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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) millimetre Wave Transmission (mWT).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Executive summary

In order to allow a correct evaluation of the operation of equipment and systems, as well as to allow proper maintenance, a collection of events by equipment can be used. The present document summarizes the mechanisms of such collection, valid for Plesiochronous Digital Hierarchy (PDH)/Synchronous Digital Hierarchy (SDH) applications and proposes specific mechanisms for the Ethernet radio.

Introduction

The present document describes the collection of events necessary to allow the activities related to maintenance and performance evaluation, traditionally based on contents of registers inside the equipment, in addition or alternatively to independent network based measurements.

Such description was very detailed for the PDH/SDH applications, widely used before the massive introduction of packed based technology in networks/equipment.

With this technological evolution, it is necessary to study if there is still need for similar measurements, and if similar mechanisms can still be considered useful, or if a new approach is consider appropriate.

In case the basic concepts are still valid, there is a need to relate the collection of data available from equipment to the specific packed based environment.

1 Scope

The present document is aimed to define proper error performance and maintenance oriented parameters for radio, both in cases of transport of traditional PDH/SDH technologies, and in cases of use of more recent Ethernet based traffic.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Recommendation ITU-T G.784: "Digital transmission systems - Terminal equipments - Principal characteristics of multiplexing equipment for the synchronous digital hierarchy".

[i.2] Recommendation ITU-R F.750-4: "architectures and functional aspects of radio-relay systems for synchronous digital hierarchy (SDH)-based networks".

[i.3] ETSI EN 301 129: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Synchronous Digital Hierarchy (SDH); System performance monitoring parameters of SDH DRRS".

[i.4] Recommendation ITU-T G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

[i.5] Recommendation ITU-T G.827: "Availability parameters and objectives for path elements of international constant bit rate digital paths at or above the primary rate".

[i.6] Recommendation ITU-T G.828: "Error performance parameters and objectives for international, constant bit rate synchronous digital paths".

[i.7] Recommendation ITU-R F.2113: "Error performance and availability objectives and requirements for real point-to-point packet-based radio links".

[i.8] Recommendation ITU-T G.7710/Y.1701: "Common equipment management function requirements".

[i.9] IETF RFC 8561: "A YANG model for Microwave Radio Links".

[i.10] Recommendation ITU-T G.8013/Y.1731: "Common equipment management function requirements".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AIS	Alarm Indication Signal
AR	Availability Ratio
AU	Administrative Unit
BBE	Background Block Error
BBER	Background Block Error Ratio
BER	Bit Error Ratio
BIP-N	Bit Interleaved parity of order N
BIS	Bringing Into Service
BNM	Bandwidth Notification Message
CSES	Consecutive SES
EB	Errored Block
ES	Errored Second
ESR	Errored Second Ratio
FC	Failure Count
FER	Frame Error Ratio
FLR	Frame Loss Ratio
FLR	Frame Loss Ratio
FSRC	Failed Switch Request Count
FSRD	Failed Switch Request Duration
IETF	Internet Engineering Task Force
LB	Lost Block
LOS	Loss Of Signal
Mo	Mean time between outages
OAM	Operation And Maintenence
OFS	Out of Frame Seconds
OI	Outage Intensity
OOF	Out Of Frame
PDH	Plesiochronous Digital Hierarchy
PE	Path Element
PEA	Percent Ethernet service Availability
PEU	Percent Ethernet service Unavailability
PJE	Pointer Justification Event
PSA	Protection Switched Actual
PSAC	Protection Switch Actual Count
PSAD	Protection Switch Actual Duration
PSR	Protection Switched Request
PSRC	Protection Switch Request Count
PSRD	Protection Switch Request Duration
RBER	Residual Bit Error Ratio
RF	Radio Frequency
RL	Received Level
RLTM	Received Level Tide Mark
RLTS	Received Level Threshold Seconds
RX	Receiver

SDH	Synchronous Digital Hierarchy
SEPI	Severely Errored Period Intensity
SES	Severely Errored Second
SESETH	Severely Errored Second Ethernet
SESR	Severely Errored Second Ratio
TCN	Threshold Crossing Notification
TL	Transmitted Level
TLTM	Transmitted Level Tide Mark
TLTS	Transmitted Level Threshold Seconds
TM	Tide Mark
TX	Transmitter
UAS	UnAvailable Seconds
UR	Unavailability Ratio

4 Basics

4.1 Operation time, availability and unavailability

Depending on propagation conditions, traffic transmission in every real link forming part of a transmission network can be affected by impairments, which can result to different conditions, during operating time.

