Protocol target test method for TD-SCDMA

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[**Abstract]** In this paper, the test method, project and procedure for international specification of TD-SCDMA is described, it provides a complete procedure for TD-SCDMA system test.
[**key word**] TD-SCDMA protocol test, test project, TSM terminal protocol test

TD-SCDMAis a flexible combination of TDMA and CDMA, the two basic transmit mode, as a 3G standard, it is proposed by CWTS(Chinese wireless Telecommunication standard) and accepted by ITU. In 3GPP, it is called low chip rate TDD (compared to UTRA TDD of 3.84M chip rate). TD-SCDMA is very suitable for dense urban to provide large capacity for speech, data and multimedia service. It can deploy an independent network or cooperate with other wireless access techniques to work. The unique features of TD-SCDMA are:

(1) TDD mode is flexible for asymmetrical service. By changing the transmit direction, TD-SCDMA can switch from uplink and downlink periodically in the same carrier.

(2) Smart antenna. The uplink and downlink are transmitted in the same carrier, the channel is reciprocity in uplink and downlink, and thus the smart antenna can be adopted easily at BS.

(3) Joint detection, TD-SCDMA is a interference limited system, the interference includes intra-cell interference and inter-cell interference.

(4)Synchronous CDMA. It means that the signals from the terminals are synchronized at the BS, and the multiple access interference is avoided, and thus the capacity and the spectrum efficiency are improved.

(5)Software radio implements the function which is implemented by hardware traditionally by DSP software.

(6)TD-SCDMA is easy to implement the evolution of GSM and support paralleled bears.

Protocol test is a black box test, it only cares the input and output of the software tested, even the test capacity is not so strong, the procedure is very simple, and it has no special requirement to the software to be tested. According to the standard, it is evaluated by the outer behavior of the software to be controlled and tested. Currently, the protocol test can be researched in 4 aspects: conformance testing, interoperability testing, performance testing,

and robustness testing. The conformance testing tests if the protocol follows the standard and if the protocols of network products follow the international standard, it is the basic test content of conformance testing. Interoperability testing cares the interoperability among the different protocols of the same protocol standard. The performance testing observes all kinds of performance coefficients by experiment. Robustness testing tests the ability of the protocol element or system to work in all kinds serious environments.

In fact, the aim of protocol conformance testing is to ensure that the product obeys the standard, decreases the probability of the error happens to the products (for example TD-SCDMA terminal) in field.

Conformance testing is a complete test procedure defined by ISO 9446, and the test criteria include 3 parts: ATS (Abstract Test Suite), PICS and PLXIT. ETS is based on the above three parts. As in figure 2,the main steps are described as following：

