

TR-117

Broadband Trouble Reporting

Issue Number: 1.0
Issue Date: December 2007

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Version History

Version Number	Version Date	Version Editor	Changes
Issue 1.0	December 2007	Anna Salguero - AT&T Labs	Original

Technical comments or questions about this document should be directed to:

Editor Anna Salguero AT&T Labs Anna_Salguero@labs.att.com
**Operations &
Network
Management
WG Chair** Peter Adams BT peter.f.adams@bt.com

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Summary

This document defines a common way to define and exchange DSL trouble information between service providers. It facilitates cooperative service restoration through agreement on a framework for DSL Fault Management that includes consistent criteria for trouble declaration, definition of trouble types, and definition of trouble attributes. This also provides both a method of exchanging trouble information and guidelines for declaring troubles so that service providers can exchange reliable and complete trouble information.

The Broadband Forum Technical Report TR-117

Broadband Trouble Reporting

1 Purpose

According to TR-022, *The Operation of ADSL-based Networks*, the definition of the flow of data across inter-provider interfaces will be an important enabler for operations and will be the subject of another Broadband Forum document. This TR defines such data and in particular is focused on the exchange of trouble reporting data between providers.

By defining a framework for DSL Fault Management, this Technical Report intends to facilitate the co-operation between providers (as defined in TR-022) with the goals of improving customer service by reducing Mean Time To Repair (MTTR) and reducing cost by eliminating confusion and automating information exchange.

The primary information to be exchanged is a trouble report. The trouble report is an abstract representation (shared over an inter-provider interface) of a provider's internal trouble ticket information that is in turn based on alarm, test, performance or customer reported information.

2 Scope

The trouble reporting interface defined in this Technical Report is intended to be used among service providers and network providers, including each of the following inter-provider interfaces defined in TR-022:

- Service to Access Provider Interface (SA)
- Service to Regional Network Provider (SN)
- Regional Network to Access Provider (NA)¹
- Access to Loop Provider (AL).

This trouble reporting interface is also applicable to the Service Customer to Service Provider Interface.²

This Technical Report intends to build upon existing industry standards for Trouble Reporting wherever possible. In particular, ITU-T X.790, *Trouble management function for ITU-T applications*, has been considered as foundational to the proposals made by this contribution.

¹ The Regional Network to Access Provider Interface is listed in TR-022, but it is not used in Figure 2/TR-022. It seems assumed that a pure Regional Network Provider will not have a trouble reporting interface or any other DSL contracting relationship with a pure Access Provider.

² When used for the Service Customer to Service Provider Interface, CTR information and some trouble type values are not applicable.

It is intended for the DSL-specific trouble reporting requirements identified within this TR to be considered by the ITU-T for possible incorporation into an updated version of the new NGN Trouble Administration ITU-T Rec. M.3343.

Another relevant industry standards organization (with respect to North America) to coordinate with is the ATIS Telecom Management and Operations Committee (TMOC) TA Task Force – Trouble Administration (see <http://www.atis.org/0130/tatf.asp>).

TR-117 is organized as follows:

- Section 4 discusses the relationship between the Trouble Report, the Customer Trouble Record, the Service Request Record and the Trouble Ticket.
- Section 5 presents a list of DSL trouble types.
- Section 6 discusses the CTR Endorsement Status and a list of values for this attribute of a trouble report.
- Section 7 discusses the exchange trouble report information between providers.
- Section 8 discusses the need to define an information model to support Broadband trouble reporting.

2.1 Abbreviations

AL	Access to Loop Provider
AN	Access Node
ASN.1	Abstract Syntax Notation One
BNG	Broadband Network Gateway
CPE	Customer Premise Equipment
CSR	Customer Service Representative
CTR	Customer Trouble Record
DNS	Domain Name Server
DSL	Digital Subscriber Line
MTTR	Mean Time To Repair
ONM	Operations & Network Management
NA	Regional Network to Access Provider
SA	Service to Access Provider Interface
SN	Service to Regional Access Provider
SRR	Service Request Record
TMOC	Telecom Management and Operations Committee

2.2 Conventions

In this document, several words are used to signify the requirements of the specification. These words are often capitalized.

- MUST** This word, or the adjective “REQUIRED”, means that the definition is an absolute requirement of the specification.
- MUST NOT** This phrase means that the definition is an absolute prohibition of the specification.
- SHOULD** This word, or the adjective “RECOMMENDED”, means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications must be understood and carefully weighted before choosing a different course.
- MAY** This word, or the adjective “OPTIONAL”, means that this item is one of an allowed set of alternatives. An implementation that does not include this option **MUST** be prepared to inter-operate with another implementation that does include the option.