Traditionally, operating time is subdivided into two main categorizations:

- Periods where transmission is possible, in normal or degraded conditions (**available time**).
- Periods where transmission is not possible, due to the "long" persistence of very bad conditions (**unavailable time**).

4.2 Time base definition

In order to define limits for parameters, a proper definition of suitable observation time is required.

Different time bases have been defined for the different uses:

- Unavailability limits is referred to for one year period.
- Error performance objectives are defined for one month period.
- Impairments are evaluated on one second base.

Other time bases (15 minutes, 24 hours, 1 day, 2 days, 7 days) are also defined to be used for BIS/maintenance scope, in related ITU-T M series recommendations.

4.3 Events, parameters, objectives

In general, impairments may result in seconds where error conditions are present, which can be associated to specific classes, depending on type of errors. One second belonging to one specific class constitutes an **event.**

In an observation period, for any event, a specific **parameter** can be defined (and calculated) based on some arithmetic operations; typically, the operation consists in the ratio between the number of events and the total number of seconds.

For each parameter, the maximum acceptable value (or percentage of time) constitutes the **objective.**

For each real link, the value of error performance and availability objectives to be guaranteed on a long-term bases can be calculated according to ITU-R specific Recommendations.

Compliance with such objectives for each link is achieved by proper link design.

4.4 Limits

During the equipment operating time, a limit for the overall unavailable time is specified in the observation period.

In the available time, a limit is fixed for each parameter defined in the related recommendation (long term for error performance scope, short term for maintenance) within proper time intervals.

4.5 Data collection/elaboration

In order to ascertain compliance with objectives, basic info, rated to events (detected with 1s time base), has to be collected by means of proper registers, according to the duration of the required time base, allowing an evaluation of parameters.

Due to the fact that some time bases are quite long, it was considered not practical to collect data in equipment with very high reliability, since specific mechanisms (such as non-volatile memory, safe backup) would be required, impacting on the complexity and cost of the systems (especially in early times).

In addition, equipment cannot be aware of specific maintenance actions decided by the network, potentially impacting measurements.

The equipment was asked to collect the information by means of an embedded set of specific registers, addressing limited periods of time, which can be accessed by network Operating Systems (OS).

OSs collect information, allowing long term evaluation, so registers can be reused by the equipment and eventual equipment loss of data can have limited impact.

5 Data collection alternatives

5.1 Path based collection: Unidirectional - Bidirectional

Data collection can be addressed to several needs, resulting in different procedures and algorithms, and in different sets of registers.

In a generic network element, data can be collected by looking at the link typology and can be classified as:

- Unidirectional approach, where each single direction is collected separately.
- Bidirectional approach, where the collection is based on an analysis of the Path, information of the two directions is necessary at each terminal.

The unidirectional approach is simpler to be implemented, since the two directions of link can be assumed as uncorrelated.

In particular, events happening on a direction A⇒B need to be taken into account when only such direction is available, not looking at the other direction state in corresponding time intervals.

The unidirectional evaluation is generally based on direct use of error detection mechanisms, (such as parity bit, BIP-N etc.) or defect indicators.

The unidirectional collection relates to direction link (or section).

On the contrary, the bidirectional approach requires a joint analysis of behaviours of two directions, since counting for each direction (e.g. A⇒B) is stopped when the other direction (B⇒A) is in the unavailable state, for the definition of path.

If only one direction is unavailable, counting of events is stopped for both directions, and unavailability counters only is incremented for both directions. As such, a bidirectional collection relates to the overall link (or section).

5.2 Direction based collection: Near end - Far end

Near end is a collection where in each terminal, the evaluation of quality of the signal received from the local terminal is accomplished, such info relates to the "income" direction, as shown in figure 1.

