Post- og teletilsynet

(Norwegian Telecommunications Regulatory Authority):

Model for

Service Level Agreement (SLA)

Included Quality of Service (QoS) descriptions

(An abbreviated and unauthorized machine translation from Norwegian to English, performed by The Norwegian Telecommunications and Information Users Group, NORTIB, January 2005)
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Preface

The document is prepared by a project under the direction of Post-and teletilsynet (the Norwegian National Regulatory Authority) and based on an initiative from the Norwegian Tele- and Information Users Group (NORTIB). The document has been an object for a broad hearing by providers and users.

The document is not a part of Norwegian rules in the telecoms area, but can contain aspects which are, or can get, regulated. In case differences should arise between this document and Norwegian rules, the requirements in Norwegian rules apply.

This document is primarily intended for use in connection with agreements between larger telecoms users and telecoms operators/providers, and is a model for an agreement about product- or service quality between a customer and a supplier. The document can also be used as a "shopping list" in case the two parties agree on a completely other structure for an agreement. For example one can reduce the number of appendices and gather more relevant aspects in a common appendix.

A SLA is a contract between supplier and customer concerning the delivery of a service. The contract shall express a common understanding by the parties concerning the quality of the service, and the parties' responsibilities, duties and rights. A precise SLA should also serve as a basis for systematic and effective cooperation between supplier and customer, with a minimum of misapprehensions and delays.

This document include both commercial relationships and specifications of the network services, of appurtenant administrative and operational processes, and of the quality of deliveries of all these.

An introductory text is given in italic to a number of the items in the model. These texts are meant as guidance, and are not a part of the agreement itself.

In this model of a SLA the ITU-T Rec. E.860 and ETSI EG 202 009-3 are taken as a starting point for definitions of QoS and the SLA and in the content of the document.

Some parameters and measuring methods are taken from ETSI EG 201 769-1 and ETSI ETR 138. Also are included the parameters given in the document “Quality parameters of ISDN basic connection”, which is a contribution from NORTIB to the project.

The systematic division in functional service areas is taken from ITU-T Rec. X.700 for “Telecommunications Managed Networks” (TMN).

ITU-T Rec. E.860: "Framework of a service level agreement"

ETSI EG 201 769-1: “Parameters for voice telephony service required under the ONP Voice Telephony Directive 98/10/EC"

ETSI ETR 138: “Quality of service indicators for the Open Network Provision (ONP) of voice telephony suspected Integrated Services Digital Network (ISDN)”

ITU-T Rec. X.700: “Management Framework for the Open Systems Interconnection (OSI) for CCITT Applications”

ETSI EG 202 009-3: “Template for Service Level Agreements (SLA)"
A little about ITU-T Rec. E.860
Recommendations in the E-series concern "Overall network operation, telephone service, service operation and human factors – Quality of telecommunication services: concepts, models, objectives and dependability planning – Use of quality of service objectives for planning of telecommunication networks".

A little about ITU-T Rec. X.700
The recommendations in the X-series concern digital data networks which are specified in the OSI model (Open System Interconnections). Other well known recommendations are ITU-T Rec. X.21 and ITU-T Rec. X.25 for respectively line switched and packet switched subscriber interfaces, and ITU-T Rec. X.400 for electronic mail services.

ITU-T Recommendations can be bought from Norges Standardiseringsforbund (Pronorm AS):
http://www.standard.no/

ETSI standards can be downloaded for free from ETSI at this internet address:
http://pda.etsi.org/pda/
1 Introduction.
This is an agreement between XXX (henceforth called customer) and YYY (henceforth called supplier) for delivery of .... (Ref. Appendix J).

2 Appendices and document ranks.
Overview over relevant appendices (the parties can choose to neglect some of them, and agree on others):

Appendix A: Log over changes in document(s)
Appendix B: Definitions, descriptions of notions and abbreviations
Appendix C: Agreement of quality of service(s)
Appendix D: Commercial and technical points of contact
Appendix E: Fault handling
Appendix F: Prices
Appendix G: Invoicing
Appendix H: Compensations
Appendix I: Suppliers product leaflet
Appendix J: Specification of delivery and connection of the service

It must be stated which mutual rank the different documents in the agreement shall have. Normally the appendices will rank over the main document. Appendix C should rank before Appendix I.

Appendix C is a model for agreement of the quality level of the service(s). The SLA shall contain target values for Quality of Service (QoS) of important functional parameters and methods for verification, plus descriptions of feasible reactions when deviations occur. It can be made separate sub-appendices for each main service included in the SLA.

Appendix A is a log over all changes in the agreement. This appendix has rank before all other documents.

3 Definitions, descriptions of notions and abbreviations
See Appendix B. Definitions are as far as possible based on international standards. The parties can specify what definitions are relevant for the agreement. The parties can also agree to adapt/modify the definition according to individual need.

4 Scope
This agreement includes the delivery of following products and services: (In this model ISDN basic rate access).

5 Professional secrecy
The parties shall keep as company secrecy all confidential information, know-how, other confidential material and all information and material which according to its character should be regarded as business secrecy, and which the parties get to know through the agreement. All material marked confidential or alike, or information about personal relationships, information which can damage one of the parties or which can be exploited by others should be handled in the same way.
Professional secrecy should also be applied to the employees of the two parties and to persons who deal on behalf of the parties in connection with the agreement.

Professional secrecy should as a minimum satisfy the requirements of the Public Administration Act on secrecy.

