TECHNICAL REPORT

TR-298

Management model for DSL line test

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 7

1 PURPOSE AND SCOPE 8

1.1 PURPOSE 8
1.2 SCOPE 8

2 REFERENCES AND TERMINOLOGY 9

2.1 CONVENTIONS 9
2.2 REFERENCES 9
2.3 ABBREVIATIONS 10

3 TECHNICAL REPORT IMPACT 11

3.1 ENERGY EFFICIENCY 11
3.2 IPV6 11
3.3 SECURITY 11
3.4 PRIVACY 11

4 OBJECT MODEL FOR DSL LINE TEST 12

5 OBJECT MODEL FOR SINGLE ENDED LINE TEST (SELT) 13

5.1 SELT CONFIGURATION MODEL 13
5.1.1 SELT Configuration Vector 14
5.2 SELT RESULT PARAMETER MODEL 15

6 OBJECT MODEL FOR DUAL ENDED LINE TEST (DELT) 16

7 OBJECT MODEL FOR METALLIC LINE TEST (MELT) 16

7.1 MELT CONFIGURATION MODEL 16
7.1.1 MELT Configuration Vector 17
7.2 MELT RESULT PARAMETER MODEL 18

List of Figures

Figure 1: Functional reference model of DSL line test 12
Figure 2: Notations 13
Figure 3: SELT configuration model 14
Figure 4: SELT result parameter model 15
Figure 5: MELT configuration model 16
Figure 6: MELT result parameter model 19

Executive Summary

This Technical Report specifies a management model for DSL line tests containing the parameters described in ITU-T Recommendation G.996.2 [2].

1 Purpose and Scope

1.1 Purpose

The purpose of this Technical Report is to provide a management model for ITU-T Recommendation G.996.2 [2] and its Amendment 2 [3]. The management model is independent of any protocol.

1.2 Scope

This Technical Report defines an object model for all the DSL line test parameters specified in G.996.2. The object model specifies the structure of the managed objects, and the detailed specifications of the parameters are given in G.996.2.

2 References and Terminology

2.1 Conventions

In this Technical Report, several words are used to signify the requirements of the specification. These words are always capitalized. More information can be found be in RFC 2119 [1].

MUST	This word, or the term "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 term "RECOMMENDED", means that there could exist valid reasons in particular circumstances to ignore this item, but the full implications need to be understood and carefully weighed before choosing a different course.
SHOULD NOT	This phrase, or the phrase "NOT RECOMMENDED" means that there could exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications need to be understood and the case carefully weighed before implementing any behavior described with this label.
MAY	This word, or the term "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.

2.2 References

The following references are of relevance to this Technical Report. At the time of publication, the editions indicated were valid. All 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 references listed below.

A list of currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

Document		Title	Source	Year
[1]	RFC 2119	*Key words for use in RFCs to Indicate Requirement Levels*	IETF	1997
[2]	G.996.2	*Single-ended line testing for digital subscriber lines (DSL)*	ITU-T	2009
[3]	G.996.2	*Single-ended line testing for digital*	ITU-T	2012

	Amendment 2	*subscriber lines (DSL) Amendment 2*		
[4]	TR-252 Issue 2	*xDSL Protocol-Independent Management Model*	BBF	2012

2.3 Abbreviations

This Technical Report uses the following abbreviations:

AC	Alternating Current
DC	Direct Current
DELT	Dual Ended Line Test
DS	Downstream
FE	Far-End
FV	Foreign Voltage
ME	Management Entity
MELT	Metallic Line Test
MMD	Maximum Measurement Duration
PMD	Physical Medium Dependent
QLN	Quiet Line Noise
RG	Ring to Ground
RT	Ring to Tip
SELT	Single Ended Line Test
SCV	Signature Conduction Voltage
TG	Tip to Ground
TR	Tip to Ring
UER	Uncalibrated Echo Response
US	Upstream

3 Technical Report Impact

3.1 Energy Efficiency

TR-298 has no impact on energy efficiency.

3.2 IPv6

TR-298 has no impact on IPv6.

3.3 Security

TR-298 has no impact on security.

3.4 Privacy

Any issues regarding privacy are not affected by TR-298.

4 Object model for DSL line test

This specification is based on the parameters listed in G.996.2 and its Amendment 2. The object model in this specification specifies the structure of the managed objects, and the detailed parameter definitions and their access mode (read-only vs read-write) are specified in G.996.2.

