid servi
prepaidPLMN	D2-CaliYa	char(30)	unknown	Name of PLMN for prepaid service



server - central o&m manager

- ▶ O&M Manager
 - ▶ Configuration of the modules and process controlling
 - ▶ Alarm generation (display, SNMP) when
 - ▶ Test system components do not work properly
 - ▶ Test runs reach a previous defined failure level

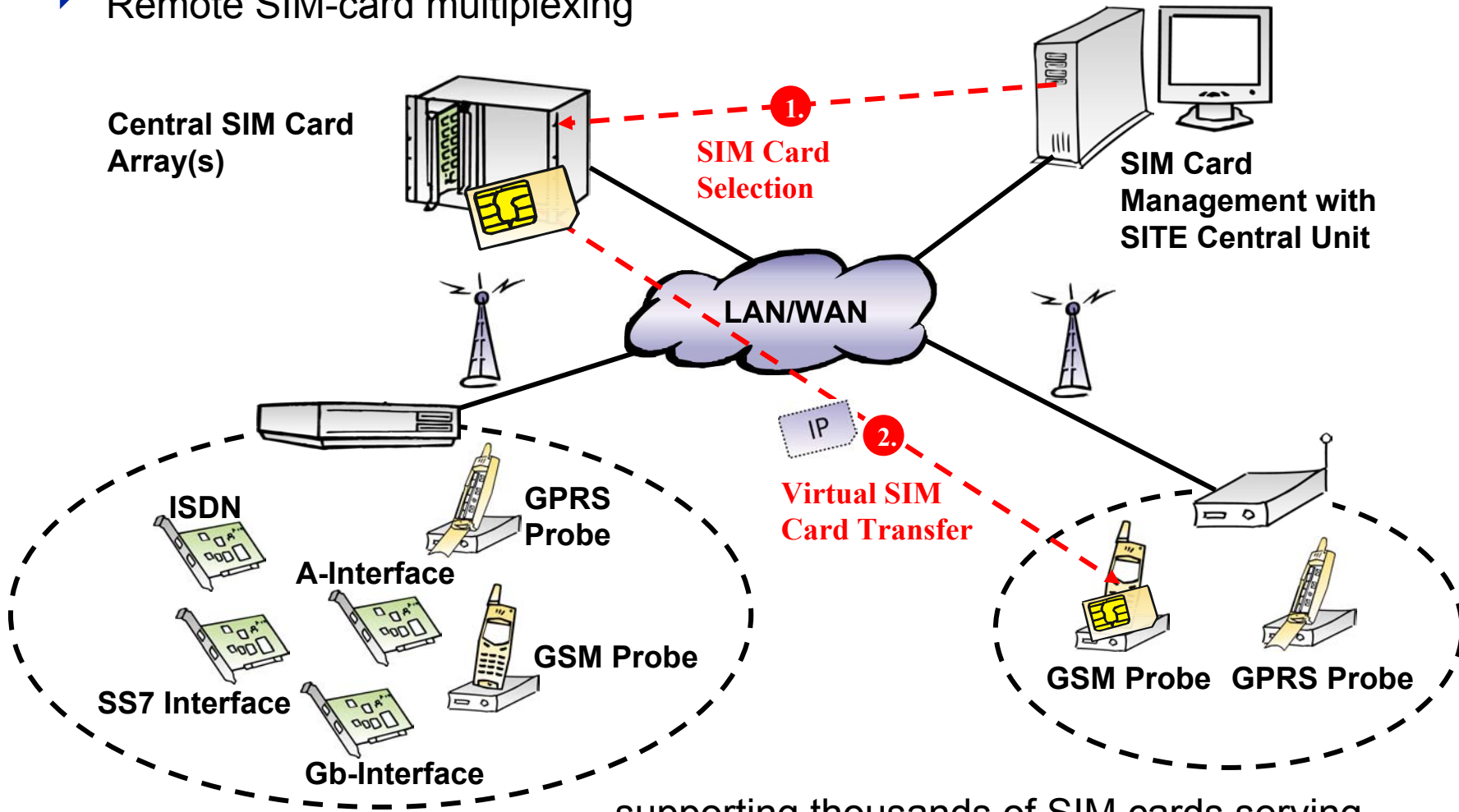


ALARM !