As an example, in terminal A of an A-B link, evaluation can be done locally on the quality of signal received by B. Such collection is referred as near end evaluation. In same way, the near end evaluation can be accomplished in B.

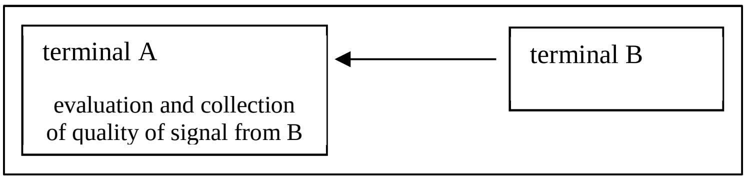

Figure 1: Unidirectional approach

Far end is a data collection where in each terminal, the information related to the evaluation of quality of the signal received from the other terminal (and transmitted back) is acquired, as shown in figure 2. The information relates to the "outcome" direction from the terminal.

EXAMPLE: Signal received from A is evaluated in B (near end), and the result of the evaluation is transmitted back to A, where only reading and recording of this information is done.

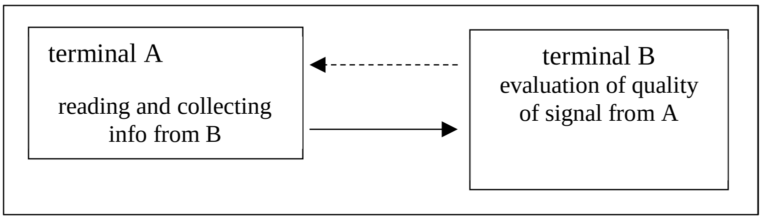

Figure 2: Bidirectional approach

5.3 Use based collection : Error performance - Maintenance

Two different kind of uses can be addressed by the data collection:

1) Determination of compliance with long term link objectives (**error performance based**).

2) Bringing Into Service (BIS) and maintenance of connection in good operating conditions, to guarantee compliance with long term objectives (**maintenance based**).

Data collection for **maintenance** scope is required to be done adopting **unidirectional** approach.

Data collection for **performance monitoring** scope is required to be done adopting **bidirectional** approach.

It should be noted that collections described in this clause are independent.

In a generic link, a complete set of collections can be associated to each side, for the two directions (near end and far end), in unidirectional and bidirectional mode.

Such kind of collection, needing a high number of registers, would constitute, if implemented, the complete coverage of current ITU normative documents.

5.4 Unidirectional/bidirectional insight for radio

In order to better define the proper collection method in radio equipment, further insight on differences between unidirectional and bidirectional is needed.

The unidirectional one allows easier computing simplifications than the bidirectional one.

The pure bidirectional approach enables, in principle, stopping counting of events happening in one direction, in case the other is unavailable. In particular, if two partially overlapping unavailable periods happen in some time period, the evaluation of bidirectional availability allows correct counting of path unavailability, while the operations coming from the unidirectional approach (addition of single unavailability figures) would overestimate the event duration.

This mechanisms is true in principle, for general network utilizations (in principle, go and return directions could be associated to different network paths) but in case of radio links, go and return use same physical link.

In such situations, the unavailability on two directions tend to be highly correlated, especially in use of high frequencies, needed to allow high capacity and implying shorter hops, where rain is the main source of such events.

In these conditions, the information available from one terminal cannot be received from the other side, implying that, even in case the bidirectional approach is chosen, in practice the information can be only detected in a unidirectional way (typically, AIS type signal is generated).

Such a situation is dependent on propagation only, and cannot be technically solved. The best approximation of real unavailability could just be the mean value of the availability recorder in each direction.

The counting of events happening in available time is correct, assuming no fault in the equipment.

Such approach is in any case necessary for maintenance.

For this reason, the unidirectional approach is considered to be the preferred one for radio.

It should be noted that asymmetrical connections are also covered by this approach.

6 Registers: types and uses

6.1 Time base

6.1.0 Normative basis

A number of ITU-T/ITU-R deliverables (e.g. Recommendation ITU-T G.784 [i.1]) foresee different types and sets of registers to be associated **to each** measured parameter.

