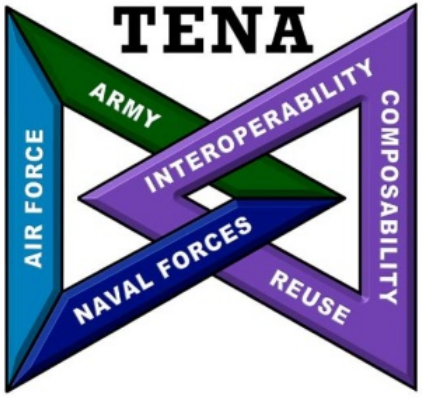
TENA LVC Object Model Collection



ITEA LVC Workshop

Jim Bak

TENA SDA

17 September 2019

Change is Needed

- **The TENA-Platform and related OMs (e.g. PlatformDetails, Engagement, Radar) were originally designed ~15 years ago**
  - Early adopters were predominately from the simulation world
  - Concepts followed the core DIS (Distributed Interactive Simulation) PDUs (Protocol Data Units)
  - Currently, these OMs are heavily used by the user community with a large install base of TENA-enabled applications

Change is Needed

- **The TENA-Platform and related OMs (e.g. PlatformDetails, Engagement, Radar) provide incomplete mappings to their respective DIS PDU counterparts**
  - Difficult to provide round-trip data translations (DIS -> TENA -> DIS)
  - TENA is used to provide the WAN mechanism for data exchange with a large number of DIS-based systems that operate at different sites
    - DIS-based systems has the majority of the market share in the simulation community
    - Large percentage of Virtual and Constructive simulations communicate natively using a subset of DIS PDUs
    - There has been a recent update to the IEEE DIS 1278.1 specification in 2012
      - Most notable change is to IFF

Is it time to introduce TENA OM changes to reflect the evolving T&E and test & training needs of our Warfighter?

OM Limitations

- **Data gaps within this subset of TENA Standard OMs have become exposed**
  - Entity Representation

Articulated Parts

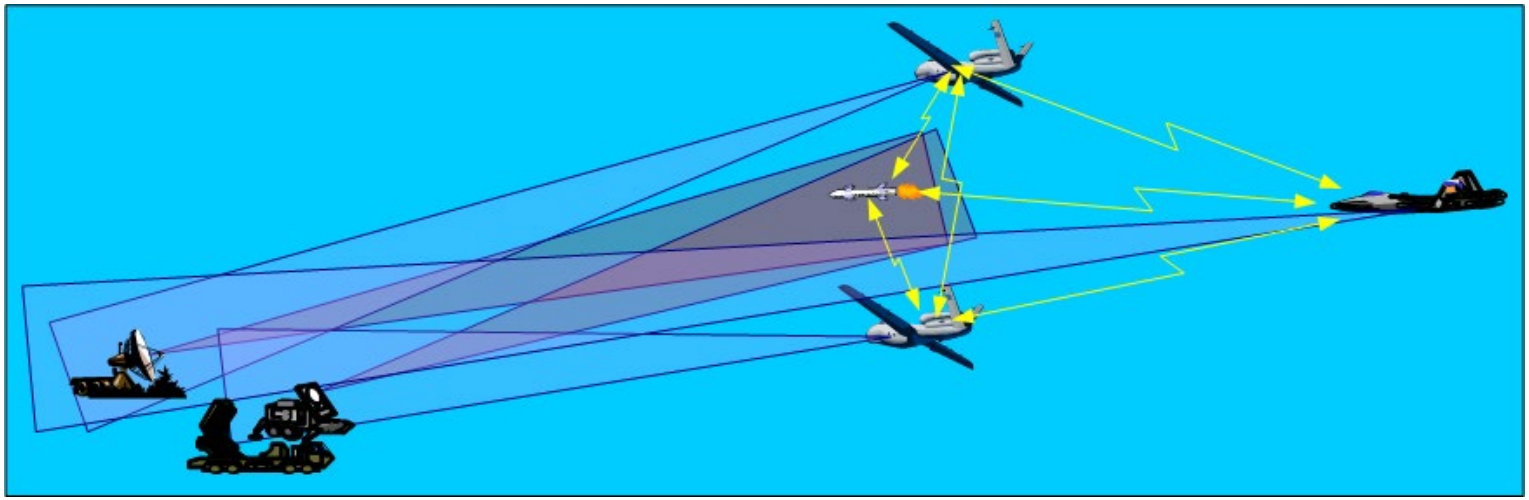
Attached Parts

OM Limitations

- **Data gaps within this subset of TENA Standard OMs have become exposed**
  - Entity Representation
    - Guise

OM Limitations

- **Data gaps within this subset of TENA Standard OMs have become exposed**
  - Electronic Warfare
    - Emissions
    - Jamming

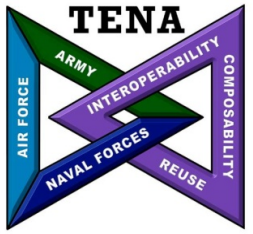


OM Limitations

- **The TENA User community has generated their own OMs to bridge identified gaps in the current TENA Standard OMs**
  - InterTEC
    - CCFW OM to augment TENA-Embedded-IFF (to include Mode 5), model Emissions for EW, and model Radio Communications (DIS Transmitter/Signal PDUs)
  - ProLogic
    - Simulating Link-16
  - JNTC
  - JPARC
  - LiveTraining
  - USNNTTR
  - Over 750 User Object Models!

Assessing OM Gaps

- **TENA SDA performed a gap analysis study of a subset of the TENA Standard OMs with their respective DIS PDU counterparts**
  - TENA-Platform-v4
  - TENA-PlatformDetails-v4
  - TENA-PlatformType-v2
  - TENA-Embedded-v3
    - TENA-IFF-v1.OM1278.2 candidate to replace TENA-Embedded-IFF and InterTEC-CCFW-IFF
  - TENA-Emitter-v1.OM1127.5 candidate
    - To replace InterTEC-CCFW-Emission
  - TENA-Engagement-v4
  - TENA-Munition-v3
  - TENA-RadioCommunication-v1.OM1279.2 candidate
    - To replace InterTEC-CCFW-Transmitter/Signal