The parties should take all necessary precautions to secure that material and information never get to the knowledge of others - in conflict with this agreement. This is also valid after a termination of the contract. Employees or others which relinquish his service by one of the parties should be imposed a secrecy also after the resignation about relationships mentioned above.

6 Follow-up

Follow-up defines the frequency (daily, monthly, half yearly…) and the scope of reports and meetings, plus format (paper based, electronic) for exchange of information.

7 Reactions and compensations

Appendix H describes reactions and compensations that can be imposed if the agreed relationship is not fulfilled.

If the quality figures and tolerances given in Appendix C on QoS are not fulfilled the delivery is in principle not completed. The customer can react in many ways, dependent of type and degree of deviation from the contract. The reactions can as an example be to refuse the reception of the service, to refuse payment, to postpone the payment until the matters are settled, to break the contract or to agree on different types of economic compensation. The latter solution is most current if the service lacks capacity, has too many faults, has to long repair times or has too bad follow-up of error messages. Normally a table should be produced showing how the compensation increases with increasing deviation from the agreed quality figures.

Responsibilities for damages following service faults, for customer premises equipment etc. should also be defined.

In Appendix B is given a description of what is meant by quality tolerances.

8 Force Majeure

If an extraordinary situation occur which lies beyond the control of the parties and which makes it impossible to fulfill the duties of the agreement, and which after Norwegian law practice is regarded as Force Majeure, the responsibilities of the hurt party is suspended as long as the extraordinary situation persists. The other party's obligations are then equally suspended in the same period of time. Force Majeure cannot be pleaded in case the party with reasonable means can avoid or conquer the event.

In case one of the parties pleads a Force Majeure situation the other party shall be informed immediately in writing, together with information of the nature of the problem and, if possible, of the duration of it.

If a Force Majeure situation is long-lasting or is of a kind which will be very disadvantageous to one of the parties, the contract can be terminated without being seen as a breach of contract. The party concerned shall alert the other party with at least one month notice.
9 Agreement of Quality of Service (QoS) and handling of deviations.

The functional qualities and the levels of quality of the delivered service(s) are specified in Appendix C. (See also definitions and descriptions in Appendix B.) The specifications include the agreed Description of Service and all relevant quality relationships within the areas of Configuration, Performance, Fault Handling, Security and Invoicing.

10 Transfer of contract to another party.

The parties can only relinquish their rights and duties of the agreement with written consent from the other part. Such consent can only be denied in case the other party has an objective reason to do so.

11 Points of contact.

The interface between supplier and customer can for a SLA be extended into these two categories:

- Business Interface, BI
- Technical Interface, TI

Agreed points of contact are given in Appendix D.

Commercial interface
This interface describes contractual points of contact/-persons between the customer and the supplier. These points of contact are used for specific functions connected to the agreement of product quality as well as to (re)negotiations, performance reports, and to reactions if the agreed level of quality is not delivered.

The supplier shall have a fixed contact person (for example a Key Account Manager) towards the customer. This person shall at all times possess full overview over, and have a close cooperation with all other contact persons under the agreement.

There shall at all times be kept an overview with names of contacts by both the customer and the supplier. (Ref. Appendix D.)

Supplier points of contact for handling of all communications from the customer are given in Appendix D. Rules for handling of communications are given in Appendix E.

Operational interface
This interface concerns points of contact in the technical interface. These points exchange process related information which concerns the technical operations of the service and takes care of measurements of agreed parameters that are included in the assessment of product quality.

11.1 Operational support
If the delivery of the product demands adaptations in the customer's internal systems, the supplier shall give technical and operational support according to agreement.
Intervals of regular maintenance of the service shall be according to agreement, between <time> and <time>.

Occasional weakening of the delivery as a result of non-routine maintenance shall be alerted at the earliest possible time, at least <X> days in beforehand.

Points of contact for operational support and for changes in the configuration of the service(s) are given in Appendix D.

11.2 Fault reporting

Supplier's point of contact for fault reporting from the customer is given in Appendix D. All faults shall be reported to this center, also faults which have arisen in any sub-contractor's network and services.

Agreed requirements of the handling of reported faults are given in Appendix E.

In the appendix is also stated the opening hours for fault reporting, maximum time for confirmation of received error message, start of fault repair, whether fault repair will go continuously, plus routines for escalation to management levels by the supplier.

12 Prices

Prices for the agreed service(s) are given in Appendix F. The appendix should be updated by supplier when agreed changes occur.

Times for potential renegotiations, plus alert times for price changes are also specified in this appendix.

If the prices are deemed no longer to be competitive in the market, the customer can demand immediate renegotiation. In case the supplier does not adjust prices to a level which is in accordance with the general market, the customer should have the right to cancel the agreement with X months warning within the contract period.

Alternatively, or as a supplement, it can be agreed upon a graded scale or a price adjustment formula based on public statistics or similar. If price is dependent on currency exchange ratio the reference exchange ratio and the part of the service(s) being dependent on this ratio should be agreed upon.

13 Invoicing

Appendix G describes how the invoices should be composed ("standard" or "tailored"), at which time they shall occur (in advance or in arrears, every month or every quarter ....) and if they should be sent per paper or electronically. Credit times should be described (normal time should be per 30 days after the date of the bill).

In case the amount is not paid within the agreed time a penalty interest can be agreed upon. Such interest should be based on current legislation.