3 References

The following Broadband Forum Technical Reports and other references contain provisions, which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All Technical Reports and other references are subject to revision; users of this Technical Report are therefore encouraged to investigate the possibility of applying the most recent edition of the Technical Report and other references listed below. A list of the currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

- [1] Broadband Forum TR-022 (June 1999), *The Operations of ADSL-based Networks*.
- [2] ITU-T Draft Recommendation M.3343 (June 2006), *Requirements and Analysis for NGN Trouble Administration across B2B and C2B interface*
- [3] ITU-T Recommendation M.3208.1 (October 1997), *TMN Management Services for dedicated and reconfigurable circuits network: Leased circuit services*.
- [4] ITU-T Recommendation X.790 (November 1995), *Trouble Management Function for ITU-T Applications*.

4 Trouble Management Functional Model

This section defines a functional model for trouble management among service customers, service providers, and network operators. It defines the terms Trouble Report, Trouble Ticket, Customer Trouble Record and Service Request Record.

On each trouble reporting interface, one side of the interface performs the customer role and one side performs the provider role. A Service Customer can only perform the customer role, since the service customer is the end customer and does not provide telecommunications services to another actor. A Service Provider (by definition) performs the provider role to its customers. A Service Provider also performs the customer role toward a Network Operator or another Service Provider that it relies on to carry its telecommunications traffic. A Network Operator is an actor that (by definition) only performs the provider role. A Network Operator in this context does not subcontract to other Service Providers or Network Operators. This model is based on ITU-T Rec. M.3208.1 and used by Rec. X.790. This model allows that a business entity can be both a Service Provider and a Network Operator under its definitions.

A trouble report is a message exchanged on a trouble reporting interface. This TR will use the term trouble report only for the message and not for the record of the trouble (whether received or sent) that is maintained on either side of the trouble reporting interface to manage the trouble and the interaction. A record of a trouble that a provider keeps about a customer's complaint (where a trouble report can be recorded) is called a Customer Trouble Record (CTR). A record of a trouble that a customer keeps about its complaint to a provider is called a Service Request Record (SRR).

The Trouble Ticket is used internally by a provider to manage the trouble resolution process. A CTR can trigger the creation of a Trouble Ticket, if it is unrelated to any exiting trouble ticket. Otherwise, it is associated with the related Trouble Ticket. A trouble ticket can be created solely based on network detected alarms without a CTR input. A provider's internal Trouble Ticket can trigger the creation of an SRR and a Trouble Report to be sent to another provider. Figure 1/TR-117 illustrates this Trouble Management Model. It shows the forward direction of trouble reporting where a customer reports to a provider. The backward direction, where a provider reports to affected customers, is also supported by this model, but not shown in Figure 1/TR-117.