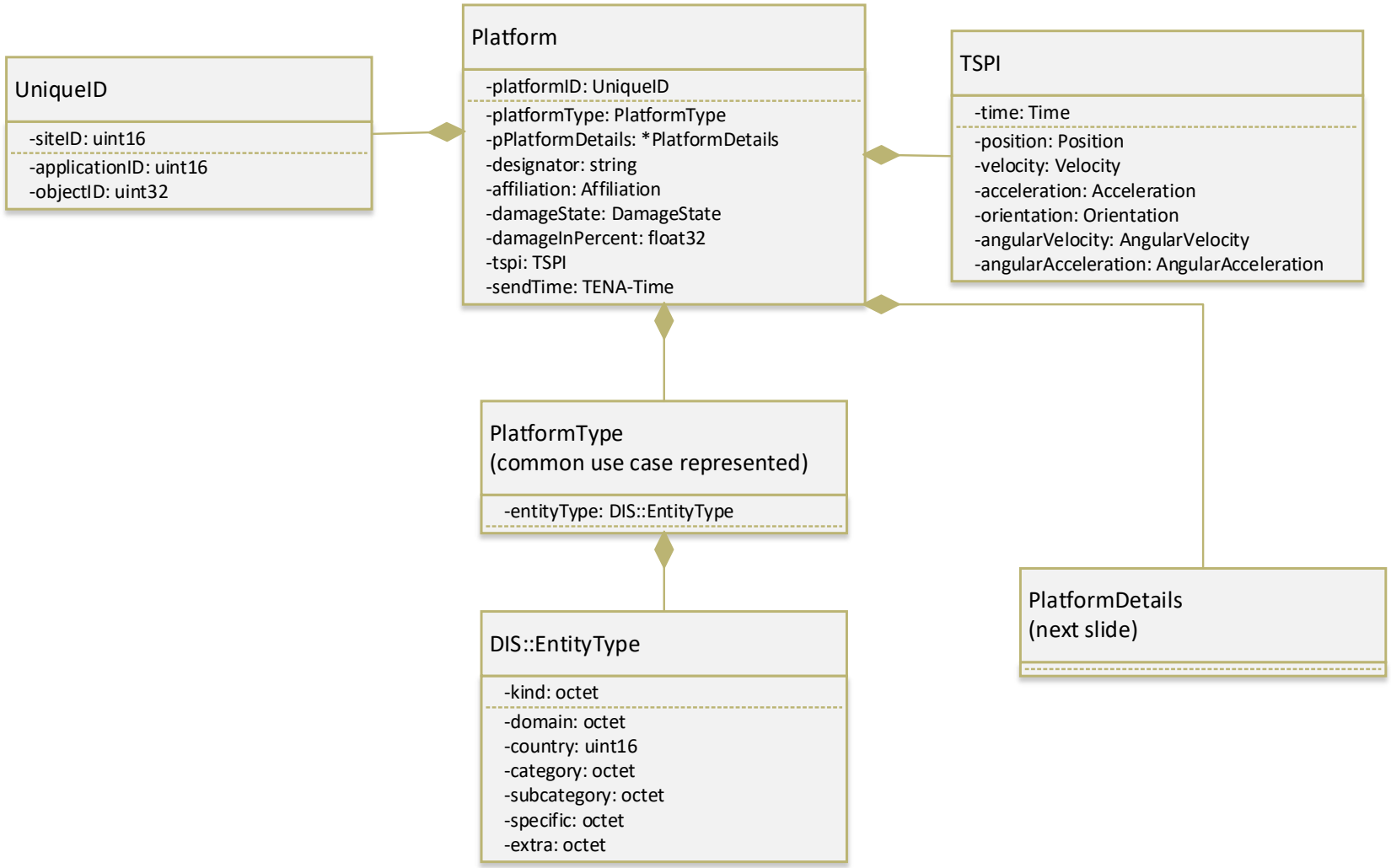


Platform / PlatformDetails

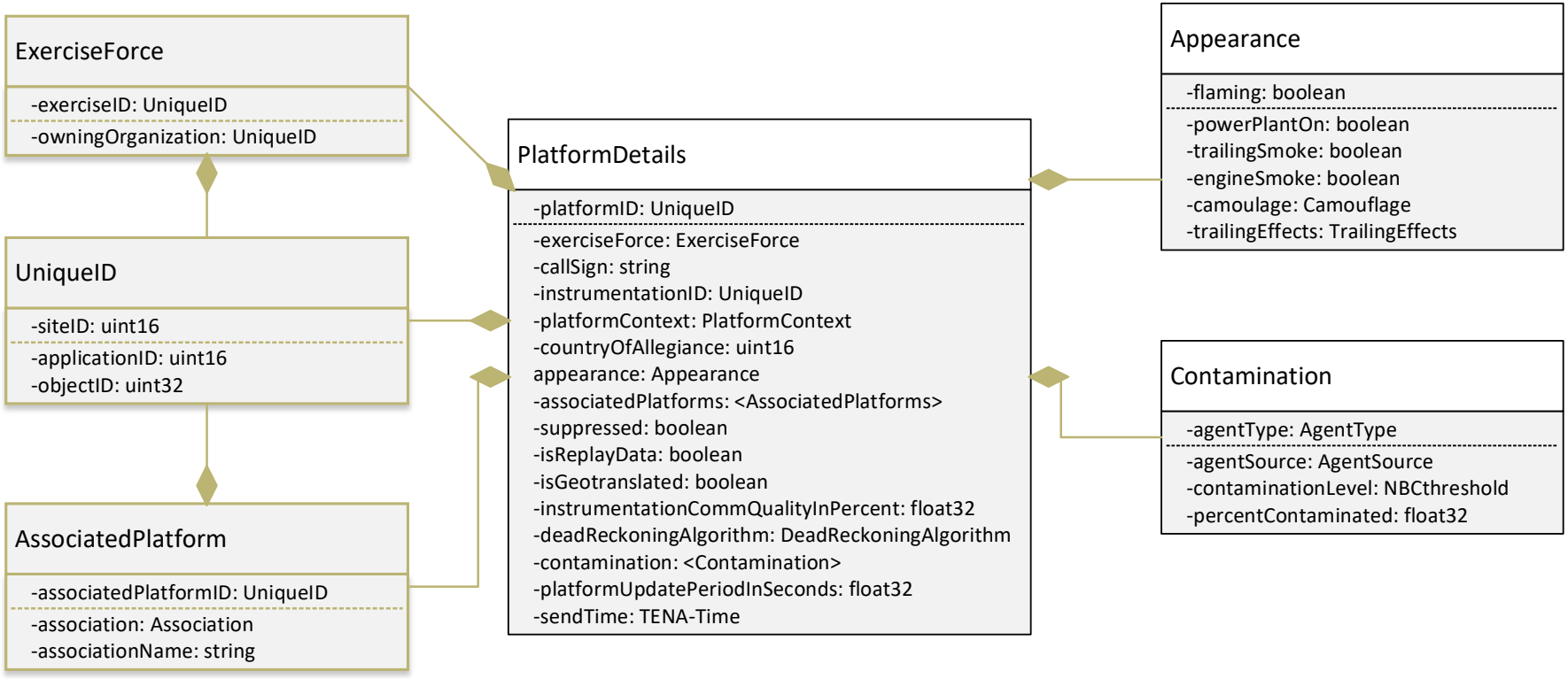
Platform / Platform Details

- **Originally was partially based from the DIS Entity State PDU**
- **Why two OMs?**
  - TENA::Platform represents attributes that require frequent data changes
  - TENA::PlatformDetails represents attributes that either infrequently changes or is static from the beginning
- **Challenges**
  - Difficult to provide complete round trip data translations
    - DIS Entity State PDU => TENA Platform/PlatformDetails => DIS Entity State PDU is NOT a lossless communication
  - Software development confusion
    - Is PlatformDetails even required?
    - What if a DIS Translator tool receives Platform but not PlatformDetails?
      - Should it translate and send an Entity State PDU anyways?
      - Should it wait for the PlatformDetails?