Figure 1 shows the line test functional reference model defined in G.996.2. This model defines several functional blocks representing different line test functions. There are two main categories of functions; processing (P) and Physical Medium Dependent (PMD). The PMD functions are related to measurements on the physical medium while the P functions are related to the processing and transformation of the PMD results into derived parameters.

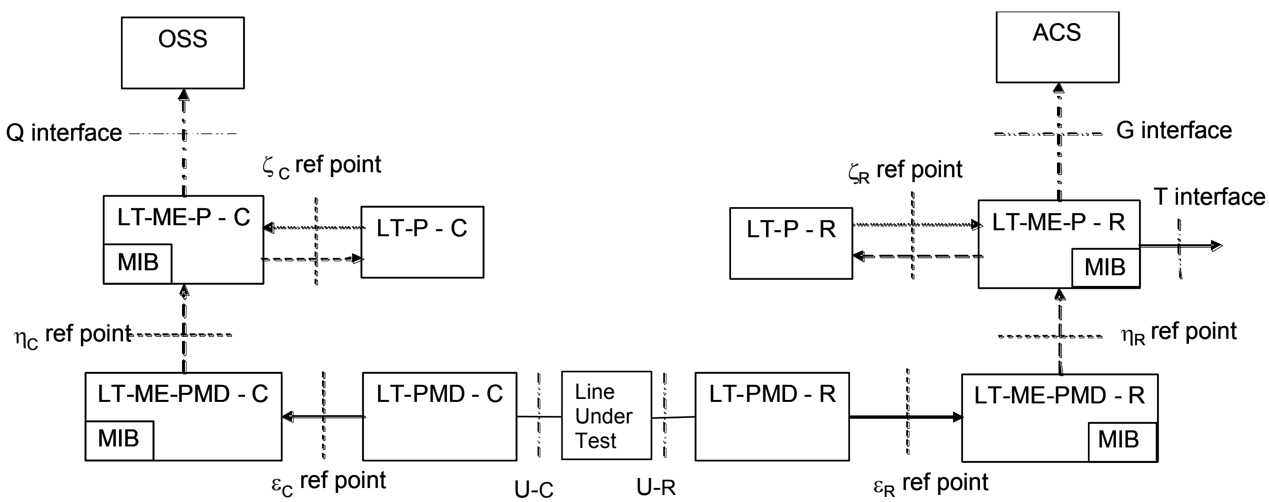

Figure 1: Functional reference model of DSL line test

Note that the functional reference model in G.996.2 defines three different interfaces (Q, T and G) and that each object in this specification is only available over some of these interfaces. The parameters supported by each interface are listed in G.996.2 and will not be further discussed in this Technical Report. It should also be noted that this Technical Report specifies full data models, including all relevant standard configuration and status parameters. However, some of those standard parameters are originally specified (e.g. G.996.2) as optional. While the structure and content of the data models are mandatory, in practice an implementation might not support any particular optional parameter. If the implementation does not support any optional parameter it should still respond appropriately to read-write operations addressing it (e.g. by an error-code, by returning a NULL value, etc.). The response type is beyond the scope of this Technical Report and mainly depends on the specific management protocol being used.

The model uses the principle of Vector of Profiles (VoP) defined in Broadband Forum TR-252 [4]. This means that the configuration parameters are divided into independent profiles and that the model uses pointers to these profiles.

Figure 2 illustrates notations used in this specification for illustrating the object model.