14 Breach of contract.

Breach of contract from supplier's side includes among other things (Force Majeure is not included):
- The delivery does not satisfy the agreement, such as prices and the quality of delivery.
- The supplier postpones its payment, or debts negotiations are opened, or bankruptcy is declared.
When a breach is found the parties should clarify what prearranged mechanisms should be put in force, such as:
- Work is started to remedy the breach
- The customer gets help from third party paid by the supplier
- The contract is lifted
- The customer demands compensation
- Price reductions

In case no prearrangements exist see 15 Dispute.

Breach from customer’ side includes among other things:
- Changes in – or inside the technical interface which affect functions in supplier networks and services
- The lack of payment within agreed time frames and conditions
- The customer has connected equipment in conflict with the agreement
- The customer has mismanaged customer premises equipment so that it is, or can be wrecked
- The customer has, despite notification, used the service in a way that harms the supplier or third party, for example by using the service in conflict with law.

When breach is found the parties shall clarify what prearranged mechanisms should be put in action, such as:
- Termination of delivery
- Termination of contract

For matters where no prearrangements exist see 15 Dispute.

*In some cases it can be useful to classify a breach according to the seriousness of the breach. One solution could be that trifling mistakes only demand repair within a certain time limit (see Fault repair), a “normal” breach could demand both repair and compensation), whereas a substantial breach could give right to both termination of contract and coverage of incurred costs.*

**15 Dispute**

In case a disagreement occurs about the contract, the dispute should be sought solved by negotiations. If these fail one should first consider arbitration under the dispute law chapter 32 before the case is brought to <court>.

**16 Administration of the agreement**

*It will be sensible to set up the agreement in such a way that chapters which are more susceptible to change en route are put in as appendices to the agreement.*

*Furthermore it should be determined who has the responsibility for commissioning and updating of the agreement, both in paper and electronically.*

*All chapters in the agreement with appendices, including updating, should be signed by both parties.*

**17 Duration of agreement**

*The parties should agree on the duration of the contract and of the rules for any notice or elongation.*
18 Signatures

The agreement should be signed by authorized persons in both parties in order to show that they formally agree to all the conditions and responsibilities.
APPENDIX B

Definitions, descriptions of notions and abbreviations

B.1 The notion Quality of Service (QoS)

Remark: It is not distinguished between “product” (refer the supplier's product descriptions) and “service”.

General definition and description of”Quality of Service”-QoS

In these comments the following definition of QoS is used (ref. ITU-T Rec. E.860):
“The degree of conformance of the service delivered to a user by a provider with an agreement between them.”

Agreement about the character of the delivered service must necessarily be described with definite (ideal) target values and appurtenant acceptable tolerances. This implies that the definition must refer to a deviation in relation to the delivery of the product which the two parties have agreed upon. In many instances the target values are implicit, as an example the target value “error free transmission channel” with a tolerance limit given as an acceptable bit error frequency, or the target value “always non-blocking network” with a tolerance limit given as an acceptable blocking frequency.

This indicates that one operates with to aspects of every relationship:

i) What is specified as a part of the product?

ii) Deviation from what is specified (NB: "specified" can also refer to implicit relationship).

Point ii) refers to the quality as also used within other branches (“does not reach expected tolerances” = “bad quality”).

This is illustrated in Figure 1.

Case I) refers to a complete faultless delivery – one example is that all calls shall be connected to the right B-subscriber (“absolute demands”).

Case II) permits some deviation from the “ideal” – as an example permits 2% of the calls to meet congestion (that is 98% non-blocking) as a part of the SLA.

Case III) shows a service specified with a certain tolerance and where no deviation is permitted beyond this – as an example a delay less than 100 ms and no deviation from this value (“strict quality control”).

For case IV) the service is described with a certain "soft" tolerance, where some overstepping is permitted – as an example delay should be less than 100 ms, but up to 150 ms is accepted for up to 95% of the connections.

The statistical objective is often attached to deviation, ex. that 95% of the deliveries shall be within certain values. This implies that it must be measured over a number of calls and the statistical objectives will be based on these measurements.

Product description and QoS

As a start four factors should be agreed upon:
- The product description (specification) = ideal functionality, target values
- The quality (permitted deviation from the specification) = Quality of Service, tolerance limits (with appurtenant reactions/compensations)
- Price and other conditions for the delivery of the product
Fig. 1 Illustration of different demands of a service and quality of service which can be formulated in the agreement (SLA)

A delivery which have wide tolerance limits in relation to expected objective can be said to have a "bad quality", while narrow tolerances give "good quality". If the delivery lies beyond the tolerance limits the agreement of delivery is not fulfilled and the delivery has in principle not happened. A service must be described by a number of qualities (achievement after the performance of a set of functions), every one with its own QoS statements. A complete delivery has happened only when all QoS-relations imbedded in the delivery are satisfied.

As part of a professional relationship important product aspects, where a check afterwards is wished, should be included in the SLA (Service Level Agreement). The various important product properties should be taken into the description of the product. The QoS part of the agreement should describe acceptable variances for these qualities, in the form of a systematic arrangement of "Agreement on quality of service (QoS Agreement) ".

In everyday talk it is common to have a certain mix of "product" and "variance" – this is often based on the assumption that the parties have a common understanding of an "ideal product" as a reference. One of the problems with this is that the notion "ideal" frequently can be based on subjective evaluations and therefore not easy to act upon by two parties (as with simple selling and buying).

In this relation it is essential that quality should never be baked into the product description – nor should it be perceived as a method of production of the service (but simply be a function/result of the production methods).

This is the challenge: To describe what the service/product actually is. The quality of service (QoS) will be described by three main groups of primary parameters:

Statement of time (ex. delay, variance of delay)
Statement of accuracy (ex. whether a due result is achieved)
Statement of reliability (ex. whether a result is actually achieved)
This is illustrated in Figure 2, where the result after the performance of a function results in a service/product delivery.