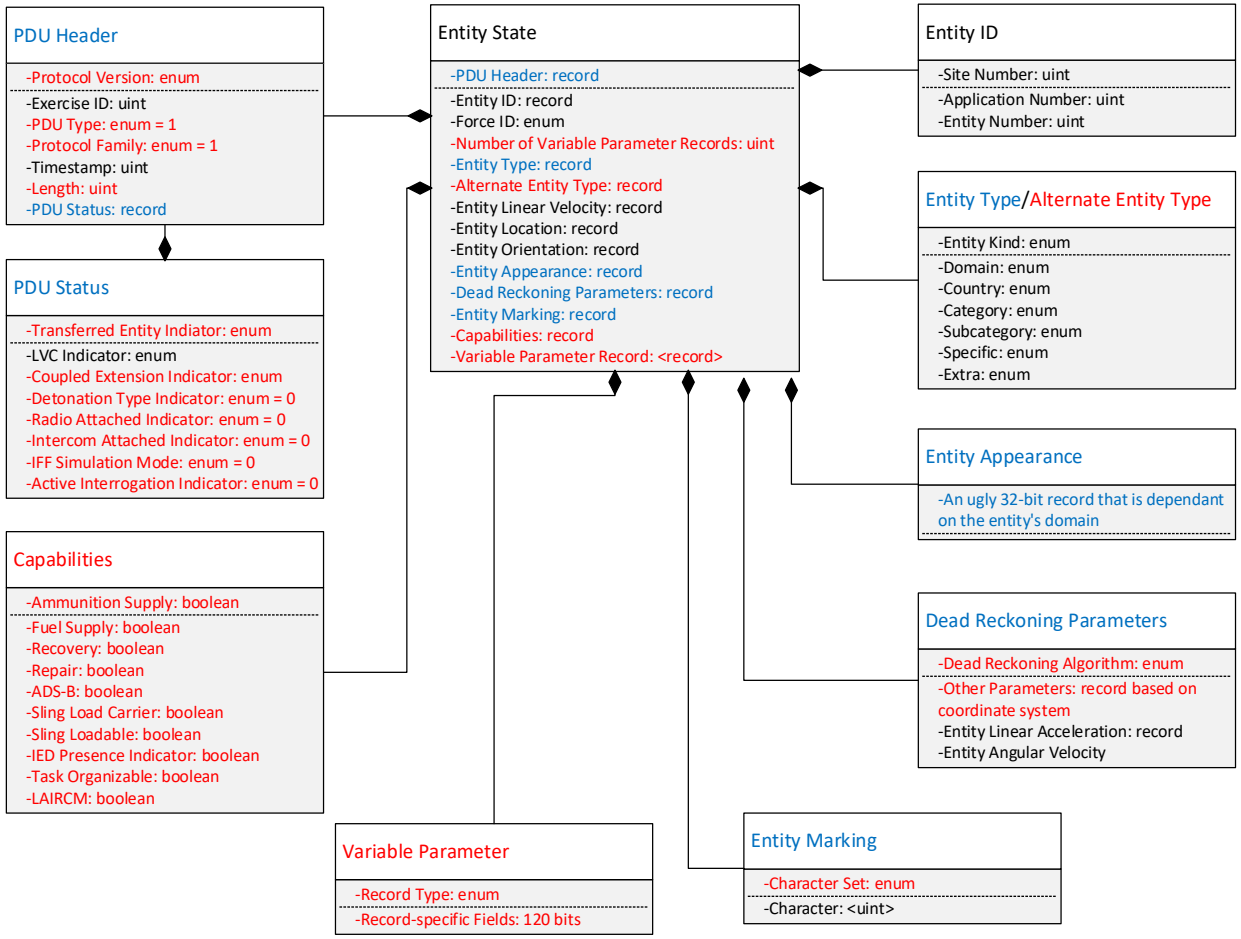
TENA::Platform (Partial UML Diagram)



TENA::PlatformDetails (Partial UML Diagram)

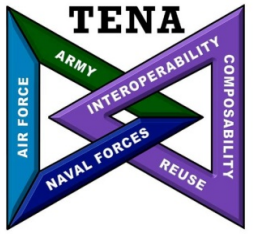


Entity State PDU



Not supported by a TENA attribute

Partially supported by a TENA attribute

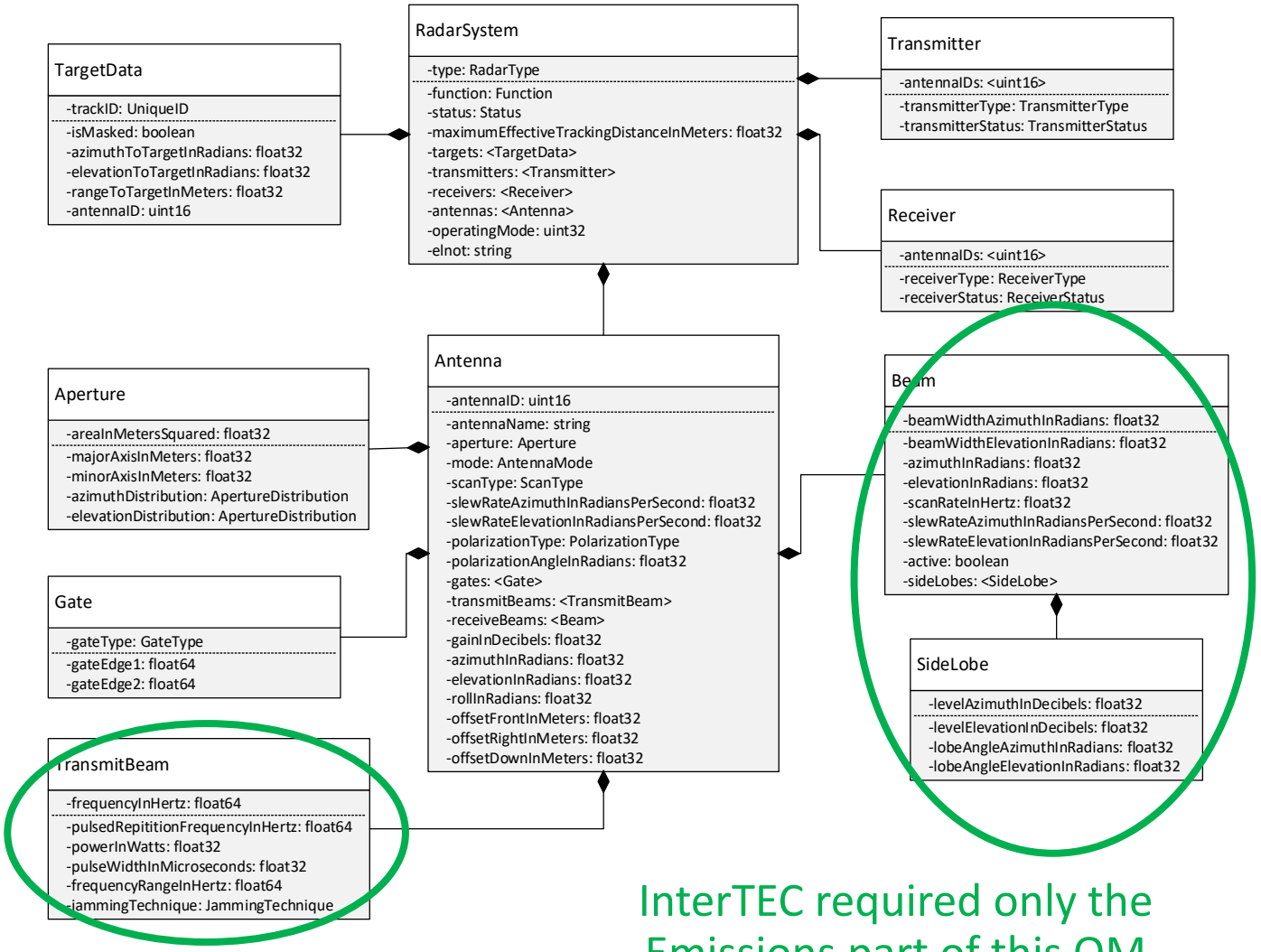


Electromagnetic Emissions

The InterTEC Story

- **Once upon a time, the Interoperability Test & Evaluation Capability (InterTEC) Program made an investment in introducing Electronic Warfare/Electronic Attack capabilities into their LVC distributed test environment**
  - All of the EW-capable sites that were recruited employed DIS-centric Virtual and Constructive simulations
- **InterTEC performed an assessment of the TENA-Radar OM**
  - Found it to be a bit overkill. Tons and tons of attributes that described the physical part of the radar system. A small subset that described the emissions
    - Did not want to always publish the physical part of the radar system for each emission state update