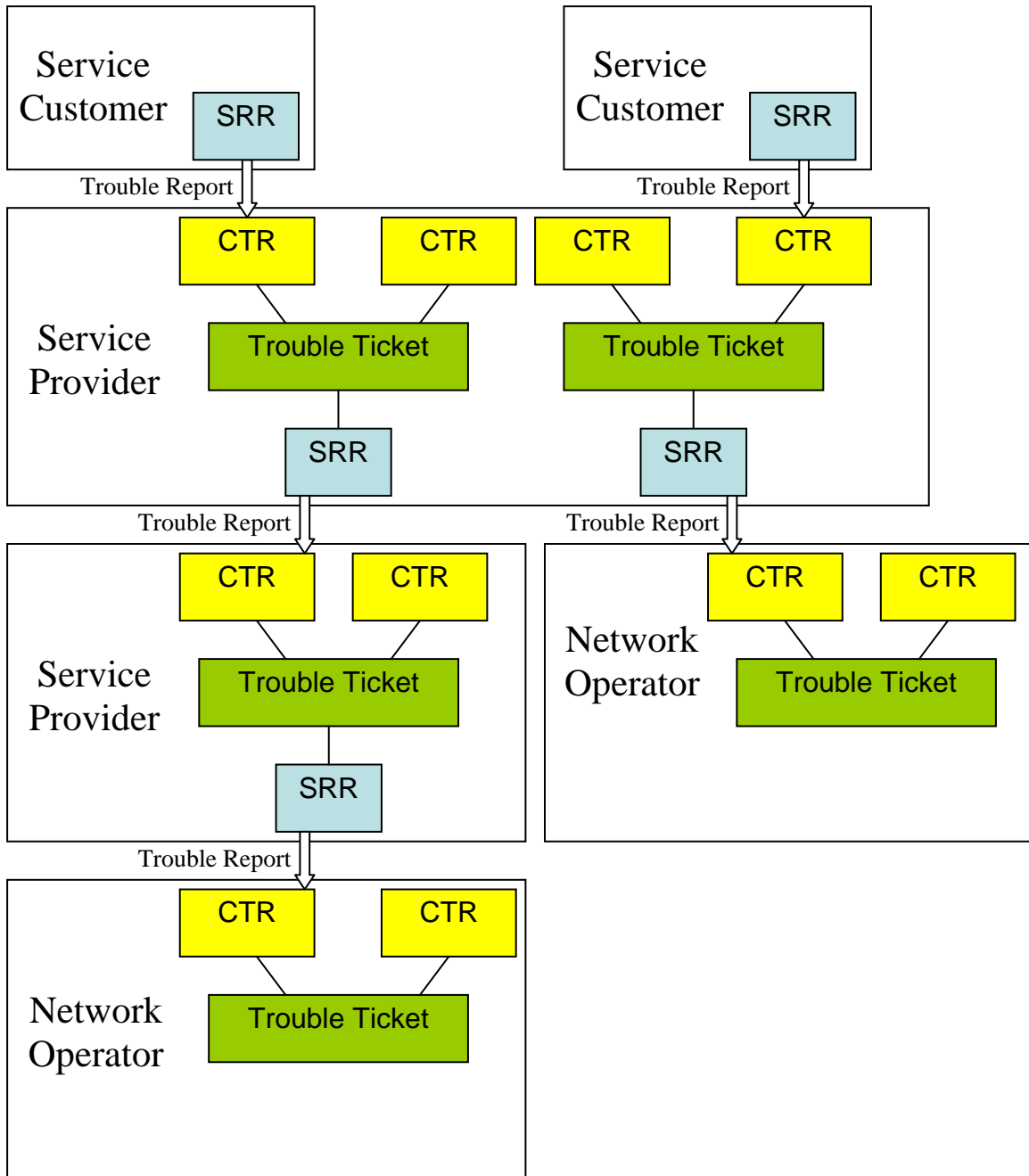


Figure 1 - Forward trouble reporting

It is possible for CTRs and SRRs to exist prior to a trouble report being sent, since such a record is the place to store information while creating the trouble report. While the common flow is for a customer to send a trouble report based on its SRR and the provider to create a CTR in response to receiving the trouble report, the reverse flow is also supported by this TR. In the reverse flow, the provider detects a trouble and sends a trouble report to the customer who creates an SRR in response to track the trouble and

verify that the provider resolves the trouble. This reverse flow can also be used by a provider to notify a customer of planned outages.

4.1 Application of the Functional Model to Broadband Trouble Reporting

TR-022 defines two types of Service Provider and two types of Network Operator. The Loop Provider and the Regional Network Provider are pure Network Operators in the DSL trouble reporting context. They perform only the provider role and do not contract out to any other provider. The Service Provider and the Access Provider are Service Providers in the DSL trouble reporting context. The Service Provider performs the provider role to the Service Customer and performs the customer role to the Regional Network Provider and the Access Provider. The Access Provider performs the provider role to the Service Provider and performs the customer role to the Loop Provider. Figure 2 illustrates these relationships and is based on Figure 2/TR-022.