One example is the connection of a call:
- Time; ex. connection time – from latest cipher is dialed until a ring back signal is given
- Accuracy; ex. connection to the right number/termination (and not to another number)
- Reliability, ex. whether a connection is made

Another example is delivery precision:
- Time; ex. the agreed time of delivery is achieved
- Accuracy; ex. the delivery is done on the right location
- Reliability; ex. a delivery is made.

In case the service is a transfer of IP-packets this can also be stated by the three same parameter groups:
- Time; ex. time delay for transfer of packets from sender to recipient or jitter (variation in the intervals of arrival) for packets
- Accuracy; ex. the packets arrive at the right recipient
- Reliability; ex. the packet does not get lost during the transfer.

Such a description of the relationship between service and QoS facilitates a common understanding even with different levels of service (and contents of the service). At the same time it is important to specify the nature of the services.

**Product-/service attributes**

As described above QoS relates to the variance/precision of the delivery of the service/product. It is therefore important to describe how the service ideally should function. In many cases a service contains a bundle of properties which can be divided into several "objects". An agreement between the parties must specify which objects should be included. The acceptable variance of each of the objects should also be stated, see Fig. 3. Different QoS-parameters can be attached to different objects.

In an agreement of QoS (QoS Agreement) all the relevant objects should be specified together with their respective tolerances. These objects can be quite different for different products, but they can also be the same. As one example the noise level is important for telephony, and bit error frequency is important for ISDN, but in both instances it is important that the call gets through.

In practice an agreement on delivered quality of service will often be based on the supplier offerings in the form of his own product description, together with changes and additions which come as the result of negotiations.
Recursive Quality of Service

The delivery of a service to a customer can be based partly on sub-supplies from other service operators, see Fig. 4. As an example a network service can be built partly on the rental of lines/transport capacity from another operator. Or the invoicing of a service is done by an accounting company through internal agreement.

The principal supplier to its customer should secure its delivery with adequate part-SLAs towards its subcontractors, included the agreements of quality of service which forms the basis of the agreement with the end user. Ideally there should be a coherent “network” of agreements, where the end user only “sees” his own agreement for service delivery.

B.2 General Concepts

Service Level Agreement (SLA)

According to ITU-T E 860 a SLA is a “Formal agreement between two or more entities that is reached after a negotiating activity with the scope to assess service characteristics, responsibilities and priorities of every part. A SLA may include statements about performance, tariffing and billing, service delivery and compensations. Every performance reporting may include only the QoS parameters agreed in the correspondent SLA.”

Agreed quality of service (Quality of Service Agreement, QoS-A)

Description of the functionality and the appurtenant agreed quality properties of the delivery (inside the tolerance area). The starting point for agreed quality will normally be the supplier’s product specification. A QoS-A is normally a part of a SLA.
Party (Entity)
A party is a general expression for somebody who can be a customer or a supplier of a service.

Technical interface
Contact points/-persons from the parties for technical and operational information which make the basis for the decision of parameters for product quality.

Business Interface
Contact points/-persons from the parties used for specific commercial functions in connection with agreements about product quality, (re)negotiations, performance reports, and reactions when the agreed level of quality is not achieved.

Product/Service
A group of functions delivered from a supplier to a user via an interface.

Network termination point
Point of connection between an electronic communications network and the terminal equipment.

B.3 Configuration Management

Configuration includes special aspects such as:
- Hardware
- Options which are affiliated with the service(s)
- Network termination point
- Geographical area
- Functional relations (“architecture”) between termination points
- Performance of parametric settings for each user

Delivery time ETSI EG 201 769-1 (see also ETSI TR 102 126)
Elapsed time from the receipt of an order by the service provider with direct connection, to a functioning service is delivered. Orally or written order according to the routines of the service provider. When simultaneous deliveries to various addresses every address counts as a separate order and delivery.

The parameter area includes
- Delivery of new access line
- Acquisition of access line from earlier customer
- New access line in addition to an existing subscription, included upgrading from analogous telephony to ISDN
(but does not include annulment of orders and deliveries via indirect (operator) access).

Documentation
Documentation may include:
- User documentation which describes all user functions (man/machine and/or machine/machine interface).
- Service documentation which contains adequate information so that (simple) operational problems can be solved, plus that accessible additional services and simple expansion of the hardware can be performed by the customer service personnel.
- Detailed engineering description of the equipment.
Geographical differences
Geographical differences include all geographical limitations for the delivery of products. This concerns amongst others limitations in geographical coverage of services and/or geographical limitations of delivery of physical equipment.

Change order handling
Change orders handling includes written orders, log in chronologic order over all agreed changes, plus updating of all product documentation which are is inflicted by the changes.

B.4 Performance Management

Performance includes the tolerance area for execution of the service, as agreed by the parties. The area may contain:
- Specifications of parameters and data for functionality and volume
- Engineering/functional measurable quality statements («90% delivered without error within 2 timer»)
- Measurable operational availability statements («availability ("uptime") at least 99,99%»), «below 3% blocking»)
- Usage delimitations which can be agreed upon (for example CIR in Frame Relay services)
- Usage delimitations which the supplier can undertake.