TENA::Radar (Partial UML Diagram)

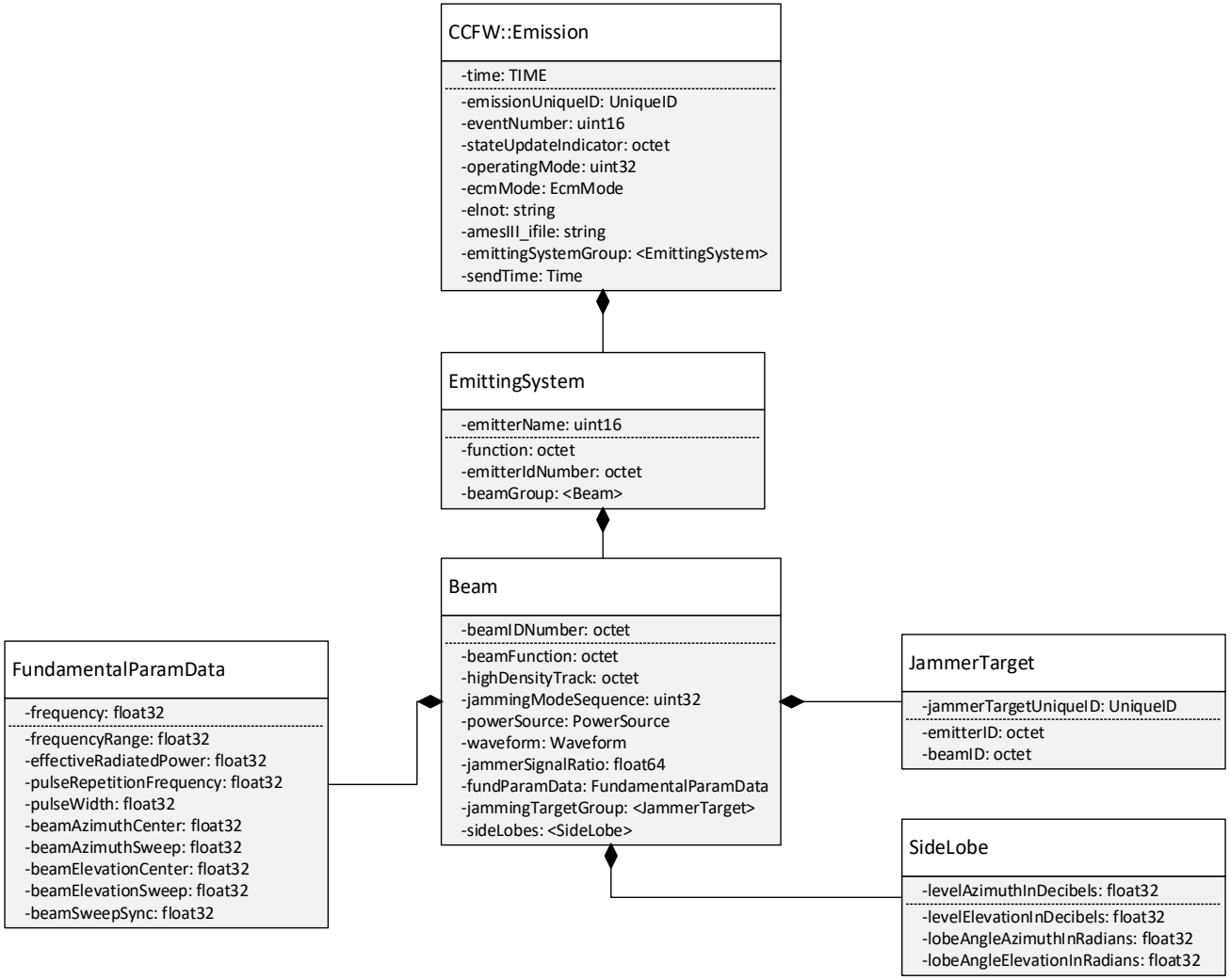


InterTEC required only the Emissions part of this OM

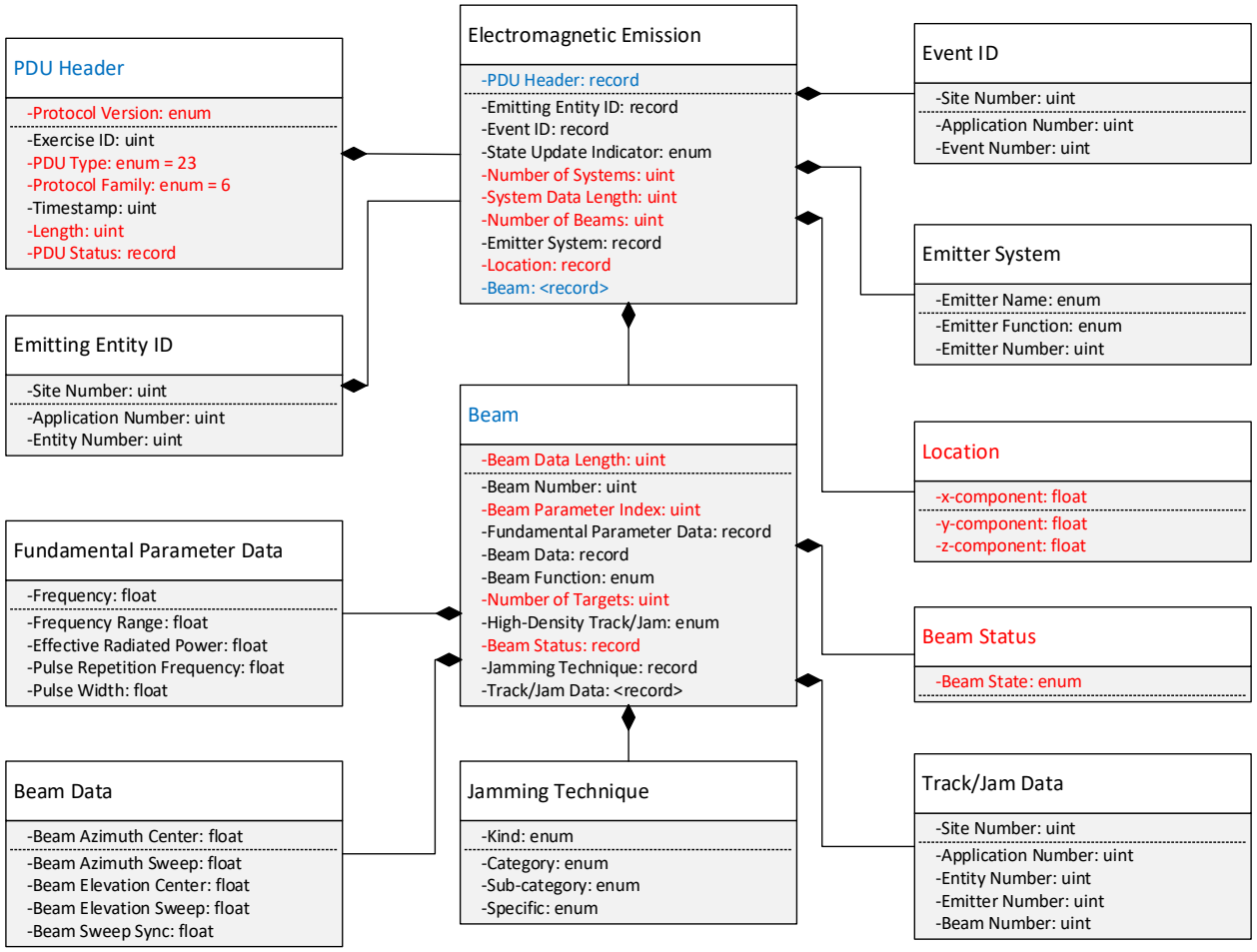
The InterTEC Story (cont'd)