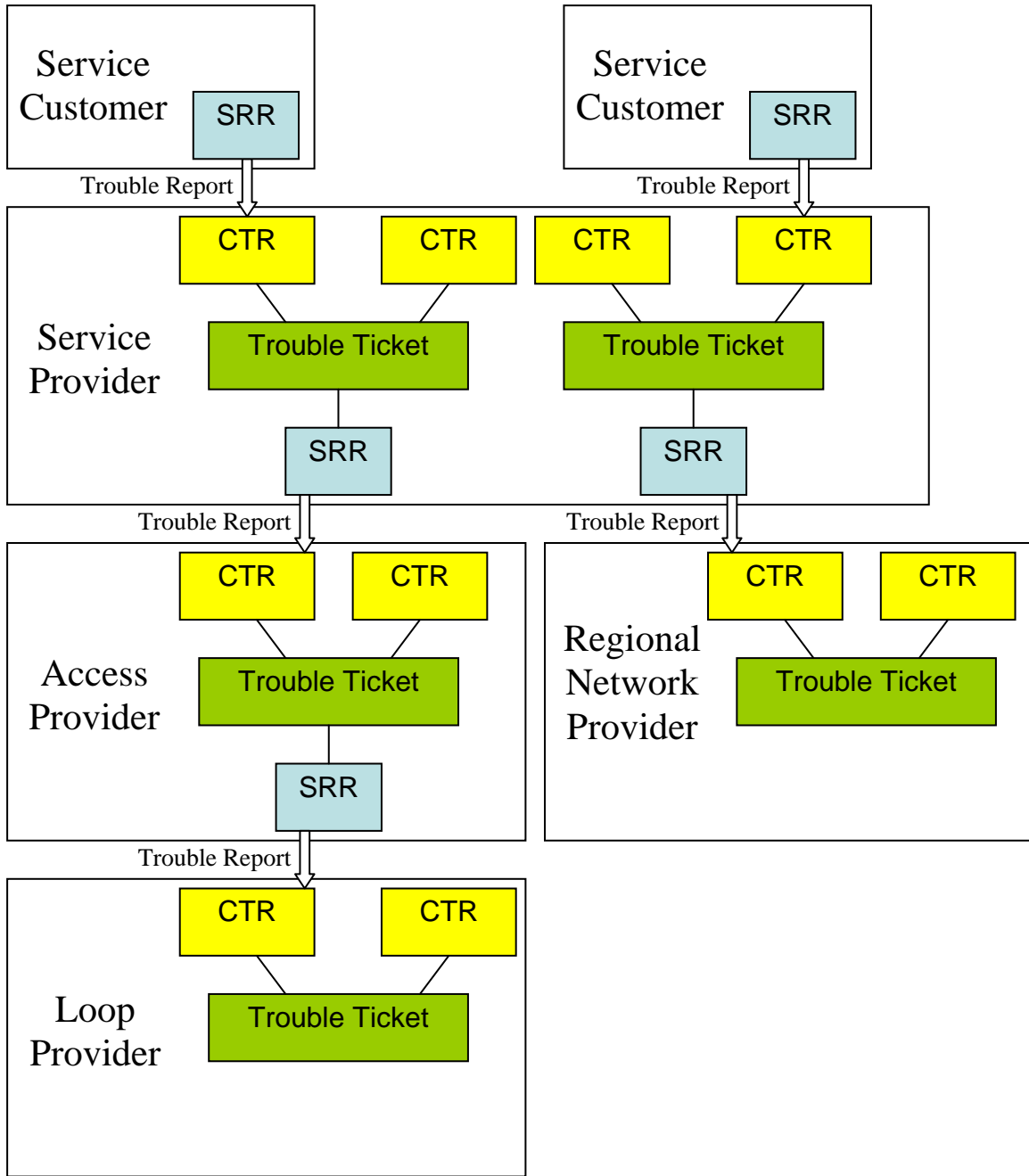


Figure 2 - Forward trouble reporting applied to DSL operations

4.2 Customer Trouble Reporting Outside the Automated Interface

It is not expected that all customers use the electronic interface described in this TR. End-customers in particular, such as residential and small business customers, are not necessarily able to support automated trouble reporting. A service provider will also accept a customer’s report of trouble through other interfaces including telephone and fax and create a CTR based on that input.

On first contact with the customer the Service Provider Customer Service Representative (CSR) will listen to the customer’s complaint, which will be expressed in terms of symptoms that relate to the service they are using. They can ask probing questions to elicit further information, e.g., “Is the modem/router power/sync light on”. The result of this dialogue is that the Service Provider CSR will choose a trouble type (see Section 5 for a list of DSL trouble types).

Depending on the result of the initial exchange with the customer, the CSR can invoke one or both of two test options. The first test option is to access the Auto-Configuration Server and extract configuration and performance data from the customer’s gateway router/modem, or even terminal. This can point to a CPE problem or indicate that there is a network problem. The second test option is to use service-specific network testing that the network provider supplies. The results of these tests will lead to an updated trouble report with a trouble type value that can be reflected in a trouble resolution attribute rather than over-writing the initially reported trouble type.