Accessibility (Service Availability) (ITU-T Rec. E.860)
Accessibility refers to the percentage of actual time (SA%) in which the customer has access to the service, as stated in the agreement. The parameter concerns end-to-end connection, i.e. the total delivery included any subcontractors which the supplier uses.

\[ SA\% = 100\% - UA\% \]

\( SA = Service \; Availability, \; UA = Service \; Unavailability. \)

\( UA\% = \frac{\text{Outage interval}}{\text{active time}} \times 100\%. \)

Regular and agreed down times caused by periodic maintenance of the service shall not be included in the “outage interval”.

The accessibility shall be stated pr week or per month, as agreed.

Unsuccessful call ratio ETSI EG 201 769-1 (see also ETSI TR 102 126)
The part of unsuccessful calls (unsuccessful call ratio) is the quotient of the number of unsuccessful calls to the total number of attempted calls within a specified period of time. An unsuccessful call is an attempted call to an available number in the supplier’s network, correctly executed after a dialing tone, where neither busy- or ringing tone, nor answering signal is received by the A-subscriber within <XX seconds> after that network received the necessary number information needed to set up the connection. (XX is dependent of which national/international networks the call is routed to.)

Call set up time ETSI EG 201 769-1 (see also ETSI TR 102 126)
The elapsed time from the moment the network has received the necessary information in order to set up the connection to the moment the subscriber receives busy-, ringing- or answering signal. If so wished this time can be differentiated dependent of which address/telephone number is called.
Bit error properties (Error performance) ITU-T Rec. G.821
Errored seconds (ES) = A one-second period in which one or more bits are in error.
Severely errored seconds (SES) = A one-second period which has a bit error ratio > 1.10^{-3} or during which Loss of Signal (LOS) or Alarm Indication Signal (AIS) is detected.
Errored seconds ratio (ESR) = The ratio of ES to total seconds in available time during a fixed measurement interval.
Severely errored seconds ratio (SESR) = The ratio of SES to total seconds in available time during a fixed measurement interval.

Various Jitter definitions

Jitter (ITU-T Rec. G.701)
Short-term non-cumulative variations of the significant instants of a digital signal from their ideal positions in time.

Alignment jitter (ITU-T Rec. G.810)
The short-term variations between the optimum sampling instants of a digital signal and sampling clock derived from it.

The short-term variations of the significant instants of a timing signal from their ideal positions in time (where short-term implies that these variations are of frequency greater than or equal to 10 Hz)

Time-lags (Signal Delay)

Round trip delay (ETSI ETR 138)
The round trip delay is defined for data packets of looped connections as the time interval from the instant the first bit of the packet is passed to the access line of the sending unit until the last bit of the same packet is received by the receiving unit.

End-to-end delay = half of round trip delay

B.5 Fault management

Fault management includes the discovery, repair, reporting and feedback concerning fault situations. Fault is discovered either by that:
- customer detects a malfunction, or
- monitoring functional control systems give alarm indication, or
- routine inspections or measurements of quality are performed.

After ascertainment of a fault the fault repair process normally consist of the following steps:
- Detailed determination of type, the location, the cause and the nature of the fault
- Transport of spare parts, if necessary
- Any (interim) reconfigurations in the system or replacement of hardware
- The specific fault repair procedure
- Logging of the occurrences and updating of configuration documentation, plus report
- Refill of spare parts store
Notification and information to the customer is normally accompanied by prognoses from the operational body as of when and how fault handling will be done; either by fault repair or by other dispositions.

An important element is a clearly defined procedure for exchange of information between customer and supplier during a fault situation.

**Fault**
The inability of an item to perform a required function, excluding that inability due to preventive maintenance, planned actions, alder force majeure. Note that a fault is often the result of a failure of the item itself, but may exist without prior failure (ITU-T Rec. M.20).

**Fault Repair Time**
The elapsed time between the moment when a fault is reported by the customer to the service provider’s fault reporting centre and the moment when the network or the service again is functioning without fault for the customer.
The “Agreed quality level” is taken as a starting point.

An agreement can contain a requirement that an agreed percentage of the faults shall be rectified within a determined time.

**Fault reporting**
Fault reporting includes routines for fault handling, as well as format and contents of fault statistics.

**B.6 Security**

Security includes aspects of the current delivered service, which not in itself necessarily is a service which explicitly will improve the security.

The common notion of “security” in general consists of concepts within the following three groups:

- **Vulnerability**
  - Physical and operational protection

- **Security**
  - Confidentiality
  - Traceability, anonymity
  - Authorization
  - Authentication and verification
  - Certification and accreditation
  - Integrity

- **Safety**
  - Harm, consequence analysis

The buyer of services will wish that supplier has an acceptable level of protection in his network, and that it is a minimum of danger that the customer’s communication or equipment and internal systems are weakened in relation to these security notions.

A number of external «threats» of «attacks» against completely secured operations of a network system exist, but at the same time the system can be «defended» by a set of security measures.
The customer needs to know whether, and to which parts of the network security measures are implemented. The customer knows which demands for security he wants to put to the total system of internal systems and bought services, and from that he can judge what he should demand from the service provider.

Additional protection of different type can be bought as supplementary services, such as encryption for confidentiality and authentication, firewall for system defense, physical installation measures against fire/water/attacks, duty guards for securing personnel, etc.

The chain of measures also includes systematic measures in service provider’s organization and operational conduct, even for "everyday" level of protection:

- Crew; their tidy and systematic conduct decides the achieved protection,
- Physical security measures; as defense against nature based or human «attacks»
- Shape and redundancy of the systems construction, etc.
- Security level of operational routines and procedures.
- Audit/-quality assurance measures

Top management has a total responsibility for security measures with regards to the scope and level of them. In this area Quality of service is connected to how the supplier has organized and implemented his security measures and to what is offered as support to the customer in this respect.