central SIM multiplexer

Remote SIM-card multiplexing

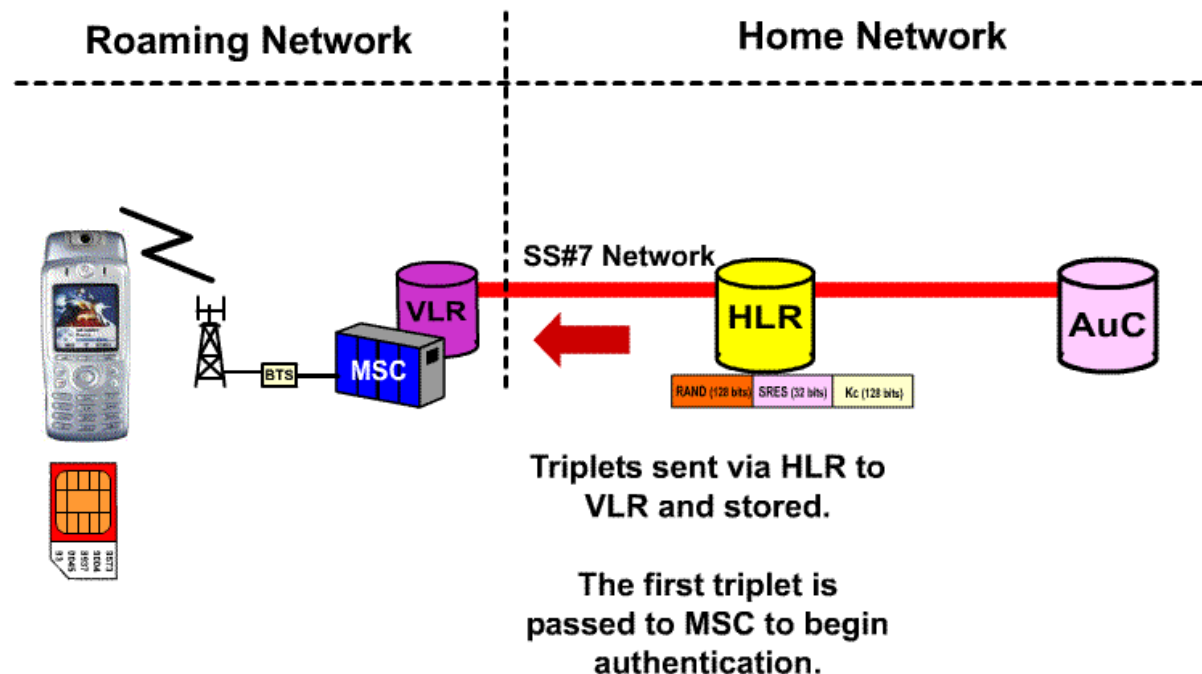


supporting thousands of SIM cards serving
U_m- and SS7-Interfaces (A, ...)

central SIM multiplexing

How a network authenticates a mobile

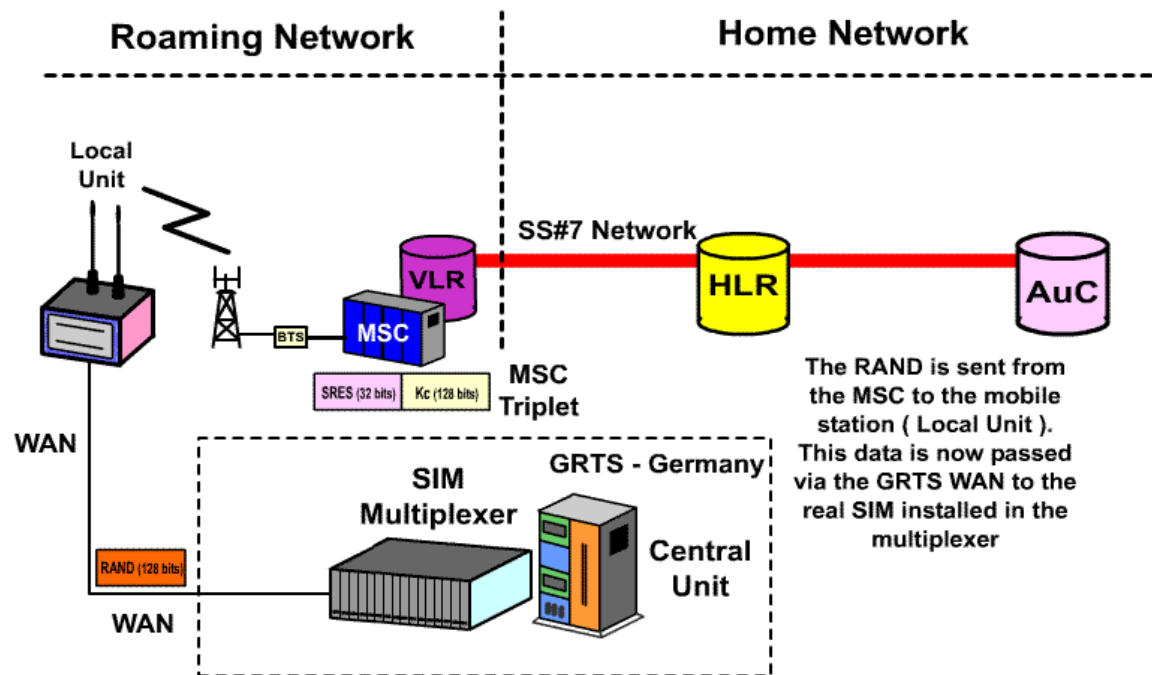
- ▶ A secret key (K_i) is stored on the SIM card and in an authentication centre (AuC).
- ▶ The AuC generates Triplets with a random value RAND, a signed response SRES and a cipher key K_c and transfers them to the switch (MSC) that serves the user.
- ▶ The MSC sends RAND to the mobile.
- ▶ The mobile asks the SIM to compute SRES and K_c for the RAND and returns SRES.
- ▶ If the MSC receives the correct SRES the authentication is successful.