Figure 3 shows how Trouble Reporting applies to DSL services. For simplicity, Figure 3 shows only one network provider. It can be extended to multiple network providers.

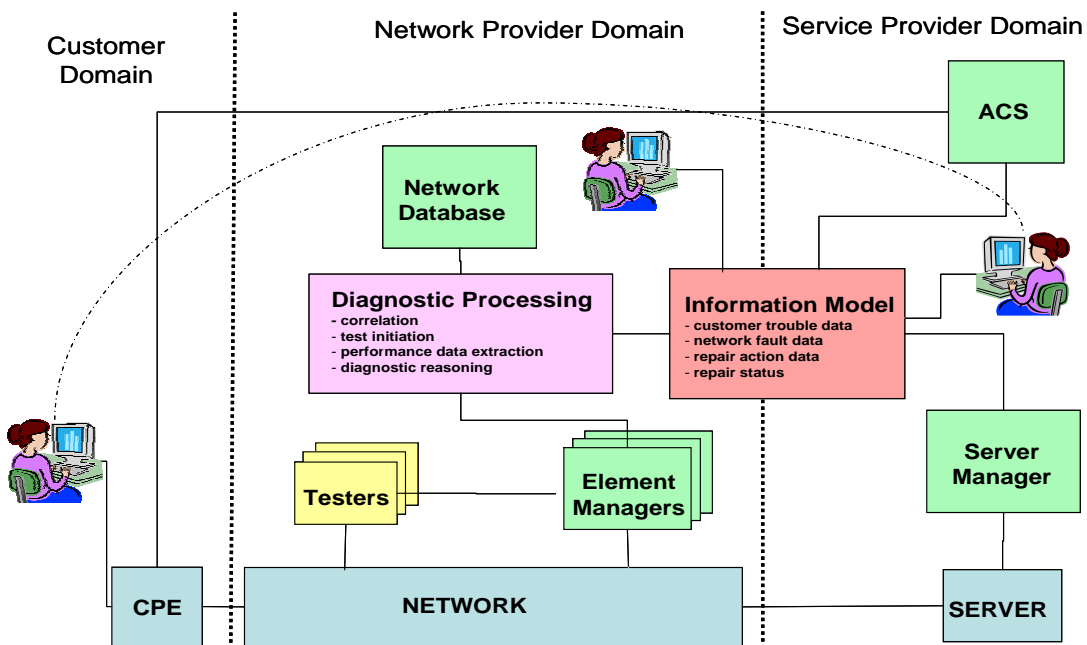


Figure 3 - Fault management process

4.3 Associating Trouble Tickets with CTRs

CTRs are a subject of this TR because a CTR from a customer can be the driver for a outgoing trouble report sent on to the next provider, in a recursive process of notification from the end customer to the network operator capable of addressing the trouble.

CTRs need to be kept distinct from an associated trouble ticket. The CTR is a record of an interaction with a customer about a trouble that the customer perceives, rightly or wrongly. A trouble ticket is a record of the trouble condition itself and the process of resolving the trouble. Many customers can contact a provider about the same trouble condition (a single fault, or impairment of a network resource). Conversely a single CTR can in a few cases correspond to more than one trouble condition in the network. Providers need to be able to track CTRs and trouble tickets separately, but be able to record the many-to-many relationships between them.

NOTE - A similar logic seems to apply to SRRs, but if a service provider needs to contact two other providers to sort out the problem, then those are two distinct troubles that need to be handled by two distinct trouble tickets. Since the relationship between trouble ticket and SRR is one-to-one, the SRR could be a part of the Trouble Ticket, but a separate object for the SRR would still be desirable since some trouble tickets would not generate an SRR.

5 DSL Trouble Types

The proposed hierarchical classification of DSL trouble types reflects the information derived from customer reported symptoms and service test results. The list also includes trouble types corresponding to root causes that are appropriate only in the later phases of troubleshooting.

DSL trouble types are identified in Table 1. Column A of Table 1 contains the name of the DSL trouble types in Abstract Syntax Notation (ASN.1) format. A description of the trouble type appears in column B. Column C contains the numeric values to be used to identify DSL-specific troubles in an ITU Rec. X.790 or other Trouble Administration interface implementation, based on the functional requirements defined in ITU Rec. M.3443.