**B.7 Accounting Management**

Accounting management can include these elements:

- Contract management
- Purchase control
- Invoice control
- Logistics, store management
- Cost analysis
- Pricing strategies against the customer
- Analysis of cost-effectiveness for given systems
- Cost-effectiveness in relation to alternative systems

Contract- and purchase control is a profession in itself with normal routines.

Invoice control often demands considerable ICT expertise and labor resources, partly because purchases are so specialized and partly because there often is no direct connection between order information, delivery and invoice. Hence professional technical examinations and possibly also internal measuring results may be needed in addition. An example is invoices, where subscription and rental follow different periods on the same invoice.

Logistics is a question about access to software, spare parts and additional parts of a complicated nature, with comparatively frequent replacements of versions. It is therefore necessary with close contact with respect to configuration management, and to the existence of an exact register.

Cost analysis demand robust technical and engineering know-how of the systems, and will also often be a basis for a suitable pricing strategy against the customer’s own end-users. In up-to-date business organizations one often demands that cost shall be debited internally to the unit which caused it, and this leads to cost based internal prices for ICT services.
Cost-effectiveness of the systems is demanded when a continuous development occur in the business. The customer frequently gets ideas from external sources about «cheaper» methods to get his ICT services directly, so the ICT department must always monitor the cost-effectiveness of the offered internal systems and always consider the possibilities of buying better concepts or services from alternative external providers. Individual users should also always be informed of all cost elements in any acquisition, and they should be asked for advice whether the present services meet their needs.

A systematic agreement of delivery should contain a specification of:
- Responsible supplier authorities for the different current relationships
- Contract documentation and –administration
- Prices for subscription and use, inclusive of discounts, etc.
- Invoice details, collection, terms of payment
- Compensations, price reduction
- Invoice information, specification of use/ delivery
- Method for complaints, claims

Bill correctness complaints ETSI EG 201 769-1 (see also ETSI TR 102 126)
The percentage of invoices resulting in a customer complaint. Instances where the customer only asks for more information in connection with invoices, are not included.

B.8 References

ITU-T Rec. G.821 Error performance of an international digital connection operating that a bit rate below the primary rate and forming part of an integrated service digital network.

ITU-T Rec. G.701 Vocabulary of digital transmission and multiplexing, and pulse code modulation (PCM) terms.

ITU-T Rec. G.810 Definitions and terminology for synchronization networks

ITU-T Rec. O.171 Timing jitter and wander measuring equipment for digital systems which are based on the plesiochronous digital hierarchy (PDH)

ITU-T Rec. O.172 Jitter and wander measuring equipment for digital systems which are based on the synchronous digital hierarchy (SDH)

ITU-T Rec. M.20 Maintenance philosophy for telecommunication networks

B.9 Abbreviations

AIS Alarm Indication Signal
BI Business Interface
C Celsius
CCITT Telegraph and Telephone Consultative Committee
CD Compact Disc
CIR Committed Information Rate
DCE Data Circuit-terminating Equipment
DSS1 Digital Subscriber Signalling System No. one
DTE Data Terminal Equipment
DVD Digital Versatile Disc
EG European Guide
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>EN</td>
<td>European Norme</td>
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<tr>
<td>ES</td>
<td>Errored seconds</td>
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<tr>
<td>ESR</td>
<td>Errored seconds ratio</td>
</tr>
<tr>
<td>ETR</td>
<td>European Technical Report</td>
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<td>ETSI</td>
<td>European Telecommunications Standards Institute</td>
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<tr>
<td>GT</td>
<td>Basic Rate Access</td>
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<tr>
<td>ICT</td>
<td>Information and Communication technology</td>
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<tr>
<td>ISDN</td>
<td>Integrated Services Digital Network</td>
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<tr>
<td>ITU-T</td>
<td>International Telecommunication Union - Telecommunication Standardization Sector</td>
</tr>
<tr>
<td>LOS</td>
<td>Loss of Signal</td>
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<tr>
<td>NT</td>
<td>Network Termination</td>
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<tr>
<td>QoS</td>
<td>Quality of Service</td>
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<tr>
<td>QoS-A</td>
<td>Quality of Service-Agreement</td>
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<tr>
<td>PCM</td>
<td>Pulse Code Modulation</td>
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<tr>
<td>PDH</td>
<td>Plesiochronous Digital Hierarchy</td>
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<tr>
<td>Rec.</td>
<td>Recommendation</td>
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<tr>
<td>SA</td>
<td>Service Availability</td>
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<tr>
<td>SDH</td>
<td>Synchronous Digital Hierarchy</td>
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<tr>
<td>SES</td>
<td>Severely Errored Seconds</td>
</tr>
<tr>
<td>SESR</td>
<td>Severely Errored Seconds Ratio</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
</tr>
<tr>
<td>TE</td>
<td>Terminal Equipment</td>
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<tr>
<td>TI</td>
<td>Technical Interface</td>
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<tr>
<td>TMN</td>
<td>Telecommunications Managed Networks</td>
</tr>
<tr>
<td>TR</td>
<td>Technical Report</td>
</tr>
<tr>
<td>TS</td>
<td>Technical Specification</td>
</tr>
<tr>
<td>UA</td>
<td>Service Unavailability</td>
</tr>
<tr>
<td>UNI</td>
<td>User-Network Interface</td>
</tr>
<tr>
<td>V</td>
<td>Volt</td>
</tr>
<tr>
<td>VA</td>
<td>VoltAmpere</td>
</tr>
<tr>
<td>W</td>
<td>Watt</td>
</tr>
</tbody>
</table>
APPENDIX C

Agreement of Quality of Service Level for ISDN Basic Rate Access (ISDN BRA)

C.1 Product description

A product description should include the elements/objects which are parts of the delivery (often called basic product and supplementary products). In order to secure clearness between the partners all objects should therefore be listed. To every aspect of the individual object appurtenant QoS parameters could be assigned. The product description should also contain information about protection and assurance.