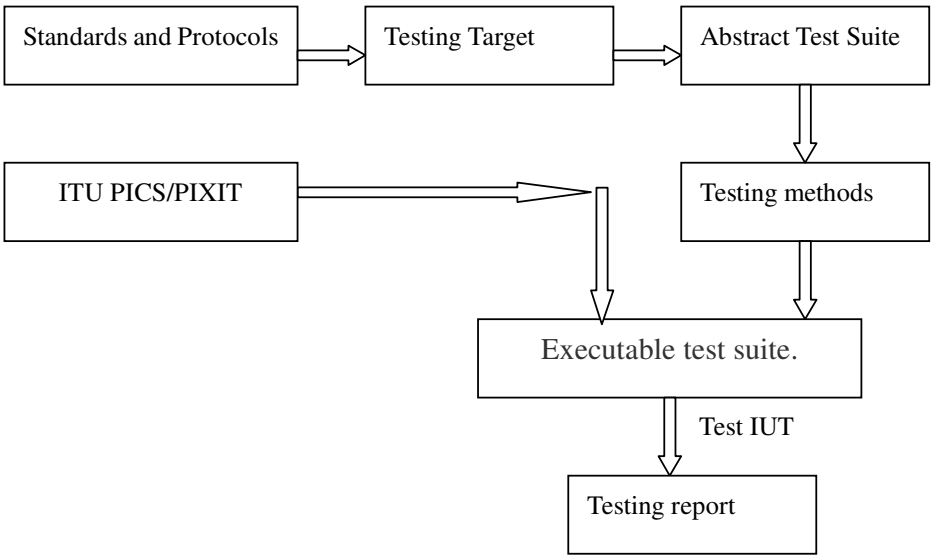

Figure 1. The procedure of consistence testing

ATS：Abstract Test Suite，is the text describing the procedure, it provides the specification of the test case.
PICS：Specify the requirement to implementation, ability and implementation of the optional item.

PIXIT：Provides the protocol coefficients, which must be specified in test.
ETS：Executable test suite.

IUT：The protocol implemented to be tested, the part of a real open system to

be tested by conformance testing, it should be one or more implementation of OSI protocol. The IUT included by the system tested can be single layer IUT(only one layer is tested) or multiple layer IUT（a serial layers neighbored need to be tested）. The interoperability testing is the next step of conformance testing. The conformance testing ensures that system A and B all follows the protocol standard, while the interoperability testing if the system A and B can interoperate. The steps of the interoperability testing is as following:
（1）define the test target by predicting the application of the protocol in the real environment. ATS
（2）implement ETS according to ATS；
（3）execute ETS at the protocol analyzer, test two or more system to be tested；
（4）attain the test report by test procedure, find the error of the system.

There is much similarity between interoperability testing and conformance testing; they have similar ATC and ATS. The main difference is that the conformance testing is based on single IUT, while interoperability testing is based on two or more system.

One typical example of interoperability testing in the interoperability testing of TSM terminal testing is the communication test between TSM terminal and BS, on terminal protocol, it is showed by the conformance of the protocol understanding.

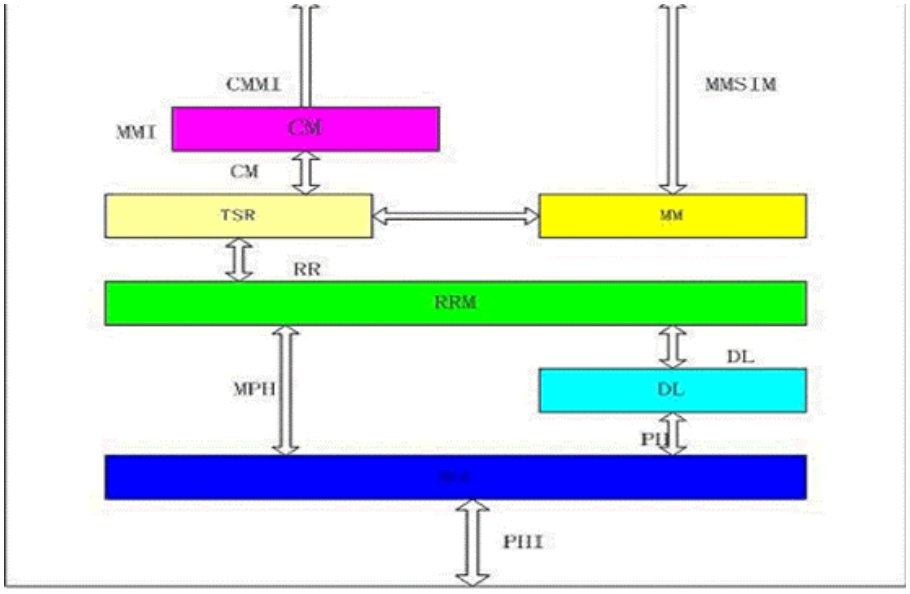

Figure2: The protocol layer structure of TD-SCDMA user terminal

PH interface delivers the control signal between HL1 and DI and data service. Most of the exchanged data need to be transmitted or received from air interface.

MPH interface is responsible for the information exchange between RRM and HL1. These control information concern to radio resource management, physical coefficients measurement.

DL interface exchanges control information between RRM and DL modules, and delivers layer 3 message.

