ASN.1 FOR MISBEHAVIOR REPORTING

VERSION 1.1

April 23, 2019

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SCMS Manager Board of Directors
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1.0 ASN.1 FOR MISBEHAVIOR REPORTING OVERVIEW

This document defines the ASN.1 for Misbehavior Reporting.

2.0 ASN.1 MODULE FOR MISBEHAVIOR REPORTING

CvpdMbdModule {iso(1) identified-organization(3) ieee(111)
standards-association-numbered-series-standards(2) wave-stds(1609)
dot2(2) tmp(256) cvpd-mbd(1)}

DEFINITIONS AUTOMATIC TAGS ::= BEGIN

EXPORTS ALL;

IMPORTS

ieee1609Dot2Data, Certificate

FROM

IEEE1609dot2 {iso(1) identified-organization(3) ieee(111)
standards-association-numbered-series-standards(2) wave-stds(1609)
dot2(2) base (1) schema (1) major-version-2(2)}

Psid,
Time32,
Uint8,
Uint16,
ThreeDLocation

FROM ieee1609dot2BaseTypes {iso(1) identified-organization(3) ieee(111)
standards-association-numbered-series-standards(2) wave-stds(1609)
dot2(2) base(1) base-types(2) major-version-2(2)};

---

-- @brief The EndEntityMaInterfacePDU is the parent message type for messages sent between End
-- Entities (EE) and the Misbehavior Authority (MA).
-- @class EndEntityMaInterfacePDU
-- @param eeMaMisbehaviorReport contains the misbehavior report sent by an end entity to the MA.
EndEntityMaInterfacePDU ::= CHOICE {
  eeMaApplicationSpecificMisbehaviorReport  EeMaApplicationSpecificMisbehaviorReport,
  ...
}
---
-- @brief This data type contains the misbehavior report sent by an end entity to the MA.
-- @class EeMaMisbehaviorReport
-- @param version contains the current version of the data type. The version specified
-- in this document is version 1, represented by the integer 1.
-- @param generationTime contains the generation time of misbehavior report.
-- @param psid contains the PSID for the application for which misbehavior is
-- being reported.
-- @param contents contains the PSID-specific misbehavior report contents.
-- @see Uint8, Time32, Psid

EeMaApplicationSpecificMisbehaviorReport ::= SEQUENCE {
  version         Uint8,
  generationTime  Time32,
  generationLocation ThreeDLocation,
  psid            APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT.&id({CvpdMbr}),
  contents        APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT.
                  &Contents({CvpdMbr}@.psid),
...}

---
-- @brief This is an ASN.1 CLASS to enable the definition of an arbitrary number
-- of PSID-specific misbehavior reports
-- @class APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT
-- @param id is the PSID for which the report is being defined
-- @param Contents is the PSID-specific misbehavior report contents.
-- @see Psid

APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT ::= CLASS {
  &id        Psid,
  &Contents
} WITH SYNTAX {&Contents IDENTIFIED BY &id}

---
-- @brief This is a list of the APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT
-- instances that are supported for CV Pilot Deployments
-- @class CvpdMbr
-- @param Psid20Mbr is the misbehavior report type associated with PSID 0x20.
-- @see APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT
-- @note it would be better to import a BsmPsid value from elsewhere rather
-- than explicitly defining it as 32 (0x20), but explicitly defining
-- it as 0x20 won't cause any inconsistencies.
CvpdMbr APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT ::= {
  { Psid20Mbr IDENTIFIED BY 32 },

---

-- @brief This data type contains the PSID 0x20-specific misbehavior report. It is intended to go inside an APPLICATION-SPECIFIC-MISBEHAVIOR-REPORT.
-- @class Psid20Mbr
-- @param version contains the current version of the data type. The version specified in this document is version 1, represented by the integer 1.
-- @param type contains an identifier for the high-level type of the report being provided. Currently two types are supported, inconsistent (tuples of) BSMs and implausible (single) BSMs.
-- @param subtype contains an identifier for the subtype of the report, and any parameters specific to that subtype.
-- @param evidence contains the evidence data structure corresponding to the indicated high-level report type.
-- @see Uint8, Time32, Psid