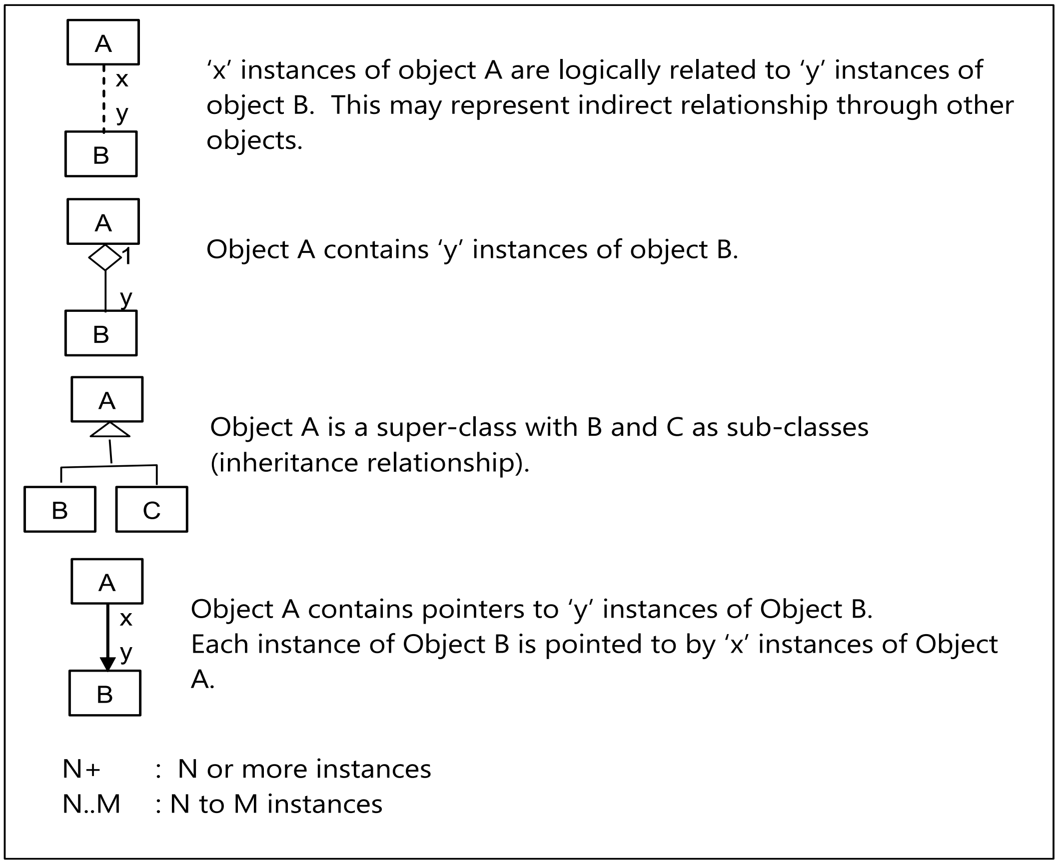

Figure 2: Notations

5 Object model for Single Ended Line Test (SELT)

The object model for SELT is divided into two submodels; One contains the configuration and control parameters and one contains the result (measurement and derived) parameters.

5.1 SELT configuration model

The SELT configuration model includes all configuration related parameters from G.996.2 and also the SELT-PMD control parameters used for triggering tests. The model is shown in Figure 3.

The parameter names are taken from G.996.2 and its amendments which give the parameter definitions. The supported types of measurements are Quiet Line Noise (QLN) and Uncalibrated Echo Response (UER).

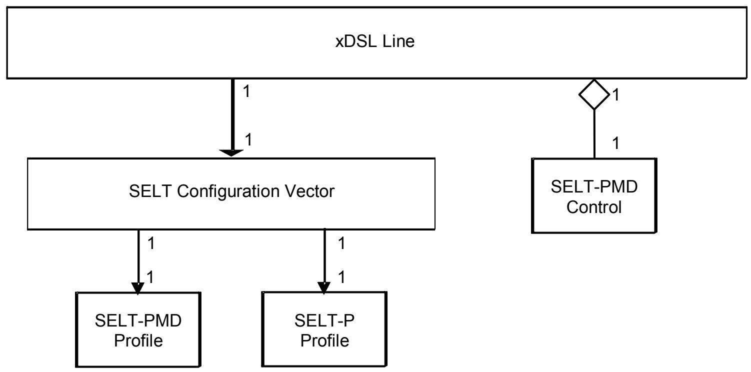

Figure 3: SELT configuration model

The xDSL Line object represents an individual physical transmission line in a similar way as defined in TR-252.

The following attributes MUST be supported by the xDSL Line object:

- Pointer to SELT Configuration Vector

The following attributes MUST be supported by the SELT-PMD Control object:

- SELT UER measurement enable C (SELT-UME-C)
- SELT UER measurement enable R (SELT-UME-R)
- SELT QLN measurement enable C (SELT-QME-C)
- SELT QLN measurement enable R (SELT-QME-R)

5.1.1 SELT Configuration Vector

The SELT Configuration Vector object represents a SELT configuration by referring to one profile for each of the functional blocks SELT-PMD and SELT-P in the G.996.2 functional reference model.

The SELT Configuration Vector MUST contain the following parameters:

- Pointer to SELT-PMD Profile
- Pointer to SELT-P Profile

5.1.1.1 SELT-PMD Profile

The SELT-PMD Profile contains the parameters for configuration of the SELT-PMD. The SELT-PMD performs measurements on the physical medium the device is connected to.