As a starting point the supplier often has described a menu of product variants (i.e. objects), for example a basic product with different variations and options. It is, however, the described achievement after negotiations between customer and supplier which should be entered into a SLA. Whether this achievement is identical with an option from the "product menu" or separately shaped for one customer is not important for the SLA model in itself. The supplier's separate product menu can be taken as information attached to the SLA.

ISDN Basic Connection (Integrated Services's Digital Network – Basic Rate Access - BRA) is a connection to the digitized public fixed telephony network with a capacity of two simultaneous and synchronous full duplex 64 kbit/s channels (B-channels), and one simultaneous full duplex 16 kbit/s channel (D-channel) to customer equipment.

The B-channels are general line mode traffic channels used for transfer of speech, data, text and picture. The D-channel is a signaling channel which primarily is used for control and signaling during connect and disconnect. The D-channel can also be used for 9600 bit/s packet mode data transfer (ex. ITU-T Rec. X.25).

Clocking is delivered from the network for bit-interval and for bit octet-interval.

Without additional products the B-channels can be used for the following basic services:
- 64 kbit/s bit sequence transparent transport channels to other ISDN connections,
- Speech telephony (standard 3.1 kHz speech band, including interconnect with any subscriber in national and international public telephone networks and mobile telephone networks),
- Audio 3.1 kHz channel (for interconnect with modem and telefax G3 in analogous network), and
- all ETSI standardized line mode based ISDN telecommunications services

By subscription of ISDN BRA an ISDN network termination box (NT1) is placed at customer premises, and this box represents the limit of the operator's functional responsibility. The subscriber's own equipment TE (Terminal Equipment) is connected to the box via a standardized S-interface, possibly via a lengthened passive bus to which a maximum of 8 terminals may be connected. Alternatively the NT1 can be purchased by the customer himself. If so a U interface must be put in according to operator's specification. NT1 could then be a technical integrated part of the user equipment TE.

The price for a complete installation covers a connection to first socket (type RJ45) on or outside the NT1. Cabling behind NT1 is invoiced separately. In buildings with internal cabling the delivery includes termination of the connecting cable in the connection rack according to customer directions.
Standards
Basic standards for ISDN BRA are:
- ETSI A 300 012 series - Integrated Services Digital Network (ISDN); Basic user-network interface; Layer 1 specification
- ETSI ETS 300 402 series - Integrated Services Digital Network (ISDN); Digital Subscriber Signaling System No. one (DSS1) protocol; Data link layer;
- ETSI A 300 403 series - Integrated Services Digital Network (ISDN); Digital Subscriber Signaling System No. One (DSS1) protocol; Signaling network layer for circuit-mode basic call control

Specification of the network termination unit:
- Power Supply: 230 V
- Power consumption: 7 VA
- Power feed to S-bus: Normal power feed: 4.5 W.
- Emergency power feed: 420 mW (feed of one telephone in emergency power mode)
- The customer must himself program in his equipment the telephone which is to be fed during a power break.
- Environment: Temperature area 0º to 45º C

The handling of subscriptions, fault reporting functions and operational support is described in individual attachments.

In addition to the basic product the customer can order a variety of separate auxiliary functions. The following possibilities are prepared for possible delivery:

- Additional services
  - Possibility for user-to-user messages
  - Extra number
  - Group hunting
  - Ring-back
  - Direct call transfer
  - Automatic voice answer/ message receival
- Alternative routings
- Catalog functions
- Arrangement for fault statistics
- Security measures
- Invoice flexibility

In addition other objects may be included:
- Emergency power solutions (in case one wishes to not have a solution as described above)
- Increase of the number of B-channels (i.e. by connecting more accesses together)
- Accessible documentation
- Concealment of agreements/customer identities

Other variants which possibly are more current for others products than ISDN BRA, such as:
- Geographical limitations
- Interconnect traffic possibilities

Additional services can be ordered from catalog.
C.2 Traffic patterns

Traffic patterns should describe expected exchange of traffic over the technical interface. Knowing the characteristics of the traffic both supplier and customer can good utilization of their resources.

C.3 Parameters and objective target values for quality

Definitions relative to parameters for quality is given in Appendix B.

In the following are listed the individual quality parameters, methods for verification, and goals or target values for these parameters. (Tables of quality descriptions, measurements, target values and reactions are produced, but not included in this English translation. The table below is an example of the lay-out.)

<table>
<thead>
<tr>
<th>Item #</th>
<th>Description / Background</th>
<th>Method of verification</th>
<th>Target values</th>
<th>Reactions</th>
</tr>
</thead>
</table>

Furthermore, in the 4th column should be stated what types of reactions should be imposed if it can be demonstrated that the agreed quality is not fulfilled.

The parameters are sorted into five operational areas, in accordance with the ITU Rec. X.700:
- Configuration Management
- Performance Management
- Fault Management
- Security Management
- Accounting Management

In this document only the level of quality normally is specified. This includes the ideal values, and the acceptable tolerances from these values.