Table 1 - DSL trouble types

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
Data Troubles Group (1200)		
noDSLConnectivity	An out of service condition characterized by no synchronization or poor synchronization numbers (i.e., parameters out of specifications).	1232
slowDSLThroughput	An Affecting Service condition characterized by slow response times to the customer.	1233
Access Network Troubles Group (1900)		
accessBearerFault	Access Network bearer fault	1901
circuitDead	Appears electrically dead	622*
grounded	Grounded	603*
short	Shorted	1902
loopDegradation	Impaired loop	1903
elecInterference	Electrical interference fault	1904
loopFault	Other loop fault	1905
Customer Account Related Group (2000)		
accountFault	General Account Management problem	2001
svcDisconnect	Service disconnected (finance, policy, customer order)	2002
notDSLCustomer	Not a DSL customer	2003

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
notRegisteredforService	Customer, but not registered for service (e.g., backend assigned id failed or customer self assigned id not done)	2004
Aggregation Network Troubles Group (2100)		
aggregationNetworkFault	Aggregation Network Fault	2101
accessNodeFault	Access Node fault	2102
accessNodeLineCardFault	Access Node line card fault	2103
accessNodeConfigFault	Access Node configuration fault	2104
aggregationNetworkFaultATM	Aggregation network fault – ATM	2105
Authentication Troubles Group (2200)		
authProblem	Authentication problem	2201
passwordReset	Password reset	2202
authenticationFailed	Could not authenticate user, notice mailed	2203
Broadband Remote Access Server Troubles Group (2300)		
bngFault	BNG fault	2301
bngConfigProb	BNG configuration problem	2302
bngANConnectivityLoss	BNG to Access Node connectivity loss	2303
Configuration Troubles Group (2400)		
configurationIssue	Configuration issue	2401

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
configurationQuestion	Configuration is inconsistent with customer's expectation	2402
configurationMismatch	Configuration is inconsistent with order/billing	2403
CPE Troubles Group (2500)		
cpeDCNFault	Trouble in the DSL customer's DCN	2501
cpePerformance	CPE Performance Issue	2502
routerConfiguration	Improper configuration of CPE router	2503
cpeFirewall	Blocked by network firewall	2504
pcSoftwareInterference	PC Software interference	2505
applicationConfiguration	Application misconfigured	2506
cpeDriver	CPE configuration – network drivers	2507
cpeDHCP	CPE Configuration – DHCP (Domain Name Server [DNS], gateway, etc.)	2508
Customer Application Troubles Group (2600)		
custApplication	Customer application problem	2601
slowConnection	Application runs too slowly, e.g., web pages download slowly	2602
noConnection	Can connect to server but can't display web pages	2603

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
cpeReconfiguration	Application no longer works following regrade/reconfiguration (i.e., worked ok before)	2604
freezeFrame	Video customers experiencing freeze framing (e.g., the result of corruption of I-frames)	2605
poorPictureQuality	Video customers experiencing poor quality video (e.g., the result of transcoding to a lower bit-rate stream)	2606
pictureBlockiness	Video customers experiencing temporary picture blockiness (e.g., the result of corruption of B-frames)	2607
Customer Connection Troubles Group (2700)		
custConnectionProblem	Customer connection problem	2701
noSession	Inability to initiate session	2702
neverSession	New account, never successful	2703
unavailableToInitiateSessionWorkedBefore	Worked previously, now can't initiate session	2704
intermittentlyUnavailToInitiateSession	Intermittently cannot initiate session	2705
dropSession	Session does not stay up	2706
connectionDrop	Can connect, but connection drops out rapidly	2707

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
noSync	No sync indication on modem router	2708
timeout	Appears to time out	2709
timeoutInactivity	Appears to time out due to inactivity	2710
timeoutWhileActive	Appears to time out while active	2711
DNS Troubles Group (2800)		
dnsFault	Domain Name Server fault	2801
Filter Troubles Group (2900)		
filter	DSL filter issue	2901
filterAbsent	Missing filters	2902
filterIncompatable	Incorrect filters	2903
filterDamaged	Damaged filters	2904
Inside Wiring Troubles Group (3000)		
insideWire	Inside wiring	3001
insideWireDegraded	Inside wiring – degraded (e.g., cracked wiring)	3002
insideWireGroundLoss	Inside wiring – grounding loss	3003
insideWireDefect	Inside wiring – defective (puncture)	3004
insideWireAltered	Inside wiring altered (cord change, wiring change, connection change, passive device change, location change, etc.)	3005