The SELT-PMD Profile MUST contain the following parameters:

- SELT UER maximum measurement duration C (SELT_UER_MMD_C)
- SELT UER maximum measurement duration R (SELT_UER_MMD_R)
- SELT quiet line noise maximum measurement duration C (SELT_QLN_MMD_C)
- SELT quiet line noise maximum measurement duration R (SELT_QLN_MMD_R)

5.1.1.2 SELT-P Profile

The SELT-P Profile contains the parameters for configuration of the SELT-P (Processing). The SELT-P processes the results from SELT-PMD measurements and transforms them into derived parameters representing the characteristics of the loop under test. The configuration parameters are related to estimation of the achievable capacity on the loop.

The SELT-P Profile MUST contain the following parameters:

- Capacity estimate calculation enabling (CECE)
- Capacity estimate signal PSD downstream (CAP-SIGNALPSDds)
- Capacity estimate signal PSD upstream (CAP-SIGNALPSDus)
- Capacity estimate noise PSD downstream (CAP-NOISEPSDds)
- Capacity estimate noise PSD upstream (CAP-NOISEPSDus)
- Capacity estimate target noise margin downstream (CAP-TARSNRMds)
- Capacity estimate target noise margin upstream (CAP-TARSNRMus)

5.2 SELT result parameter model

The SELT result parameter object represents all the results related to the SELT process. It contains two sub-classes; one for the measured parameters in SELT-PDM and one for the derived parameters in SELT-P.

The SELT result parameter model is illustrated in Figure 4.

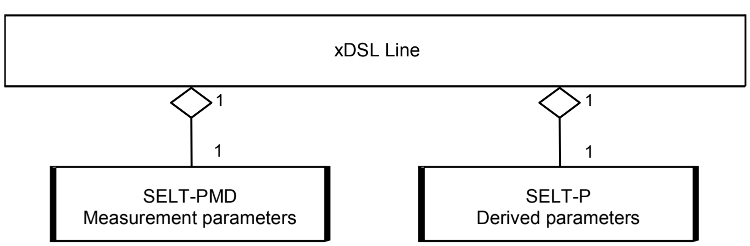

Figure 4: SELT result parameter model

The SELT result parameter model MUST contain the following SELT-PMD measurement parameters:

- SELT uncalibrated echo response C (SELT-UER-C)
- SELT uncalibrated echo response R (SELT-UER-R)
- SELT variance of uncalibrated echo response C (SELT-UER-VAR-C)
- SELT variance of uncalibrated echo response R (SELT-UER-VAR-R)
- SELT quiet line noise C (SELT_QLN_C)
- SELT quiet line noise R (SELT_QLN_R)

The SELT result parameter model MUST contain the following SELT-P derived parameters:

- Loop termination indicator (LOOP-TERM)
- Loop length (LOOP_LEN)
- Loop topology (LOOP-TOPOLOGY)
- Attenuation characteristics TFlog(f) (ATT-CHAR)
- Missing micro-filter or splitter (MIS-FILTER)
- Capacity estimate (CAP-EST)

6 Object model for Dual Ended Line Test (DELT)

DELT is currently for further study in G.996.2 and is thus for further study in this Technical Report.

7 Object model for Metallic Line Test (MELT)

The object model for MELT is divided into two submodels; one contains the configuration and control parameters and one contains the result (measurement and derived) parameters.

7.1 MELT configuration model

The MELT configuration model includes all configuration related parameters and also the MELT-PMD control parameters used for triggering tests. The model is shown in Figure 5.

The parameter names are taken from G.996.2 and its amendments which give the parameter definitions.

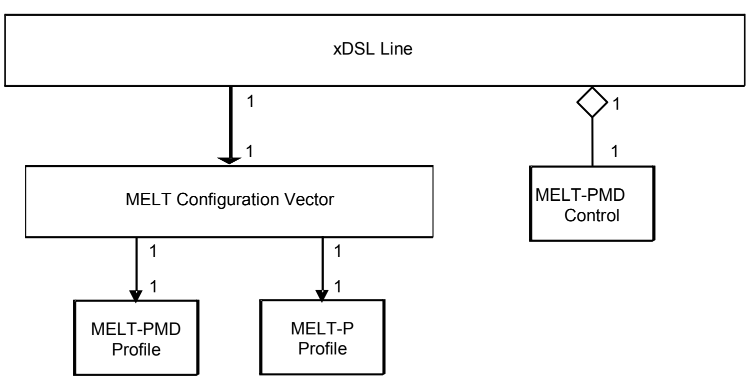

Figure 5: MELT configuration model

The xDSL Line object represents an individual physical transmission line in a similar way as defined in TR-252.