Psid20Mbr ::= SEQUENCE {
    version  Uint8, -- 1 for this version
    type     PSID-20-SPECIFIC-MBR.&type({CvpdPsid20Mbr}),
    subtype  PSID-20-SPECIFIC-MBR.&SubtypeArrayAndParams({CvpdPsid20Mbr}{@.type}),
    evidence PSID-20-SPECIFIC-MBR.&Evidence({CvpdPsid20Mbr}{@.type}),
}

---

-- @brief This is an ASN.1 CLASS to enable the definition of an arbitrary number of misbehavior reports specific to PSID 0x20
-- @class PSID-20-SPECIFIC-MBR
-- @param type is the high-level report type
-- @param SubtypeArray is the type-specific array of subtypes and associated parameters
-- @param Evidence is the type-specific set of evidence relevant to this type of MBR
-- @see Psid

PSID-20-SPECIFIC-MBR ::= CLASS {
    &type Psid20MbrType,
    &SubtypeArrayAndParams,
    &Evidence
} WITH SYNTAX {&Evidence FOR SUBTYPES &SubtypeArrayAndParams IDENTIFIED BY &type}

---

-- @brief This data type contains the misbehavior report type.
-- @class Psid20MbrType
-- @param psid20MbrType1VInconsistent Indicates that the report concerns two or more BSMs from the same sender that are inconsistent with each other.
-- @brief This is a list of the PSID-20-SPECIFIC-MBR
-- instances that are supported for CV Pilot Deployments. Entries
-- are of the form [Evidence] FOR SUBTYPES [Subtypes and params]
-- IDENTIFIED BY [Subtype ID].
-- @class CvpdPsid20Mbr
-- @see Psid20MbrType, Psid20MbrEvidence1VInconsistent,
-- Psid20MbrSubtype1VInconsistentList,
-- Psid20MbrEvidenceImplausible,
-- Psid20MbrSubtypeImplausibleList
--   - mbr-Psid20Mbr-1VInconsistent
--   - mbr-Psid20Mbr-Implausible
--   - mbr-Psid20Mbr-ObsImplausible

CvpdPsid20Mbr PSID-20-SPECIFIC-MBR ::= {
   {Psid20MbrEvidence1VInconsistent
    FOR SUBTYPES Psid20MbrSubtype1VInconsistentList
    IDENTIFIED BY psid20MbrType1VInconsistent} |
   {Psid20MbrEvidenceImplausible
    FOR SUBTYPES Psid20MbrSubtypeImplausibleList
    IDENTIFIED BY psid20MbrTypeImplausible} |
   {Psid20MbrEvidenceObsImplausible
    FOR SUBTYPES Psid20MbrSubtypeObsImplausibleList
    IDENTIFIED BY psid20MbrTypeObsImplausible},
...
}
---
-- @brief This data type contains the set of report subtypes corresponding
-- to an Inconsistent BSM report.
-- @class Psid20MbrSubtype1VInconsistentList
-- @see Psid20MbrSubtype1VInconsistent
Psid20MbrSubtype1VInconsistentList ::= SEQUENCE (SIZE (1..MAX)) OF Psid20MbrSubtypeParams1VInconsistent

---
-- @brief This data type contains the subtype and parameters for reports of type
-- single-vehicle inconsistent BSMs
-- @param subtype the subtype of the report.
-- @param params the parameters associated with that subtype, if any.
-- @see  CvpdPsid20Mbr1VInconsistentStParams
Psid20MbrSubtypeParams1VInconsistent ::= SEQUENCE {
  subtype  PSID-20-MBR-ST-PARAMS-1VINCONSISTENT.
    &subtype({CvpdPsid20Mbr1VInconsistentStParams}),
  params         PSID-20-MBR-ST-PARAMS-1VINCONSISTENT.
    &Params({CvpdPsid20Mbr1VInconsistentStParams}{@.subtype})
}