- **So, InterTEC decided to create their own object model to represent Emissions for their EW/EA modeling requirement**
  - Creation of the Communications Control Framework Object Model (CCFW OM) containing Emissions
    - An ***almost*** one for one mapping with the DIS Electromagnetic Emissions PDU
    - Additional attributes included to support the Joint Research Analysis and Assessment Center (JRAAC) HLA FOM
    - Additional attributes thrown in to enable the M&S of real-world emitters using the Electronic Warfare Integrated Reprogramming Database (EWIRDB)
    - Not designed for high fidelity modeling of an electromagnetic waveform

TENA::InterTEC::CCFW::Emission (Partial UML Diagram)



Electromagnetic Emissions PDU



Not supported by a CCFW::Emission attribute

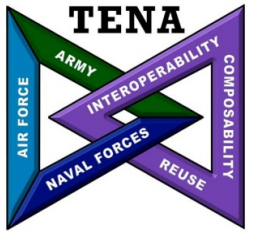
Partially supported by a CCFW::Emission attribute

The InterTEC Story (cont'd)

- **However, all good stories come to an end**
  - InterTEC Program ended over five years ago
  - But this OM continues to be used in a number of TENA-based tools and applications
  - And this OM has been downloaded 199 times over the past 2 years
  - And is used in many distributed test events on the JSN
    - Most recently, the Interoperability Development & Certification Test (IDCT) series of distributed test events conducted by the Navy

Is this because InterTEC's CCFW OM nearly models the same attributes that are in the DIS Electromagnetic Emission PDU?


TEST RESOURCE MANAGEMENT CENTER
DEPARTMENT OF DEFENSE


TENA
ARMY
INTEROPERABILITY
COMPOSABILITY
AIR FORCE
NAVAL FORCES
REUSE

IFF

IFF

- **IFF has the same InterTEC story as Emissions**
  - So, we'll spare you the UML eyecharts
  - Currently represented by TENA::Embedded::IFF
  - TENA::Embedded::IFF evaluated by the InterTEC project
    - Some attributes were there, but, not all
  - InterTEC created TENA::CCFW::IFF to extend TENA::Embedded::IFF
    - An almost one for one mapping of the DIS IFF PDU
  - InterTEC updated TENA::CCFW::IFF to support IFF Mode 5
    - IFF Mode 5 data model support introduced in the IEEE Std 1278.1-2012 specification – released 19 December 2012
  - Currently used in the DIS Gateway (DISGW) Product
  - And is used in many distributed test events on the JSN

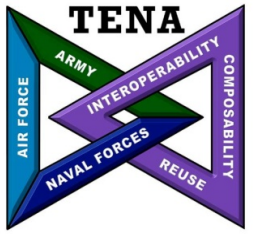
Again, is this because the CCFW OM nearly models the same attributes that are in the DIS IFF PDU?

The Proposal

- **Propose to have an LVC OM Collection that is based on the Data Model from the DIS 1278.1-2012 PDU messages**
  - Entity State
  - IFF
  - Electromagnetic Emission
  - Fire
  - Detonate
  - Transmitter
  - Signal
- **Promote that DIS => TENA => DIS round-trip data translations are lossless**
- **Integration of this LVC OM Collection would require a mechanism for backward compatibility to current users of the associated TENA Standard OMs**
  - "Behind the scenes" "transmogrifiers" from within the middleware/OM implementation

User Community Input

- **Series of JMETC Technical Exchanges (JTEXs) have been held over the past two years**
  - User Community in attendance during the LVC Track agreed that the core set of TENA Standard OMs representing LVC needed to be refined
  - User Community also agreed that the best path forward is to develop a TENA LVC OM Collection that aligned to the subset of DIS PDUs representing LVC
    - Data attribute alignment
    - Beware of bitbuckets!!



TENA LVC OM Collection

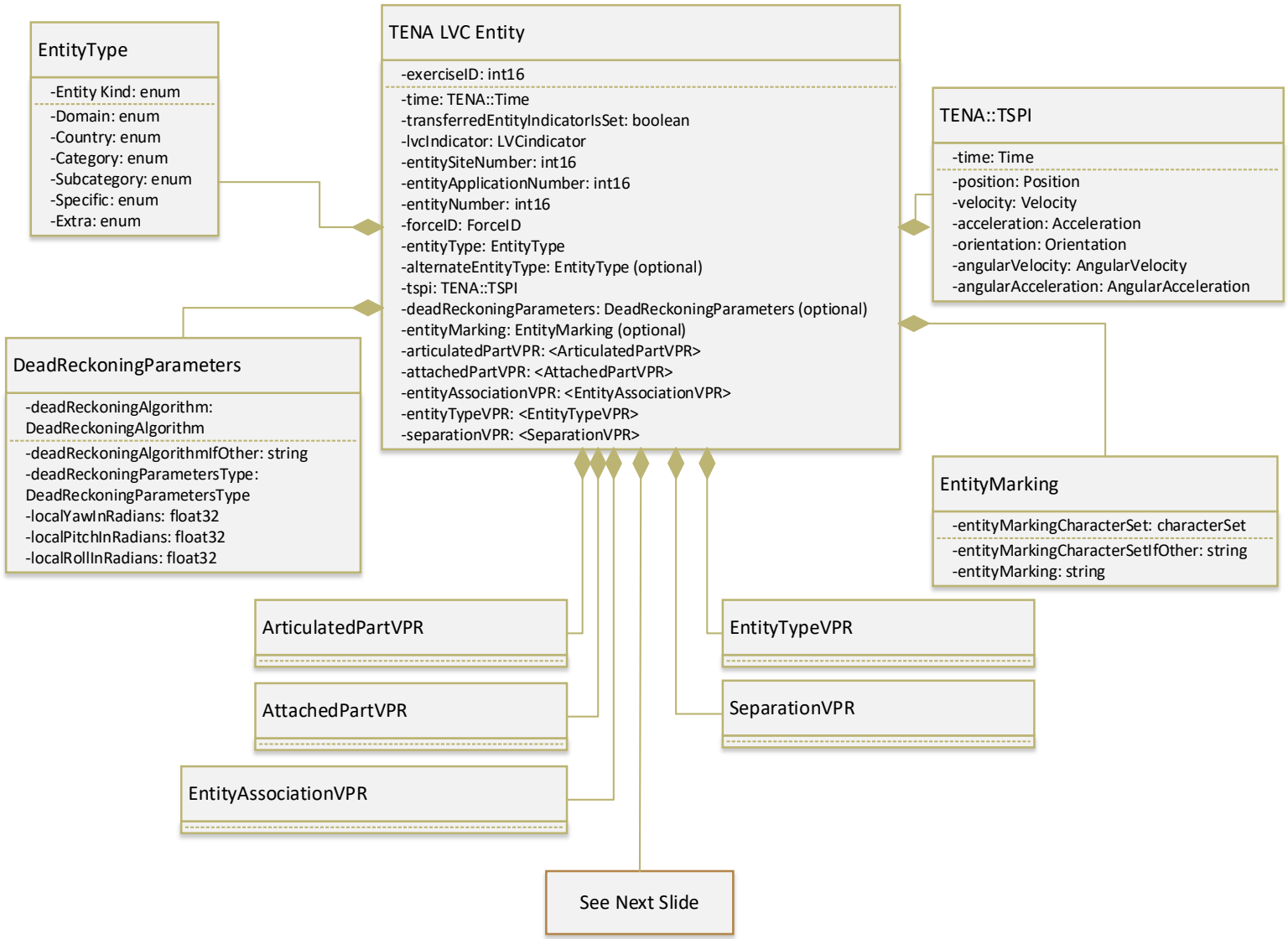
TENA LVC OM Collection

- **The Collection**
  - TENA LVC Entity ⇔ DIS Entity State
  - TENA LVC Engagement
    - TENA LVC Fire ⇔ DIS Fire
    - TENA LVC Detonation ⇔ DIS Detonation
  - TENA LVC Emissions ⇔ DIS Electromagnetic Emissions
  - TENA LVC IFF ⇔ DIS IFF
  - TENA LVC RadioCommunications
    - TENA LVC Transmitter ⇔ DIS Transmitter
    - TENA LVC Signal ⇔ DIS Signal
  - TENA LVC EntityType ⇔ DIS Entity Type