RR interface delivers layer 3 messages of non-access layer, exchanges the inter-layer control message (RR layer and non-access layer), all these messages are delivered and forwarded to corresponding non-access layer by TSR module.

MM interface delivers the signal between MM and RRM modules, CM modules and MMI environment, and these signals are delivered and forwarded by TSR.

CM interface delivers the signal between CM and RRM modules, CM modules and MMI environment, and these signals are delivered and forwarded by TSR.

PHI interface delivers the signal and exchanges service data between HL1 module and physical environment (DSP).

MMI interface delivers the signal between MMI environment and CM module, MM module and RRM module.

CMMI interface delivers the call control signal between CM module and MMI environment, and this interface is directional.

MMSIM interface delivers the messages between MM module and SIM card environment.

CC sub-layer test

（1）the setup and release of MO call；
（2）setup and release of MT call；
（3）After the call setup, the test of the other function during the communication, for example DTMF message delivery.
（4）test on call setup again when the call is abnormal during the talking or setting up；
（5）CC multiple example test.

MM sub-layer test

（1）test on the procedure to select a network；
（2）test on TMSL and TMSL reallocation；
（3）Authentication test，including the authentication accept and authentication refuse；

（4）Identification test，including general test and the case to verify the processing ability of MS when the length of IMSI is shorter than the maximum length；
（5）Location updating test，including location updating accept, reject and abnormal,T3240 timeout release, periodic location updating and the case where the ATTACH procedure interleaved with periodic location updating.
（6）MM connection test，including MM connection cipered, MM connection not cipered, reject to MM connection setup, reject to MM connection setup for Cause4, T3230 timeout of MM connection setup, network ABORTMM connection and Follow-on Request Pending.
（7）Test on interface to SIM card, including SIM card and no SIM card, and the cases where some items can't be read from SIM card.

RR sub-layer test
（1）Cell selection test, including barrd cell, PLMN no selected, test on C1、<0 cell, the case where the cell power level is less than the limit, the case where the barrd cell??
（2）Test on normal idle, including measurement on neighboring cell and serving cell, the response of paging.
（3）test on cell reselection, including the judging if it is a new cell, the procedure of cell reselection, priority of the selected cell, the success of cell reselection, returning to the cell reselection when the procedure fails;
（4）test on call admission
（5）test on assignment immediately, including SYNCI procedure, random access procedure, immediate assignment success, immediate assignment refused, abnormal case, T3211 timeout after the immediate assignment is refused;
（6）test on paging, including paging mode and type;
（7）test on reporting the measurement, channel mode changing procedure, channel assignment procedure, handover procedure, setting the cipher mode, Classmark inquiring procedure when connecting;
（8）test on the RR connection release procedure , including the normal release;
（9）Test on returning to idle mode from connecting mode, including returning to current cell after the normal release, and the cell reselection or cell selection after the abnormal release;

Test on L2
（1）test on the Contention resolution when connecting, including success, DM and abnormal.

（2）test on connection setup without contention Resolution, for example when handover happen;
（3） transmission of I frame, monitoring frame and U frame after the

connection setup;
（4） test on I frame retransmission, including retransmission success, the number of the retransmission failure exceed the limit;
（5）test on REJ frame
（6）test on UL frame of BCCH、AGCH、PCCH received when idle;
（7） the test on the other abnormal cases, such as wrong C/R measurement message, wrong sequence number, etc.