---
-- @brief This is an ASN.1 CLASS to enable the definition of an arbitrary number
-- of misbehavior reports specific to single-vehicle BSM inconsistency.
-- @class PSID-20-MBR-ST-PARAMS-1VINCONSISTENT
-- @param type is the high-level report type
-- @param SubtypeArray is the type-specific array of subtypes and associated
-- parameters
-- @see Psid
PSID-20-MBR-ST-PARAMS-1VINCONSISTENT ::= CLASS {
  &subtype      Psid20MbrSubtype1VInconsistent,
  &Params
} WITH SYNTAX {SUBTYPE &subtype USING PARAMS &Params}

---
-- @brief This data type indicates the misbehavior report subtype for
-- inconsistent BSMs from a single sender. A single-vehicle Inconsistent
-- BSM report can in principle correspond to multiple subtypes, although
-- in practice the ones defined in this project are mutually exclusive.
-- @class Psid20MbrSubtype1VInconsistent
-- @param psid20MbrSubtype1VInconsistentConstantPosition Indicates that
-- multiple consecutive BSMs from the same sender have the same
-- position but non-zero speed.
-- @param psid20MbrSubtype1VInconsistentRandomPosition Indicates that
-- multiple consecutive BSMs from the same sender have positions
-- @brief This data type contains the set of report subtypes corresponding to an Implausible Single BSM report and their associated parameters
-- @class Psid20MbrSubtypeImplausibleList
-- @see Psid20MbrSubtypeParamsImplausible

Psid20MbrSubtypeImplausibleList ::= SEQUENCE (SIZE (1..MAX)) OF Psid20MbrSubtypeParamsImplausible

---

-- @brief This data type contains the subtype and parameters for reports of type single implausible BSM.
-- @class Psid20MbrSubtypeParamsImplausible
-- @param subtype the subtype of the report.
-- @param params the parameters associated with that subtype, if any.
-- @see CvpdPsid20MbrImplausibleStParams

Psid20MbrSubtypeParamsImplausible ::= SEQUENCE {
  subtype  PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE.
    &subtype({CvpdPsid20MbrImplausibleStParams}),
  params         PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE.
    &Params({CvpdPsid20MbrImplausibleStParams}{@.subtype})
}

---

-- @brief This is an ASN.1 CLASS to enable the definition of an arbitrary number of misbehavior reports specific to single-BSM implausibility.
-- @class PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE
-- @param type is the high-level report type
-- @param SubtypeArray is the type-specific array of subtypes and associated parameters
-- @see Psid

PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE ::= CLASS {
  &subtype    Psid20MbrSubtypeImplausible,
  &Params
} WITH SYNTAX [SUBTYPE &subtype USING PARAMS &Params]

---

-- @brief This data type indicates the misbehavior report subtype for implausible single BSMs. A single-vehicle Inconsistent BSM report can correspond to multiple subtypes.
-- @class Psid20MbrSubtypeImplausible
-- @param psid20MbrSubtypeImplausibleMaxSpeed Indicates that the speed given in the BSM in the evidence field is implausibly high.
-- @param psid20MbrSubtypeImplausibleMaxAcceleration Indicates that the acceleration
-- given in the BSM in the evidence field is implausibly high.
-- @param psid20MbrSubtypeImplausibleBrakeAcceleration Indicates that in the
-- BSM in the evidence field, the brakes are showing as on but the
-- acceleration is not negative, i.e. not in basically the opposite
-- direction to the speed.
Psid20MbrSubtypeImplausible ::= INTEGER (0..255)
psid20MbrSubtypeImplausibleMaxSpeed    Psid20MbrSubtypeImplausible ::= 1
psid20MbrSubtypeImplausibleMaxAcceleration Psid20MbrSubtypeImplausible ::= 2
psid20MbrSubtypeImplausibleBrakeAcceleration Psid20MbrSubtypeImplausible ::= 3