6.1.1 24 hours related registers

Registers related to current 24 hours (ongoing period): n. 1 register.

Registers related to last 24 hours recorded (period closed): n. 1 register.

Total = 2 registers

6.1.2 15 minutes related registers

Registers related to current 15 minutes (ongoing period): n. 1 register.

Registers related to last 15 minutes (periods closed): n. 16 registers.

Total = 17 registers.

15 minutes and 24 hours **unidirectional** registers are utilized only for **maintenance** scope**; error performance** monitoring only need 24 hours **bidirectional** registers; as such, 15 minutes registers are required only to be unidirectional, while the ones related to 24 hours can be bidirectional and unidirectional.

6.2 Primitives for counting

For each time interval, the value of a **parameter** is obtained by means of an operation made on one or more associated **events**, which are classified on the base of counting some of the "elementary primitives", different for each traffic type. Basics are summarizes in table 1.

Table 1: Base for events evaluation

Traffic type	PDH	SDH	Packet
	Errors (errored bits)	Block (errored frames)	Packets (errored, mis inserted, redirected, lost, etc.)

6.3 Specific mechanisms

6.3.1 Threshold crossing mechanisms

In order to guarantee maintenance operations, related registers are required to give the operating systems the notification of a presettable value of threshold if such value is exceeded before the end of the time interval (TCN, Threshold Crossing Notification).

Return to normal condition can be done in explicit mode (normal state restored after detection) or implicit (status reset at the beginning of the next 15 min/24 h period) mode.

Since implicit mode allows fast recovery in case of self-healing events, such mode is normally used for the 24 h registers.

An external reset should be possible.

The capacity of registers should be adequate to the number of primitives to be counted.

6.3.2 Thresholds

All aspects are not completely covered in standards, so values to be set for thresholds settings should be done in line with the characteristics of measures and on the expectation (i.e. based on "unacceptable working condition criteria").

6.3.3 Suspect interval flag

A specific mechanism allows each interval to be reported as "suspect". In case of need of some test-maintenance activity is undertaken, the content of such registers can be excluded from the counting.

6.3.4 Events crossing two consecutive time intervals

During operating condition, events are randomly generated, depending on several conditions, such as propagation, interference, faults, human activity. Some of them can therefore happen at the crossing between two consecutive recording time intervals. In particular, such condition can be observed on behalf of unavailability, which is interested by events at least 10 s long.

Such kind of events need to be given due attention to guarantee a correct counting (such as to allow ten or more seconds delay in closing the time period, with readjustment of recording in successive time period).

7 Basic error performance related events

7.1 Error performance events for paths

Errored Block (EB): A block in which one or more bits are in error.

Errored Second (ES): A one-second period with one or more errored blocks or at least one defect.

Severely Errored Second (SES): A one-second period which contains ≥ 30 % errored blocks or at least one defect. SES is a subset of ES.

Background block error (BBE): An errored block not occurring as part of an SES.

7.2 Error performance events for connections

Errored Second (ES): It is a one-second period in which one or more bits are in error or during which Loss Of Signal (LOS) or Alarm Indication Signal (AIS) is detected.

Severely Errored Seconds (SES): It is 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.

7.3 Unavailability events

Availability Ratio (AR) is the proportion of time that a path is in the available state during an observation period.

Unavailability Ratio (UR) is the proportion of time that an end-to-end path is in the unavailable state during an observation period.

Mean time between outages (Mo) is the average duration of intervals when the PE is available during a measurement period.

Outage Intensity (OI) is the number of outages per measurement period. A period of unavailability is also known as an "Outage".

7.4 Ethernet events

7.4.1 ITU-R

ITU has defined the following basic events for Ethernet based traffic.

Severe Errored Second Ethernet (SESETH) outcome occurs for a block of frames observed during a one-second interval at ingress MP0 when the corresponding FLR (i.e. the ratio of lost frames to total frames in the block) at egress MPi exceeds s1 (0,5 is suggested).