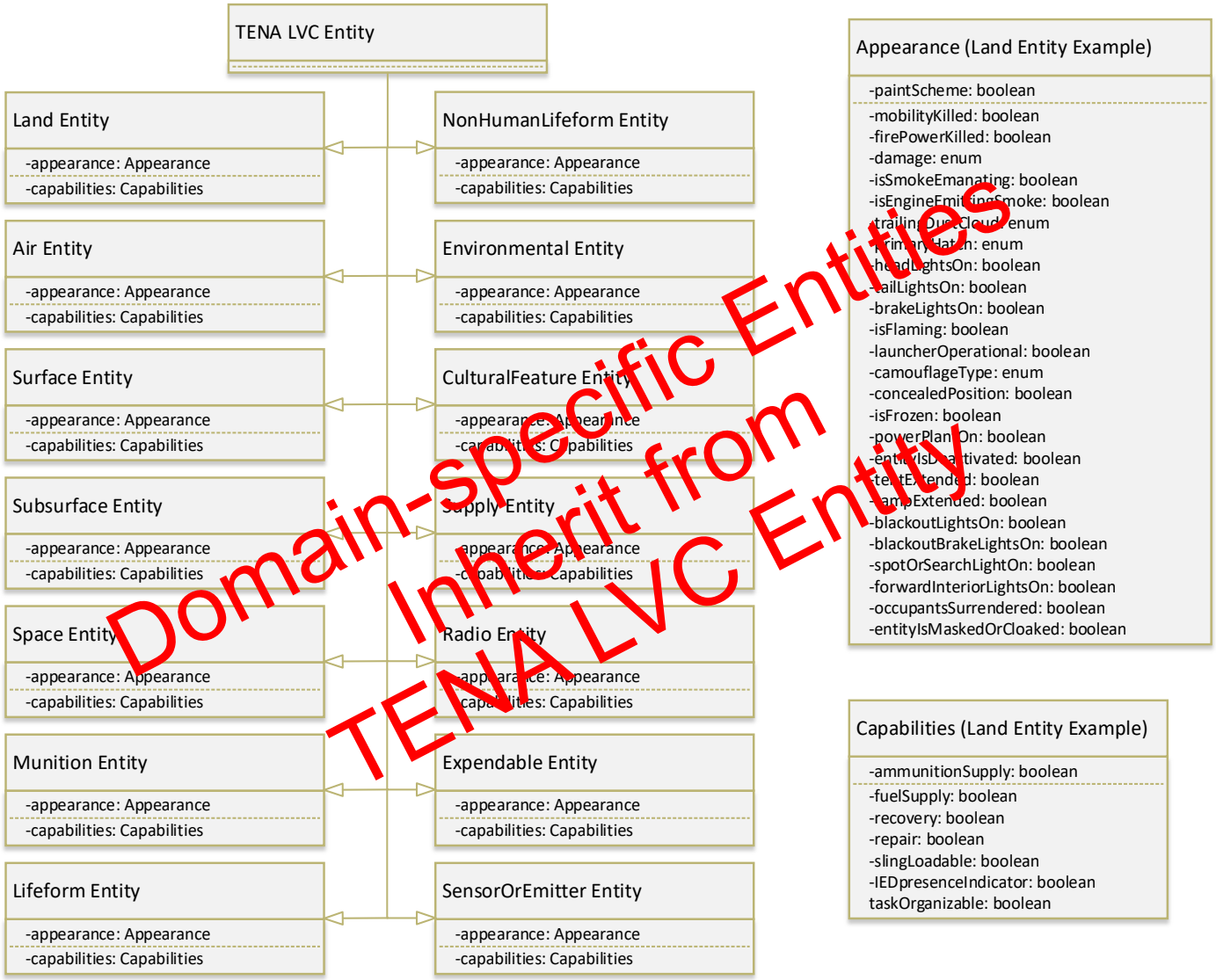
TENA LVC OM Collection

- **Based on IEEE 1278.1-2012 – IEEE Standard for Distributed Interactive Simulation – Application Protocols, 19 December 2012**
- **Based on SISO-REF-010-2016 – Reference for Enumerations for Simulation Interoperability, Version 22, 10 May 2016**
- **Wiki page documenting the development progress**
  - Location of the TENA LVC Collection TDL files
  - https://www.trmc.osd.mil/wiki/display/OM/TENA+LVC+OM+Collection
- **This is NOT a Final product**
  - Expect many, many more drafts and iterations to take place

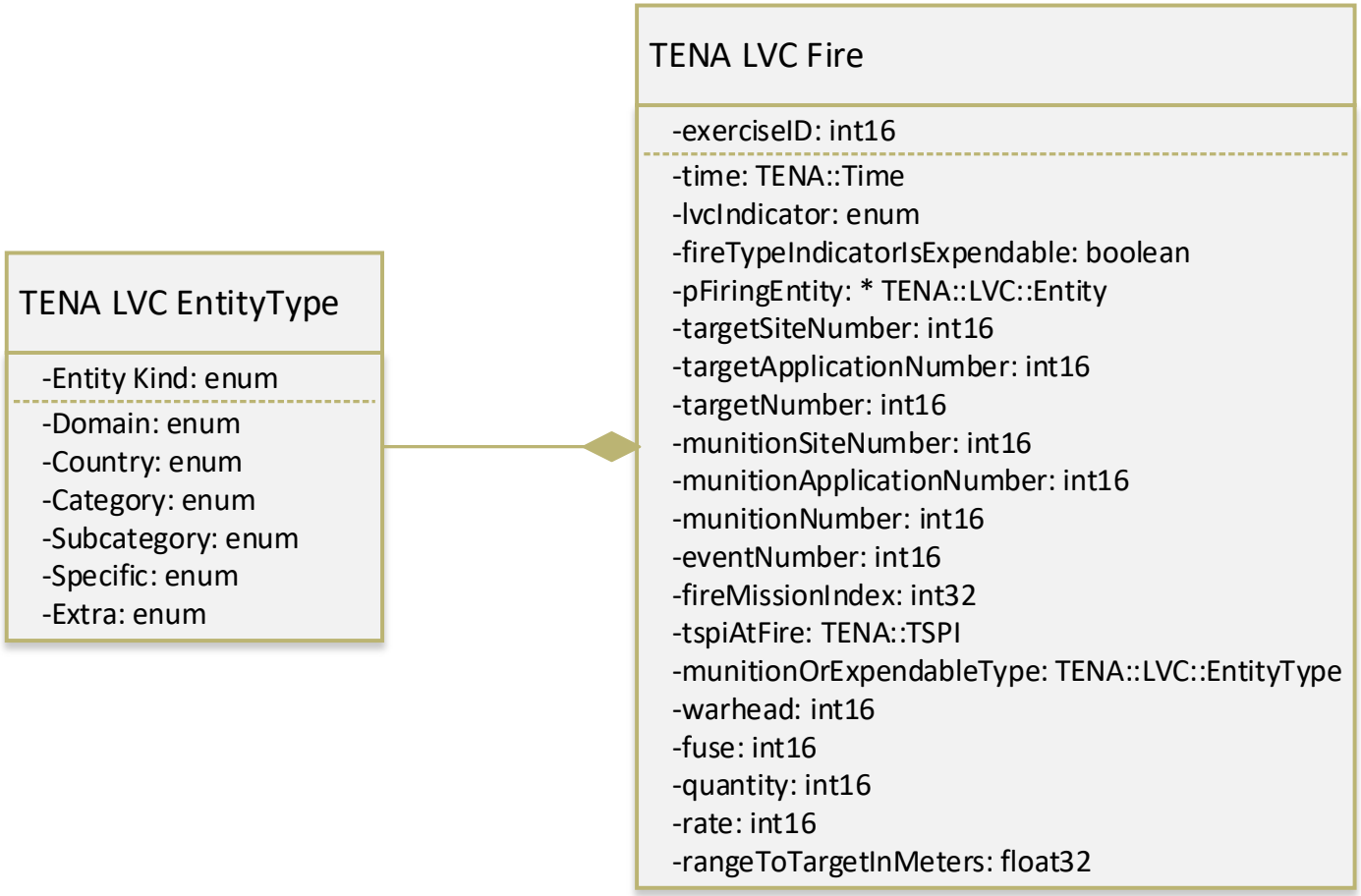
TENA::LVC::Entity (Partial UML Diagram)