Test on HL1 layer
（1）test on frequency adjustment, measurement on neighboring cell RSCP, BSIC decoding, the phase judgment of DwPTS, reading BCCH, configuration of BCH, etc. when select the cell;
（2）test on reading the CCCH, periodic measurement on RSCP of serving cell and neighboring cells, periodic synchronization to neighboring cell, decoding of BCCH from serving cell and neighboring cells when idle;
（3）test on random access, SYNC1 probing, send the channel access, reading CCCH(PCCH,AGCH),measurement for serving and neighboring cells, reading BCCH of serving and neighboring cells when in random access procedure;
（4）Test on Measurement of RSCP of serving and neighboring cells, reading SACH,FACCH and TCH, sending SACH,FACCH and TAH, configuring DCH, channel handover;

In the protocols test above, the test procedure and contents are introduced, and in Td-SCDMA system, the system test, RF test, terminal test and the protocol test should be performed, here only the detail of the protocol test is given out for the time limited. In protocol test, the OSI9646 standard is adopted which is adopted in communication protocol test usually; TTCN is a standard AST description language where the Tree-Table is combined, so when implementing the TD-SCDMA terminal protocols, SDL AND TTCN SUITE4.0 of TELELOGIL AB TAU is adopted, which is a tool for simulation, development and test, it can do simulation test and online test.

For example, a assumed X protocol and its ITU, it needs the user to define a new data type, when defining the timer, variable, constant, PDU is used by ASP, and the default dynamic action is used. It is showed in figure 3.

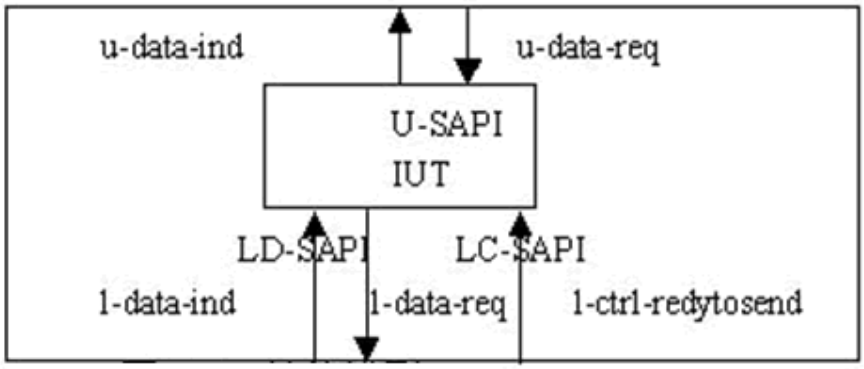

Figure3. The model of X protocol

As Showed in figure 3, X protocol is at the N layer of the protocol layer, and it has a service access point, U-SAPI, with upper layer (N+1), and it has two service access points with layer N-1. LD-SAPI is used for data transmission; LC-SPAI is used for control, as Figure 4.

primitive	parameter	explain
u-data-req	pdulen	This parameter specifies the real byte number of the PDU from the upper layer.
	payloadtype	The type of PDU is control or data
	pdu	It is a number set with length of 60 bytes
u-data-ind	pdulen	This parameter specifies the real byte number of the PDU from the upper layer.
	payloadtype	The type of PDU is control or data
	pdu	It is a number set with length of 60 bytes
l-data-req	sendnumbers	this parameter indicates if there is data to transmit.
	pdu	It is a number set with length of 60 bytes
l-data-ind	pdu	li Data[1] ... Data[20] Bsn block number, (0~7) payloadtype Li, the real data length. Data[1] ... Data[20]
l-ctrl-readytosend		

Figure 4. X protocol function

As the X protocol function in Figure 4, assumed that the connection has been setup, the data can be received and transmitted, it also assumes that no error happen to the bottom layers, so the data loss is not considered; The SDU from upper layer is received, the SDU bigger than 20Byte is segmented into small SDU with the length of 20Byte, then it is added with BSN and LI and padded as PDU to transmit, and the new BSN is started from 0; The number is 7 if the segmentation is end, if there is a segment, it is numbered as 7. Control SDU always has a block, it don't need segmentation; It receives the

L-Ctrl-readytosend from the bottom layer, and transmit the PDU padded, set send numbers=1, if no PDU to transmit, set v, the control block has higher priority; the L-Ctrl-readytosend of the bottom layer is transmitted once per 20ms; Receiving the data from the bottom later, integration the data belonging to the same PDU and send to upper layer. The purpose is to introduce how to construct the test case by TTCN.