Forms of reactions or compensation can be (as an example)
- Requirement of improvement of documentation
- Refusal of reception of the service
- Postponement of payment
- Economic compensation (ref. appendix H)
- Renegotiation of contract
- Voluntary arbitration
- Annulment of contract
- Error message/repair

C.3.1 Configuration Management

Configuration includes special aspects such as:
- Hardware
- Options which are affiliated with the service(s)
- Network termination point
- Geographical area included in the agreement
- Functional relations ("architecture") between termination points
- Performance of parametric settings for each user, - and totally for whole agreement
The assumption for tidy operational services is that there exists systematic and correct information about the configuration in a methodic and straight accessible format. This demands a defined system for updating/maintenance and control of information («Change Management» procedures).

C.3.2 Performance management
Performance includes the tolerance area for execution of the service, as agreed by the parties. The area may contain:
- Specifications of parameters and data for functionality and volume
- Engineering/functional measurable quality statements («90% delivered without error within 2 timer»)
- Measurable operational availability statements («availability (‘uptime’) at least 99,99%», «below 3% blocking»)
- Usage delimitations which can be agreed upon (for example CIR in Frame Relay services)
- Usage delimitations which the supplier can undertake.

C.3.3 Fault Management
Fault management includes the discovery, repair, reporting and feedback concerning fault situations. Fault is discovered either by that:
- customer detects a malfunction, or
- monitoring functional control systems give alarm indication, or
- routine inspections or measurements of quality are performed.

After ascertainment of a fault the fault repair process normally consist of the following steps:
- Detailed determination of type, the location, the cause and the nature of the fault
- Transport of spare parts, if necessary
- Any (interim) reconfigurations in the system or replacement of hardware
- The specific fault repair procedure
- Logging of the occurrences and updating of configuration documentation, plus report
- Refill of spare parts store

Notification and information to the customer is normally accompanied by prognoses from the operational body as of when and how fault handling will be done; either by fault repair or by other dispositions.

An important element is a clearly defined procedure for exchange of information between customer and supplier during a fault situation.

Procedure between supplier and customer points of contacts during a fault situation will be separately documented in Appendix E to this SLA.

C.3.4 Security Management
Security includes aspects of the current delivered service, which not in itself necessarily is a service which explicitly will improve the security.

The common notion of “security” in general consists of concepts within the following three groups:
- Vulnerability
  - Physical and operational protection
- Security
  - Confidentiality
  - Traceability, anonymity
  - Authorization
  - Authentication and verification
  - Certification and accreditation
  - Integrity

- Safety
  - Harm, consequence analysis

The buyer of services will wish that supplier has an acceptable level of protection in his network, and that it is a minimum of danger that the customer’s communication or equipment and internal systems are weakened in relation to these security notions.

A number of external «threats» of «attacks» against completely secured operations of a network system exist, but at the same time the system can be «defended» by a set of security measures.

The customer needs to know whether, and to which parts of the network security measures are implemented. The customer knows which demands for security he wants to put to the total system of internal systems and bought services, and from that he can judge what he should demand from the service provider.

Additional protection of different type can be bought as supplementary services, such as encryption for confidentiality and authentication, firewall for system defense, physical installation measures against fire/ water/attacks, duty guards for securing personnel, etc. The area covers relationships in the delivered service, which not in itself necessarily is a service which will better the security.

Top management has a total responsibility for security measures with regards to the scope and level of them. In this area Quality of service is connected to how the supplier has organized and implemented his security measures and to what is offered as support to the customer in this respect.

The supplier may choose to get a security certificate from an authority institution.

C.3.5 Accounting Management

Accounting management can include these elements:
- Contract management
- Purchase control
- Invoice control
- Logistics, store management
- Cost analysis
- Pricing strategies against the customer
- Analysis of cost-effectiveness for given systems
- Cost-effectiveness in relation to alternative systems

Contract- and purchase control is a profession in itself with normal routines.

Invoice control often demands considerable ICT expertise and labor resources, partly because purchases are so specialized and partly because there often is no direct connection between order information, delivery and invoice. Hence professional technical examinations and possibly
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A systematic agreement of delivery should contain a specification of:
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- Invoice details, collection, terms of payment
- Compensations, price reduction
- Invoice information, specification of use/delivery
- Method for complaints, claims

C.4 References

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
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<tbody>
<tr>
<td>ETSI TR 102 126</td>
<td>Implementation of QoS parameters measurements according to ETSI EG 201 769.</td>
</tr>
<tr>
<td>ETSI TS 102 080</td>
<td>Integrated Services Digital Network (ISDN) basic rate access; Digital transmission system on metallic local lines.</td>
</tr>
<tr>
<td>ETSI EG 202 057-2</td>
<td>Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 2: Voice telephony, Group 3 fax and modem data services</td>
</tr>
<tr>
<td>ETSI EN 300 012 series</td>
<td>Integrated Services Digital Network (ISDN); Basic User-Network Interface (UNI); (several parts)</td>
</tr>
<tr>
<td>ITU-T Rec. G.107</td>
<td>The E-Model, a computational model for use in transmission planning</td>
</tr>
<tr>
<td>ITU-T Rec. G.109</td>
<td>Definition of categories of speech transmission quality</td>
</tr>
<tr>
<td>ITU-T Rec. G.821</td>
<td>Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated service digital network.</td>
</tr>
<tr>
<td>ITU-T Rec. G.823</td>
<td>The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy</td>
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<tr>
<td>ITU-T Rec. X.25</td>
<td>Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit</td>
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