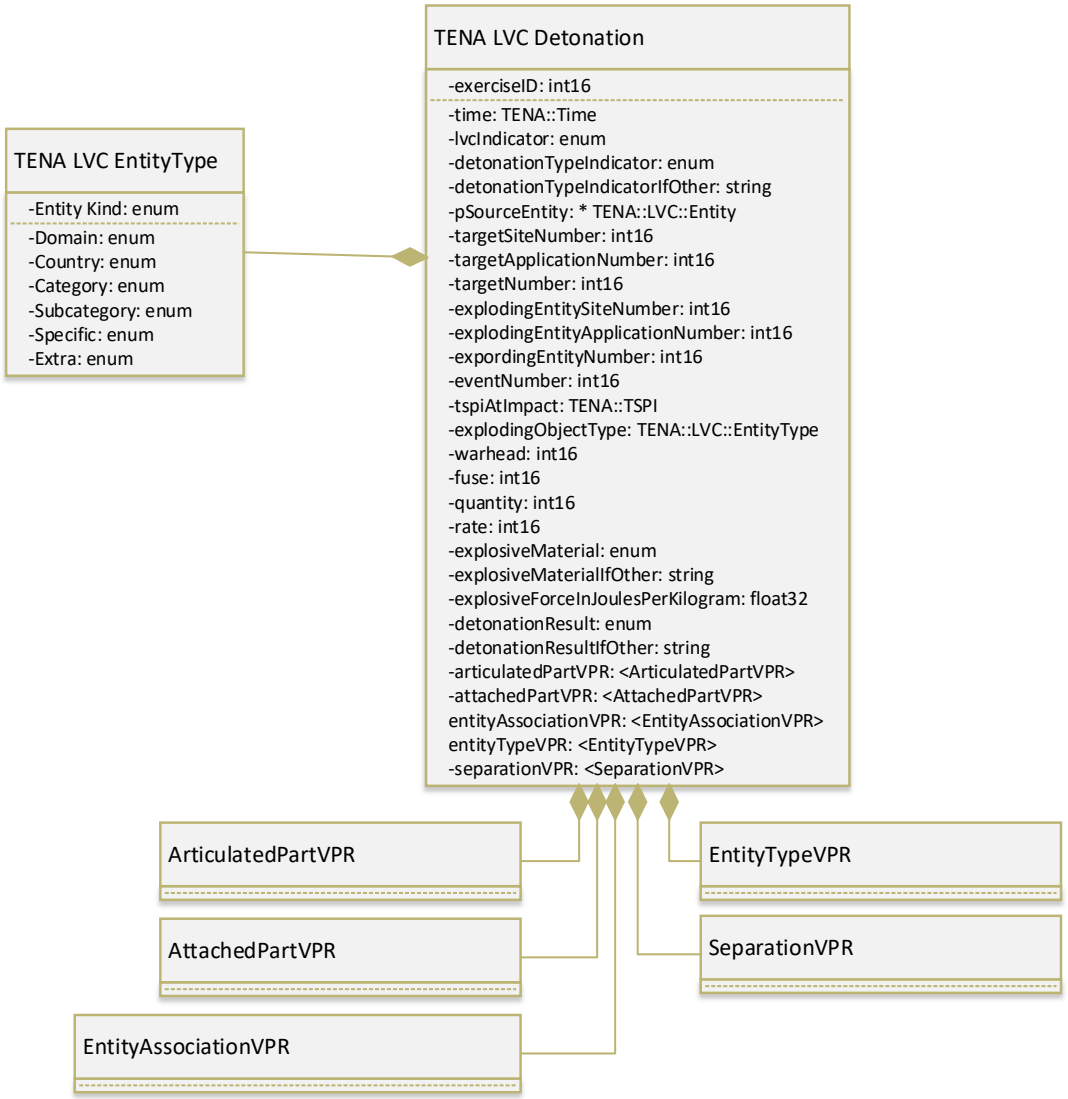
TENA::LVC::Entity (Partial UML Diagram)