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
insideWireEndpoints	Inside wiring endpoints are defective (loose wiring, corrosion, dirt, paint over, etc.)	3006
IP Network Troubles Group (3100)		
ipNetwork	IP network fault	3101
Latency Troubles Group (3200)		
latency	Latency is unsatisfactory	3201
Modem Troubles Group (3300)		
modemfault	DSL modem issue	3301
modemAuthFailed	Modem authorization failed (e.g., LDAP, RADIUS)	3302
modemIP	Modem did not receive IP address	3303
modemLOS	Modem did not detect physical broadband connection	3304
failureToTrain	Modem not able to train	3305
modemPower	Modem not powered (e.g., not plugged in, switched outlet, switched power strip)	3306
modemDead	Modem is not operational (damaged)	3307
modemSoftware	Modem Software has known limitation/issue	3308
modemACS	Modem not properly configured – ACS	3309

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
modemIPConfiguration	Modem not properly configured – Public IP block (vs. single dynamic IP address)	3310
modemFirewall	Blocked by modem firewall	3311
modemPortForwarding	Improper or lack of modem port forwarding	3312
modemIncompatible	Improper modem for service	3313
modemAbsent	Not using modem when one is required	3314
Network Interface Troubles Group (3400)		
nidFault	Network Interface Device fault	3401
Loop Qualifications Troubles Group (3500)		
loopNotQualified	Loop not qualified for DSL service ordered	3501
notQualifyingFeature	DSL disqualifying service present (alarm system, door service, etc.)	3502
notQualifiedDistance	Not qualified based on distance from Access Node	3503
Security Troubles Group (3600)		
generalSecurity	General security Issue	3601
excessiveSessions	Excessive sessions (e.g., caused by Virus)	3602
denialOfService	Denial of service	3603

Trouble Type Name (A)	Description (B)	Trouble Type Value (C)
Throughput Troubles Group (3700)		
throughputUnsatisfactory	Throughput is unsatisfactory	3701
lowThroughput	Un-errored, low transmission rate	3702
erroredTransmission	Errored transmission	3703
erroredSwap	Modem swapped, still errored	3704

NOTE 1 - Trouble Type values identified by an asterisk (*) in Table 1 are referenced from ITU Rec. M.3443 and are applicable to DSL trouble reporting.

NOTE 2 – The Data Troubles Group (1200) in ITU Rec. M.3343 contains Trouble Type values from 1201 through 1231. DSL trouble type values 1232 and 1233 in Table 1 are pertinent to the Data Troubles Group in ITU Rec. M.3343. These two DSL trouble type values are uniquely labeled herein in the event that the trouble reporting information model defined in ITU Rec. M.3343 is extended to include a comprehensive list of NGN trouble types, including these DSL trouble types defined in Table 1.

NOTE 3 - The two-level hierarchy leveraging the use of Trouble *Groups*, as shown in Table 1, is consistent with the approach taken in ITU Rec. M.3343 (and ITU Rec. X.790).

TR-117 is not intended to stand on its own as a Trouble Reporting reference. Rather, it is intended that TR-117 leverage existing requirements for Broadband Trouble Reporting (e.g., ITU Rec. M.3343) to enable standard inter-carrier reporting of DSL troubles. The next two requirements apply.

R-01 Trouble Administration processes supported via mechanized interfaces between administrative domains such as Customers, Service Providers, and Network Operators **MUST** support the DSL Trouble Types and Trouble Type Values listed in Table 1.

R-02 Administrative domains supporting DSL Trouble Reporting **MUST** support the trouble report content, creation, tracking, management, and resolution functional requirements defined in ITU Rec. M.3343.

6 Representing CTR information in Trouble Reports

6.1 Characterization of Customer Reported Trouble Information

When trouble report information is exchanged between providers, it is important that providers have a common understanding of how to interpret the data. To help facilitate this common understanding, this section describes guidelines for categorizing and qualifying (i.e., confirming the merit of) customer reported trouble information.

A provider needs to manage troubles received from its customers individually to support the satisfaction of each customer.

The CTR contributes to fault localization and the creation of a trouble ticket, but its primary function is to facilitate interactions with the customer. The CTR is the institutional memory of the customer's complaint and the provider's response to it. The CTR also enables automation of customer care; it supports escalation, trouble status, update reporting to the customer, and broader customer relationship management activities. While CTRs are not wholly shared between providers, key information is shared such as the type of trouble and the degree to which the trouble has been validated. Thus standardization of these data elements is highly desirable.