Percent Ethernet service unavailability (PEU) is the percentage when the Ethernet network is in unavailable state in the total scheduled Ethernet service time (the percentage of one-second intervals).

Percent Ethernet service availability (PEA) is the percentage of time when the Ethernet network is in available state in the total scheduled Ethernet service time (the percentage of one-second intervals).

Ethernet Frame Error Ratio (FER) is the ratio of total errored Ethernet frame outcomes to the total of successful Ethernet frame transfer outcomes plus errored Ethernet frame outcomes in a population of interest.

The Ethernet Frame Loss Ratio (FLR) is the ratio of total lost Ethernet frame outcomes to total transmitted Ethernet frames in a population of interest.

A Background Block Error (BBE) is a LB not occurring as part of a severely errored second (SES). A block is a non-drop eligible frame or packet with a specific priority associated with the connection (LB = Lost Block).

7.4.2 IETF

IETF has defined a completely different approach, where the addition of basic events is done by means of 32 bit registers, which automatically reset to 0 when the upper limit is reached.

Four 32 bit registers are foreseen to count: BBE, ES, SES, UAS.

8 Events to be collected

8.0 Basics

In principle, it is required that the basic collection of events allowing the determination of long term objectives is made available. Such collection is based on the media independent approach which is adopted by the ITU-T.

In addition to this, specific registers can be defined, in a media dependent way.

In radio applications, a specific collection has been used for radio, in relation to:

- radio specific activity (RF);
- switching operation.

8.1 Main events

Recommendations require the collection of the basic events, allowing a complete set of actions required for error performance evaluation or maintenance oriented procedures; table 2 provides a summary of them.

Table 2: Basic events for traffic type

Traffic type	PDH	SDH	Packet
Events	ES SES UAS	ES SES BBE AR (UNAV)	ES SES BBE AR (UNAV)

It should be considered that, for very high capacity foreseen today for next generation networks, such as 10 Gbit/s and higher, some parameters, such as the ES, tend to become meaningless since, at normal levels of the BER, such as 10^{-12}, the percentage of errored seconds increases up to values exceeding the limits established when the set of recommendations based on Recommendation ITU-T G.826 [i.4] was developed, intended to be used for lower capacities.

In order to have a more detailed possibility to analyse the behaviour of the network elements and to solve in due time as soon as possible problems, additional parameters have been defined, in addition to those addressed to error performance and unavailability. Related parameters are ESR, BBER, SESR. RBER, used for PDH systems, is not to be collected.

8.2 Additional parameters

8.2.0 Basic categories

Additional optional parameters related to error performance issues, such as Severely Errored Period Intervals (SEPI) (Recommendation ITU-T G.828 [i.6]), mean time between digital outages (Mo) (Recommendation ITU-T G.827 [i.5]) are not foreseen.

8.2.1 SDH additional parameters

Recommendation ITU-T G. 784 [i.1] establishes the following additional optional parameters, for SDH systems, in a media independent vision (nothing specific for radio) implementation is optional:

- Out of Frame Seconds (OFS) - declared when the STM-N frame alignment process is in the Out Of Frame (OOF) state at least once in the second.
- Administrative Unit Pointer Justification Event (AU PJE).
- Consecutive SES (CSES).

- Errored Second type A (ESA). - just 1 EB, no defects.
- ESB Errored Second type B - more than 1 EB but not SES.
- Failure Count (FC).

8.2.2 Radio additional parameters

8.2.2.0 Generalities

ETSI EN 301 129 [i.3] and Recommendation ITU-R F.750 [i.2] define specific parameters to be used for radio specific monitoring. The IETF model described in IETF RFC 8561 [i.9] also addresses these parameters.

Two different categories are given:

- Parameters related to power levels.
- Parameters related to radio switching functionalities (not embedded switch for packet traffic).