-- @brief This is a list of the PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE
-- instances that are supported for CV Pilot Deployments. Entries are
-- of the form [Subtype ID] [(optionally) USING PARAMS [Params]].
-- @class CvpdPsid20MbrImplausibleStParams
-- @see   Psid20MbrSubtypeImplausible, Psid20MbrParamsImplausibleMaxSpeed,
--        Psid20MbrParamsImplausibleMaxAcceleration
CvpdPsid20MbrImplausibleStParams PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE ::= {
  {SUBTYPE psid20MbrSubtypeImplausibleMaxSpeed USING PARAMS
              Psid20MbrParamsImplausibleMaxSpeed} |
  {SUBTYPE psid20MbrSubtypeImplausibleMaxAcceleration USING PARAMS
              Psid20MbrParamsImplausibleMaxAcceleration} |
  {SUBTYPE psid20MbrSubtypeImplausibleBrakeAcceleration USING PARAMS NULL},
...}

-- @brief This data type gives the parameters for the Implausible
-- Max Speed misbehavior report type
-- @class Psid20MbrParamsImplausibleMaxSpeed
-- @param threshold This is the threshold that the reporting device
-- implemented for reporting implausible max speeds. The BSM
-- provided in the corresponding Evidence field will indicate
-- a horizontal speed greater than this value. The units of
-- this quantity are meters per second.
Psid20MbrParamsImplausibleMaxSpeed ::= SEQUENCE {
  threshold        Uint16,
...}

-- @brief This data type gives the parameters for the Implausible
-- Max Acceleration misbehavior report type
-- @class Psid20MbrParamsImplausibleMaxSpeed
-- @param threshold This is the threshold that the reporting device
-- implemented for reporting implausible max acceleration. The
-- BSM provided in the corresponding Evidence field will indicate
-- a horizontal acceleration greater than this value.
The units of this quantity are hundredths of a meter per second squared.

Psid20MbrParamsImplausibleMaxAcceleration ::= SEQUENCE {
    threshold        Uint16,
    ...
}

---

@brief This data type contains the evidence used to support an Implausible Single BSM report, which is a single BSM from the suspect sender. NOTE that SignedBsmsWithCertificate may have more than one BSM, but if used in this context it SHALL only contain a single BSM.

@class Psid20MbrEvidenceImplausible
@see SignedBsmsWithCertificate
Psid20MbrEvidenceImplausible ::= SignedBsmsWithCertificate

---

@brief This data type contains the set of report subtypes corresponding to an Implausible Observed BSM report and their associated parameters.

An implausible observed BSM is a BSM which is not implausible considered on its own, but is implausible considered in conjunction with information known to the observer. Implausible Observed BSM Reports may include sensor information from the observer but do not need to include BSMs from other vehicles.

@class Psid20MbrSubtypeObsImplausibleList
@see Psid20MbrSubtypeParamsObsImplausible
Psid20MbrSubtypeObsImplausibleList ::= SEQUENCE (SIZE (1..MAX)) OF Psid20MbrSubtypeParamsObsImplausible

---

@brief This data type contains the subtype and parameters for reports of type single implausible BSM.

@class Psid20MbrSubtypeParamsObsImplausible
@param subtype the subtype of the report.
@param params the parameters associated with that subtype, if any.
@see CvpdPsid20MbrObsImplausibleStParams
Psid20MbrSubtypeParamsObsImplausible ::= SEQUENCE {
    subtype  PSID-20-MBR-ST-PARAMS-OBS-IMPLAUSIBLE.
        &subtype({CvpdPsid20MbrObsImplausibleStParams}),
    params  PSID-20-MBR-ST-PARAMS-OBS-IMPLAUSIBLE.
        &Params({CvpdPsid20MbrObsImplausibleStParams}@.subtype)
---
- @brief This is an ASN.1 CLASS to enable the definition of an arbitrary number
  - of misbehavior reports specific to observed BSM implausibility.
- @class PSID-20-MBR-ST-PARAMS-OBS-IMPLAUSIBLE
- @param type is the high-level report type
- @param SubtypeArray is the type-specific array of subtypes and associated
  - parameters
- @see Psid

PSID-20-MBR-ST-PARAMS-OBS-IMPLAUSIBLE ::= CLASS {
  &subtype       Psid20MbrSubtypeObsImplausible,
  &Params
} WITH SYNTAX {SUBTYPE &subtype USING PARAMS &Params}