central SIM multiplexing

How central SIM multiplexing is implemented in the SITE system:

- ▶ All requests issued from a mobile to the SIM are handled by a SIM card simulation process.
- ▶ The SIM card simulation implements a virtual SIM card, i.e. stores or provides information like telephone book entries or SMSes.
- ▶ Almost all requests are performed on the local unit.
- ▶ If an authentication request is received, the request is transferred via WAN to the SIM multiplexer. The SIM computes SRES and Kc.
- ▶ The results are returned via WAN to the SIM card simulation to answer the authentication request.



TDL overview

- ◆ Designed for the implementation of test cases according to the ISO 9646 test methodology.
- ◆ Allows the definition of parameters with default values and dynamic selections to support the user with test case parameterization.
- ◆ Handling of send and receive and timer events and default behaviours.
- ◆ Supports encoding and decoding of various telecommunication protocols like ISUP, MAP, CAP, BSSAP.
- ◆ Supports sending, receiving and matching of ASN.1 data units.
- ◆ No compilation is required.
- ◆ HTML test case documentation generated from the TDL source.

Test Definition Language (TDL): A simple example

```
#!/usr/bin/tclsh
#--- Load the SITE Tdl Environment
source /site/tclui/tdl.tcl
LOAD_TDL_ENVIRONMENT

DEFINE TESTCASE T_Hello {
  DESCRIPTION {Simple 'Hello World' test case to write a
              message and return the verdict PASS}
  PARAMETERS {
    PARAMETER Message {
      DESCRIPTION "a message to be traced"
      TYPE PrintableString
      DEFAULT "Hello World"
    }
  }
  RESOURCES {
    RESOURCE PTC_A GSM_Um location "*"
  }
  BODY {
    SITE_Log INFO "[VALUE Message] from SITE"
    VERDICT P
  }
}
```

TDL: parameter definition

```
DEFINE TESTCASE T_ExternalCall {
  DESCRIPTION "Establish a call to an external number"

  PARAMETERS {
    PARAMETER a_side_where {
      DESCRIPTION "the location of the Gsm_Um mobile"
      TYPE {ELEM_OF SQL "select location from GSM_Tab where resourceType = 'GSM_Um'"}
    }
    PARAMETER a_side_who {
      DESCRIPTION "the telephone number of the subscriber, i.e. the msisdn for speech"
      TYPE {ELEM_OF SQL "select msisdn_speech, plmn, country from simTab"}
    }
  }
  RESOURCES {
    RESOURCE PTC_A GSM_Um location [VALUE a_side_where] subscriberSelection "msisdn_speech like
      '[VALUE a_side_who]'"
  }
  BODY {
    +Preamble
    SEND var_pcoName "ATD[VALUE b_number];"
    ...
  }
}
```

TDL: call establishment using AT commands

```
BODY {
  +Preamble
  SEND var_pcoName "ATD[VALUE b_number];"

  WAITFOR -timer callSetupTimer s 80 {
    var_pcoName OK {
    }
    TIMEOUT callSetupTimer {
      LOG_ERROR "timeout after [Tdl_LastSent]"
      SEND var_pcoName ATH
      +Postamble F "timeout after ATD"
    }
  }
  SITE_SetTimestamp connect -state "CALL connect"
  TDL_WAIT s 5
  SITE_SetTimestamp release -state "CALL release"
  +AT_Cmd ATH
}
```

- ▶ Although the SIGOS team had no experience with Tcl the project made rapid progress and was quite successful (already more than 300 installations).
- ▶ The product has been ported to SUN OS and the GUI runs on Windows without major effort on the tcl side.
- ▶ Major use of subst, uplevel and eval to create the TDL GUI, execution and documentation environment.