8.2.2.1 Power related parameters

ITU-R/ETSI: A description and list of following radio additional parameters related to TX/RX power can be found in ETSI EN 301 129 [i.3]/Recommendation ITU-R F.750 [i.2]:

- Received Level (RL): (on demand, no 15 m/24 h registers).
- Transmitted Level (TL): (on demand, no 15 m/24 h registers).
- Received Level Threshold Seconds (RLTS): 1 s period during which the detected RL value is below a selected threshold. At least two separate counters required (RLTS1 and RLTS2).
- Transmitted Level Threshold Seconds (TLTS): 1 s period during which the detected TL value is greater than a selected threshold - TLTS 2 optional.
- Received Level Tide Mark (RLTM): the maximum and the minimum value reached by the RL during a - measurement period.
- Transmitted Level Tide Mark (TLTM):the maximum or the minimum value reached by the TL during a measurement period.

IETF: The IETF model also foresees use of RL TM and TL TM, for minimum and maximum value, without collection in 15 minutes and 24 registers.

Min-RLTM, max- RLTM, min-TLTM, max-TLTM are considered.

8.2.2.2 Adaptive modulation related

Recommendation ITU-T G.8013/Y.1731 [i.10] provides the description of an adaptive modulation mechanism; in relation with the new Ethernet OAM messages, namely Bandwidth Notification Message (BNM). There is no mention of possibility to record these messages.

The IETF model foresees the indication of current modulation used.

ETSI EN 301 129 [i.3]/Recommendation ITU-R F.750 [i.2], so as Recommendation ITU-T G.7710 [i.8] do not address adaptive modulation.

8.2.2.3 Switch additional parameters

These parameters are used to control switching systems at RF level and to protect working radio channels by means of standby channels: switches designed for other layers of signals (like Ethernet switches) are not addressed.

- Protection Switched Actual (PSA) actual automatic switch from a protected (working) channel to a protecting (stand-by) channel.

- PSR: activation of a switch initiation criteria which may lead to automatic switches from a protected channel to a protecting channel.
- Protection Switch Actual Count (PSAC): number of PSA occurrences in a time period.
- Protection Switch Actual Duration (PSAD): number of seconds, in a time period, for which a channel is in the switched status.
- Failed Switch Request Duration (FSRD): count of the number of seconds in a time period for which the request cannot be serviced.
- Failed Switch Request Count (FSRC): count of switch requests which did have not been served by a switching action.
- Protection Switch Request Count (PSRC): number of the occurrences of PSR in a time period.
- Protection Switch Request Duration (PSRD): number of seconds, in a time period, for which a channel is in the PSR status.

Considering the new approach tailored for packet transport and concerning the switching method, the above parameter may not be significant and not taken into consideration. Therefore, it is up to the manufacturers to provide such a performance monitoring or not in case of systems equipped with a radio switch.

8.3 Necessary Registers for Maintenance

Number of required registers for maintenance is specified as follows:

- 17 (16+1) registers, 15 min for near end.
- 17 (16+1) registers, 15 min, for far-end.
- 2 (1+1) registers, 24 h min for near end.
- 2 (1+1) registers, 24 h min for far end.

The result is 38 registers, for each parameter to be evaluated, and in each side of the link.

In case that collection is accomplished only for near-end, 19 registers are required in each side.

8.4 Necessary Registers for error performance-monitoring

Number of required registers for maintenance is specified as follows:

- 2 (1+1) bidirectional registers, 24 h min for near end.
- 2 (1+1) bidirectional registers, 24 h min for far end.

This results in a total of 4 registers, for each parameter to be evaluated, and in each side of the link.

In case that the collection is accomplished only for near-end, 2 registers are required in each side.

Availability needs also to be evaluated by means of 2 (1+1) bidirectional registers, 24 h min for each side of the link.

Since it is expected that, with the current technology, equipment supporting a specific link are controlled by the same management system, collection of far end monitoring data is considered no longer necessary.

8.5 Performance Evaluation capabilities of equipment

Depending on the type of traffic and type of equipment, it may be possible that the accurate evaluation of events or parameters is not available, but just an estimation is possible in the field.

Such estimation is acceptable, provided that proper justification is given, based on test or theoretical study.