The following attributes MUST be supported by the xDSL Line object:

- Pointer to MELT Configuration Vector

The following attributes MUST be supported by the MELT-PMD Control object:

- MELT measurement enable
- MELT pair identification tone generation

7.1.1 MELT Configuration Vector

The MELT Configuration Vector object represents a MELT configuration by referring to one profile for each of the functional blocks MELT-PMD and MELT-P in the G.996.2 functional reference model.

The MELT Configuration Vector MUST contain the following parameters:

- Pointer to MELT-PMD Profile
- Pointer to MELT-P Profile

7.1.1.1 MELT-PMD Profile

The MELT-PMD Profile contains the parameters for configuration of the MELT-PMD. The MELT-PMD performs measurements on the physical medium the device is connected to.

The MELT-PMD Profile MUST contain the following parameters:

- Peak metallic voltage between tip and ring (MELT-PV)
- Pair identification tone frequency (MELT-PIT-F)
- Maximum far-end signature conduction voltage (MELT-MAXFE-SCV)
- Minimum far-end signature conduction voltage (MELT-MINFE-SCV)
- Measurement class (MELT-MCLASS)
- Signal frequency for active AC tests (MELT-AC-F)

The supported types of measurements specified by the measurement class (MELT-MCLASS) are:
- Measurement of the 4-element DC resistance with a controlled metallic voltage
- Measurement of the 3-element capacitance with a controlled metallic voltage
- Measurement of foreign DC voltage
- Measurement of foreign AC voltage
- Measurement of the loop capacitance with a high metallic voltage
- Measurement of the loop resistance with a high metallic voltage

- Measurement of the 3-element complex admittances with a controlled metallic voltage
- Measurement of the loop complex admittance with a high metallic voltage

7.1.1.2 MELT-P Profile

The MELT-P Profile contains the parameters for configuration of the MELT-P (Processing). The MELT-P processes the results from MELT-PMD measurements and transforms them into derived parameters representing the characteristics of the loop under test. The supported types of MELT-P derived parameters are:

- Identification of an open wire failure
- Open wire failure type
- Distance to the open wire failure
- Identification of a short circuit failure
- Short circuit failure type
- Leakage identification
- Resistive fault identification
- Foreign voltage classification
- Foreign voltage type
- Foreign voltage level class
- Far-end signature topology identification
- Far-end signature topology type

The MELT-P Profile MUST contain the following parameters:

- Loop resistance classification threshold (MELT-LRC-TH)
- Loop parameters per unit length (MELT-LOOP-PARAMS)
- Hazardous DC voltage level (MELT-HDCV-L)
- Hazardous AC voltage level (MELT-HACV-L)
- Foreign EMF DC voltage level (MELT-FDCV-L)
- Foreign EMF AC voltage level (MELT-FACV-L)
- System capacitance at the CPE side (MELT-SYSC-CPE)

7.2 MELT result parameter model

The MELT result parameter object represents all the results related to the MELT test. It contains two sub-classes; one for the measured parameters in MELT-PMD and one for the derived parameters in MELT-P.

The MELT result parameter model is illustrated in Figure 6.

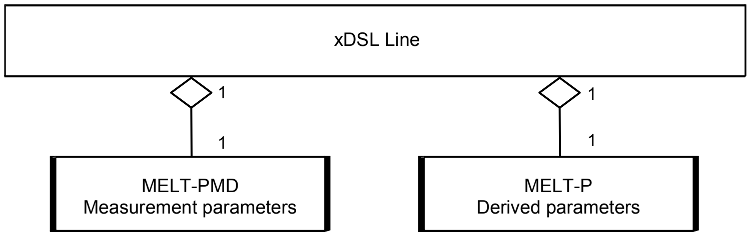

Figure 6: MELT result parameter model

The MELT result parameter model MUST contain the following MELT-PMD reporting parameters:

- Measurement frequency for active AC tests (MELT-MFREQ)
- Input impedance for foreign voltage measurements (MELT-IMP-V)
- Measurement voltage for loop complex admittance with a high voltage test (MELT-HCA-V)

The MELT result parameter model MUST contain the following MELT-PMD measurement parameters:

- 4-element DC resistance with controlled metallic voltage RTR (MELT-CDCR-TR)
- 4-element DC resistance with controlled metallic voltage RRT (MELT-CDCR-RT)
- 4-element DC resistance with controlled metallic voltage RTG (MELT-CDCR-TG)
- 4-element DC resistance with controlled metallic voltage RRG (MELT-CDCRRG)
- 3-element capacitance with controlled metallic voltage CTR (MELT-CC-TR)
- 3-element capacitance with controlled metallic voltage CTG (MELT-CC-TG)
- 3-element capacitance with controlled metallic voltage CRG (MELT-CC-RG)
- Foreign DC voltage VTR,DC (MELT-FVDC-TR)
- Foreign DC voltage VTG,DC (MELT-FVDC-TG)
- Foreign DC voltage VRG,DC (MELT-FVDC-RG)
- Foreign AC voltage VTR,AC (MELT-FVAC-TR)
- Foreign AC voltage VTG,AC (MELT-FVAC-TG)
- Foreign AC voltage VRG,AC (MELT-FVAC-RG)
- Foreign AC voltage frequency FTR,AC (MELT-FVACF-TR)
- Foreign AC voltage frequency FTG,AC (MELT-FVACF-TG)
- Foreign AC voltage frequency FRG,AC (MELT-FVACF-RG)
- Loop capacitance with high metallic voltage CTR,HV (MELT-HC-TR)
- Loop resistance with high metallic voltage RTR,HV (MELT-HDCR-TR)
- Loop resistance with high metallic voltage RRT,HV (MELT-HDCR-RT)
- DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDCTR (MELT-CDCV-TR)
- DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDCRT (MELT-CDCV-RT)
- DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDCTG (MELT-CDCV-TG)

- DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDCRG (MELT-CDCV-RG)
- Test current for the 4-element DC resistance with a controlled metallic voltage IDCTR (MELT-CDCI-TR)
- Test current for the 4-element DC resistance with a controlled metallic voltage IDCRT (MELT-CDCI-RT)
- Test current for the 4-element DC resistance with a controlled metallic voltage IDCTG (MELT-CDCI-TG)
- Test current for the 4-element DC resistance with a controlled metallic voltage IDCRG (MELT-CDCI-RG)
- Test voltage for the measurement of the loop resistance with a high metallic voltage VDCHTR (MELT-HDCV-TR)
- Test voltage for the measurement of the loop resistance with a high metallic voltage VDCHRT (MELT-HDCV-RT)
- Measurement voltage VACTR-CC (MELT-ACV-CC-TR)
- Measurement voltage VACTG-CC (MELT-ACV-CC-TG)
- Measurement voltage VACRG-CC (MELT-ACV-CC-RG)
- Measurement voltage VACTR-HC (MELT-ACV-HC-TR)
- Measurement voltage VACTR-CA (MELT-ACV-CA-TR)
- Measurement voltage VACTG-CA (MELT-ACV-CA-TG)
- Measurement voltage VACRG-CA (MELT-ACV-CA-RG)
- Measurement voltage VACTR-HA (MELT-ACV-HA-TR)
- 3-element complex admittance with controlled metallic voltage real part GTR (MELT-CAG-TR)
- 3-element complex admittance with controlled metallic voltage imaginary part BTR (MELT-CAB-TR)
  3-element complex admittance with controlled metallic voltage real part GTG (MELT-CAG-TG)
- 3-element complex admittance with controlled metallic voltage imaginary part BTG (MELT-CAB-TG)
- 3-element complex admittance with controlled metallic voltage real part GRG (MELT-CAG-RG)
- 3-element complex admittance with controlled metallic voltage imaginary part BRG (MELT-CAB-RG)
- Loop complex admittance with high metallic voltage real part GTR,HV (MELTHAG-TR)
- Loop complex admittance with high metallic voltage imaginary part BTR,HV (MELT-HAB-TR)

The MELT result parameter model MUST contain the following MELT-P derived parameters:

- Identification of an open wire failure (MELT-O-WIRE-type) – Open wire failure Type
- Identification of an open wire failure (MELT-O-WIRE-DIST) – Distance to the open wire failure
- Identification of a short circuit failure type (MELT-S-CCT-type)
- Leakage identification (MELT-LEAK-ID)

- Resistive fault identification (MELT-RFAULT-ID)
- Foreign voltage type classification (MELT-FV-TYPE)
- Foreign voltage level classification (MELT-FV-LEVEL)
- Far-end signature topology type identification (MELT-FES-ID)

End of Broadband Forum Technical Report TR-298