6.1.1 CTR Endorsement Status

The endorsement status is an attribute of a trouble report that qualifies the contributing CTR when a CTR is the primary indicator of the trouble. When persistent alarms events or test results exist that fully characterize the trouble the CTR information including the endorsement status can be omitted from the trouble report. When no CTRs are related to a trouble report, then CTR information including the endorsement status is not applicable and needs to be omitted from the trouble report.

The endorsement status represents the results of CTR verification in a trouble report exchanged between providers. CTR verification can be accomplished to varying degrees through soliciting information from the reporting customer, verification of configuration data, through cross-reference to other CTRs and existing trouble tickets, and through testing. An endorsement status would indicate that the provider that received the CTR from the customer is endorsing the complaint to a greater or lesser degree. An endorsement would be a further aid to prioritizing and resolving the trouble for the provider receiving the trouble report.

Table 2 contains a set of endorsement states to convey the degree of validation performed on customer input. The table is arranged in increasing order of confidence. Only one state is meant to be used at a time. The states are defined so that if a later state applies, any earlier state that also applies is not relevant to note. For example, if the CTR is confirmed by testing, it does not matter whether there are related CTRs or whether the customer is trusted or not, it is quite clear from the test that the trouble is valid.

Table 2 - Endorsement states

Endorsement State	Meaning
UNVERIFIED	Completely unverified, customer's raw input, unquestioned
CONSISTENT	Complaint is consistent with customer's order and current configuration
COHERENT	Customer confirmed symptoms of the trouble, complaint appeared credible
TRUSTED	Trusted Customer (customer has been trained or certified and/or has a positive CTR history), unverified
COMMON	Common Complaint – other related CTRs corroborate this CTR
TESTCONFIRMED	Testing confirms the complaint
NETDETECTED	Mapped to network detected trouble

R-03 Administrative domains supporting DSL Trouble Reporting **MUST** support the endorsement states defined in Table 2.

NOTE - It is recommended that a new attribute called Endorsement State be added to the trouble report record defined in ITU Rec. M.3343.

7 Trouble Reporting Between Providers

This section contains criteria for exposing trouble report information to other providers based on a need for cooperation in trouble resolution.

7.1 General Requirements

The purpose of trouble reporting is the exchange of trouble report information to another provider to facilitate restoration and repair of faults and resolution of the trouble. Trouble reporting is not an end in itself.

R-04 Trouble reporting **SHOULD** be a pair-wise exchange of data between two providers on a need to know basis. It should not be a broadcast of all trouble information to all providers.

Restricting trouble reporting to recipients with a need to know not only protects proprietary information; it also reduces the volume of information and focuses the data exchange on the relevant issues.

- R-05 As each trouble ticket is created by a provider, network topology and network element configuration records **MUST** be evaluated to determine whether the trouble has an impact on another provider. If there is an impact on another provider, a trouble report **MUST** be sent to that provider. The trouble report will be delivered on an interface that is encrypted to prevent inappropriate disclosure.
- R-06 In addition to automatic reporting when the trouble is declared, the trouble reporting interface **MUST** automatically report trouble status and content changes, including a change to the trouble type and the endorsement status.
- R-07 The trouble reporting interface **MUST** support trouble queries and the return of trouble information in response.
- R-08 Trouble queries **SHOULD** be honored only according to the same need to know criteria that govern trouble reports.

8 Information Model for NGN Trouble Reporting

A protocol-neutral information model is needed to represent troubles and all trouble attributes relevant for exchange between providers in resolving troubles. It would represent partially characterized troubles as well as thoroughly characterized troubles. It would represent network detected troubles as well as customer reported troubles. It would support autonomous notifications of trouble declaration and updates of trouble information as well as queries of active troubles. It would support compartmentalization of trouble information by cooperating provider and appropriate security features.

Furthermore, the model also represents the relationship between CTRs and trouble tickets used both internal to a provider and for trouble reports between providers. Each CTR contains a set-valued attribute containing related trouble ticket numbers. Each trouble ticket needs to contain a set-valued attribute containing related CTR numbers.

A complete specification of a trouble reporting interface includes functional requirements, an information model, and the selection of one or more management protocols. ITU-T Rec. X.790 provides an example of a trouble reporting interface specification. The information model found in ITU-T Rec. X.790 is a protocol-specific model (specific to CMISE). Though useful, a trouble reporting information model is needed that extends ITU Rec. M.3343 to include a comprehensive list of NGN trouble types, including the DSL trouble types defined in Table 1.