9 Implementation

Two different approaches are available in relation with the collection of events to be used for error performance or maintenance of transmission networks:

ITU approach:

- This is a kind of approach historically developed to cover digital technology starting from the PDH, and extended to the following technologies:
  - Recommendation ITU-T G.7710 [i.8] foresees mechanisms in line with SDH/PDH data collection, including BBE, which has been defined for packet.
  - Recommendation ITU-R F.2113 [i.7] provides error performance objectives limits has not been used to develop any Deliverables specifically addressing error performance collection.

IETF approach:

- This is a more recent approach, specifically applicable to Ethernet traffic.
- IETF has defined a completely different approach, where the addition of basic events is done by means of 32 bit registers, which automatically reset to 0 when the upper limit is reached. Tl and TM are also considered.
- Based on considerations in previous clauses, the unidirectional approach is preferred for collection of error performance and maintenance parameters of case of radio links carrying Ethernet or packed based traffic.
- Near end collection at each side is also preferred to minimize number of registers.
- Events and parameters, to be considered, together with preferred procedure for collection, are summarized in table 3.

Table 3: Collection type and events to be considered

Data collection procedures	Traditional (ITU - Registers)	New (IETF - counters-variables)
Data collection type	**Unidirectional, near end**	**Unidirectional, near end**
Non Ethernet based parameters	SES, BBE, ES, UAS	
Ethernet based parameters	or SESETH, BBE, ES, PEU	SESETH, PEU
Optional ethernet	FER, FLR	
Optional radio	- RL, - TL, - RLTS1, RLTS2, TLTS, - TLTM	RITm, TITm, min, max
Optional switch	PSA, PSR, PSAC, PSAD, FSRD, FSRC, PSRC, RD	
Optional adaptive modulation	-	-

10 Conclusion

Mechanisms necessary to accomplish error performance related actions, in addition to BIS and maintenance, have been established since long for non-packet base traffic and are described by existing standards by ITU-T, ITU-R and ETSI.

Such mechanisms are based on collection of basic events, to be recorded by the network elements by means of a specific set of registers.

In particular, two different approaches are available:

- ITU:
  - Registers collecting data over 15 min and 24 h periods are defined, whose contents are incremented as addition of single events during the period.

  - Recommendation ITU-T G.7710 [i.8] foresees mechanisms in line with SDH/PDH data collection, including BBE, which has been defined for packet.
  - Recommendation ITU-R F.2113 [i.7] provides error performance objectives limits has not been used to develop any Deliverables specifically addressing error performance collection.

- IETF:

  IETF has defined a completely different approach, where the addition of basic events is done by means of 32 bit registers, which automatically reset to 0 when the upper limit is reached. Tl and TM are also considered.

  The framework for packet based traffic radio (in particular, for Ethernet based radio which is widely used in today's radio equipment) is more recent, and most details have still to be defined completely.

  Although the traditional ITU approach is still considered appropriate for non-Ethernet based traffic, no specific preference was expressed in favour of one of the approaches for the Ethernet based traffic, so both approaches are possible, depending on manufacturer's choice.

A possible list of parameters to be considered is provided in clause 9 of the present document.

Annex A: Bibliography

- ITU-R Radio Regulation 2016.
- Recommendation ITU-R F.1703: "Availability objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections".
- ETSI EN 302 217-3: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Equipment operating in frequency bands where both frequency coordinated or uncoordinated deployment might be applied; Harmonised EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- Recommendation ITU-R F.1668: "Error performance objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections".
- Recommendation ITU-T G.829: "Error performance events for SDH multiplex and regenerator sections".
- Recommendation ITU-T M.2101: "Maintenance: defines limit values for BIS/maintenance for SDH sections".
- Recommendation ITU-T M.2120: "Maintenance: clarifies aspects related to threshold related mechanisms".
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- Recommendation ITU-R F.2313: "Performance - Error performance and availability objectives and requirements for real point-to-point packet-based radio links".
- Recommendation ITU-T Y.1540: "Performance - Internet protocol data communication service - IP packet transfer and availability performance parameters".
- Recommendation ITU-T Y.1541: "Performance - Network performance objectives for IP-based services".
- Recommendation ITU-T Y.1563: "Performance Ethernet frame transfer and availability performance".
- ETSI EN 300 417: "Monitoring: defines le functional characteristics of transport equipment".

History

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