---
- @brief This data type indicates the misbehavior report subtype for
  - implausible single BSMs. A single-vehicle Inconsistent BSM report can
  - correspond to multiple subtypes.
- @class Psid20MbrSubtypeObsImplausible
- @param psid
  - 20MbrSubtypeObsImplausibleDistance Indicates that the distance
    - between the BSM and the receiver is implausibly high.
Psid20MbrSubtypeObsImplausible ::= INTEGER (0..255)
psid20MbrSubtypeObsImplausibleDistance       Psid20MbrSubtypeObsImplausible ::= 1

---
- @brief This is a list of the PSID-20-MBR-ST-PARAMS-IMPLAUSIBLE
  - instances that are supported for CV Pilot Deployments. Entries are
    - of the form [Subtype ID] [(optionally) USING PARAMS [Params]]. The
    - list contains only one entry in this version of this file.
- @class CvpdPsid20MbrObsImplausibleStParams
- @see   Psid20MbrSubtypeObsImplausible, Psid20MbrParamsObsImplausibleDistance
CvpdPsid20MbrObsImplausibleStParams PSID-20-MBR-ST-PARAMS-OBS-IMPLAUSIBLE ::= {
  {SUBTYPE psid20MbrSubtypeObsImplausibleDistance USING PARAMS
    Psid20MbrParamsObsImplausibleDistance} ,
  ...
}

---
- @brief This data type gives the parameters for the Implausible Observed
  - Distance misbehavior report type
- @class Psid20MbrParamsObsImplausibleDistance
- @param threshold This is the threshold that the reporting device
  - implemented for reporting implausible distances. The units of
    - this quantity are meters.
- @param gpsDrift This is the maximum amount of difference in position
The quantity MAY be 0. The units of this quantity are meters.

The Evidence associated with these parameters will include a single Suspect BSM and a single Reporter BSM for which the difference in location is greater than threshold even taking gpsDrift into consideration.

Psid20MbrParamsObsImplausibleDistance ::= SEQUENCE {
  threshold        Uint16,
  gpsDrift         Uint16,
  ...
}

---

@brief This data type contains the evidence used to support an Implausible Observed BSM report, which is a single BSM from the suspect sender, and a single BSM from the observer, which shall have the 1609.2 generation times which are within 0.25 seconds of each other.

@class Psid20MbrEvidenceImplausible

@param suspectBsm The BSM sent by the sender. NOTE that SignedBsmsWithCertificate may have more than one BSM, but when used in this context it SHALL only contain a single BSM.

@param reporterBsm The BSM sent by the sender. NOTE that SignedBsmsWithCertificate may have more than one BSM, but when used in this context it SHALL only contain a single BSM.

@see SignedBsmsWithCertificate

Psid20MbrEvidenceObsImplausible ::= SEQUENCE {
  suspectBsm     SignedBsmsWithCertificate,
  reporterBsm    SignedBsmsWithCertificate,
  ...
}

---

**Structures common to multiple report subtypes**

---

@brief This data type contains BSMs along with the certificate used to sign them.

@class SignedBSMsWithCertificate

@param signedBSMList contains a list of signed BSMs which were all signed with the same certificate, in which the SignerIdentifier is of type digest.

@param signingCertificate contains the certificate used to sign above BSMs.

SignedBSMsWithCertificate ::= SEQUENCE {
  signedBsmList  SEQUENCE (SIZE(1..MAX)) OF SignedBSM,
signingCertificate Certificate,
...
}

---
- @brief This data type contains a signed BSM.
- @class SignedBSM
- @param unsecuredData is the UPER encoded BasicSafetyMessage as defined in J2735
- and J2945/1.
SignedBSM ::= ieee1609Dot2Data (WITH COMPONENTS { ...
  content (WITH COMPONENTS {
    signedData (WITH COMPONENTS { ...
      tbsData (WITH COMPONENTS { ...
        payload (WITH COMPONENTS {
          data (WITH COMPONENTS {
            content (WITH COMPONENTS {
              unsecuredData
            }
          }
        }
      }
    }
  }

END
## 3.0 Revision History

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<td>February 14, 2019</td>
<td>Release</td>
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<td>V1.1</td>
<td>April 19, 2019</td>
<td>Added generationLocation to MBR</td>
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