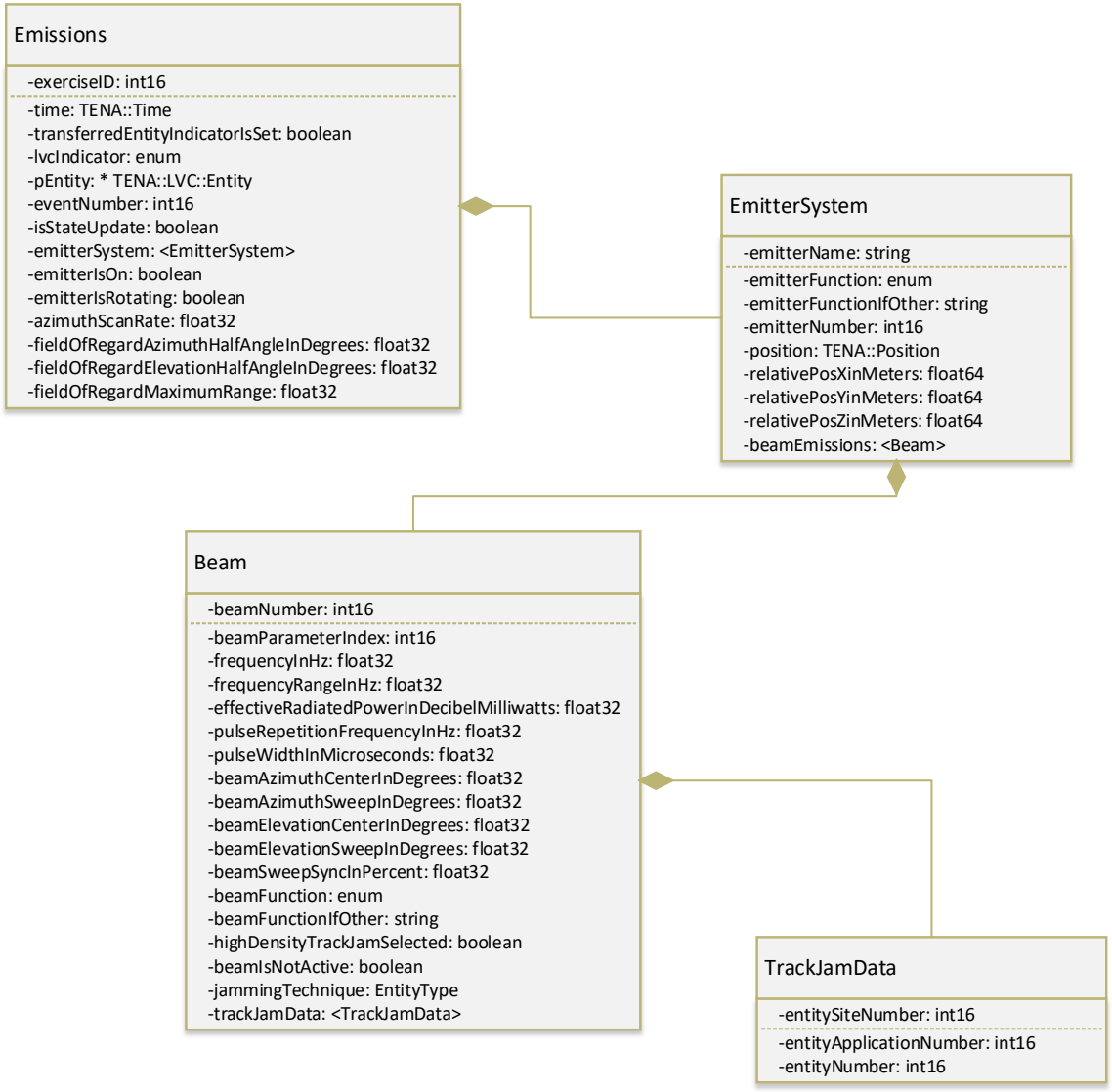
TENA::LVC::Fire (Partial UML Diagram)



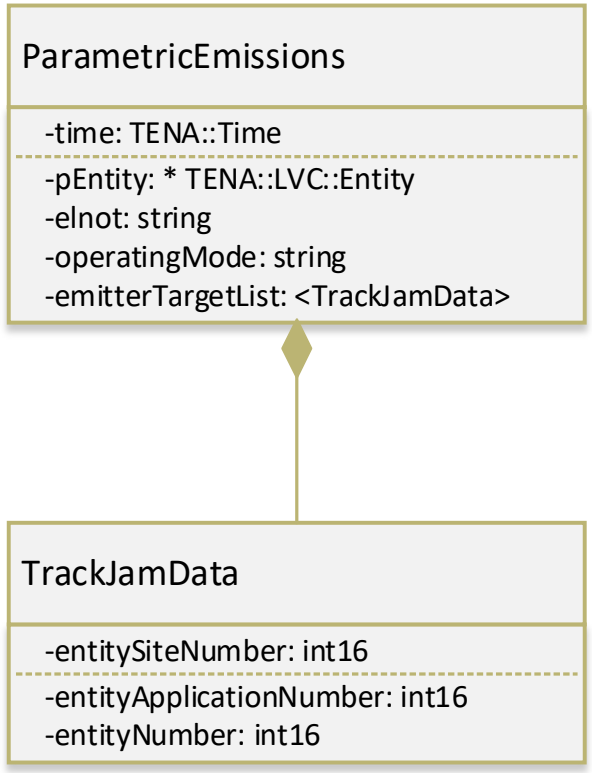
TENA::LVC::Detonation (Partial UML Diagram)



TENA::LVC::Emissions (Partial UML Diagram)

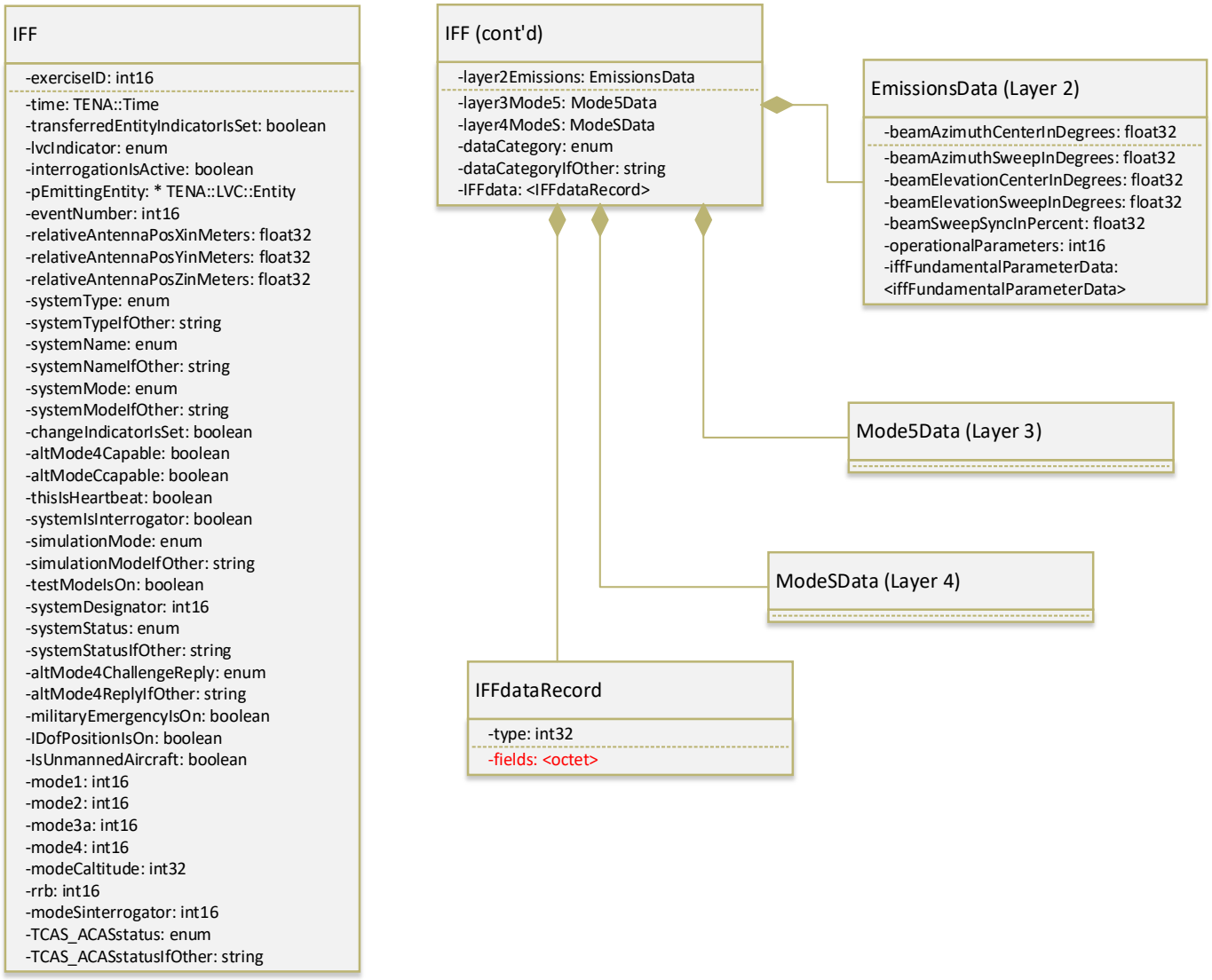


TENA::LVC::ParametricEmissions

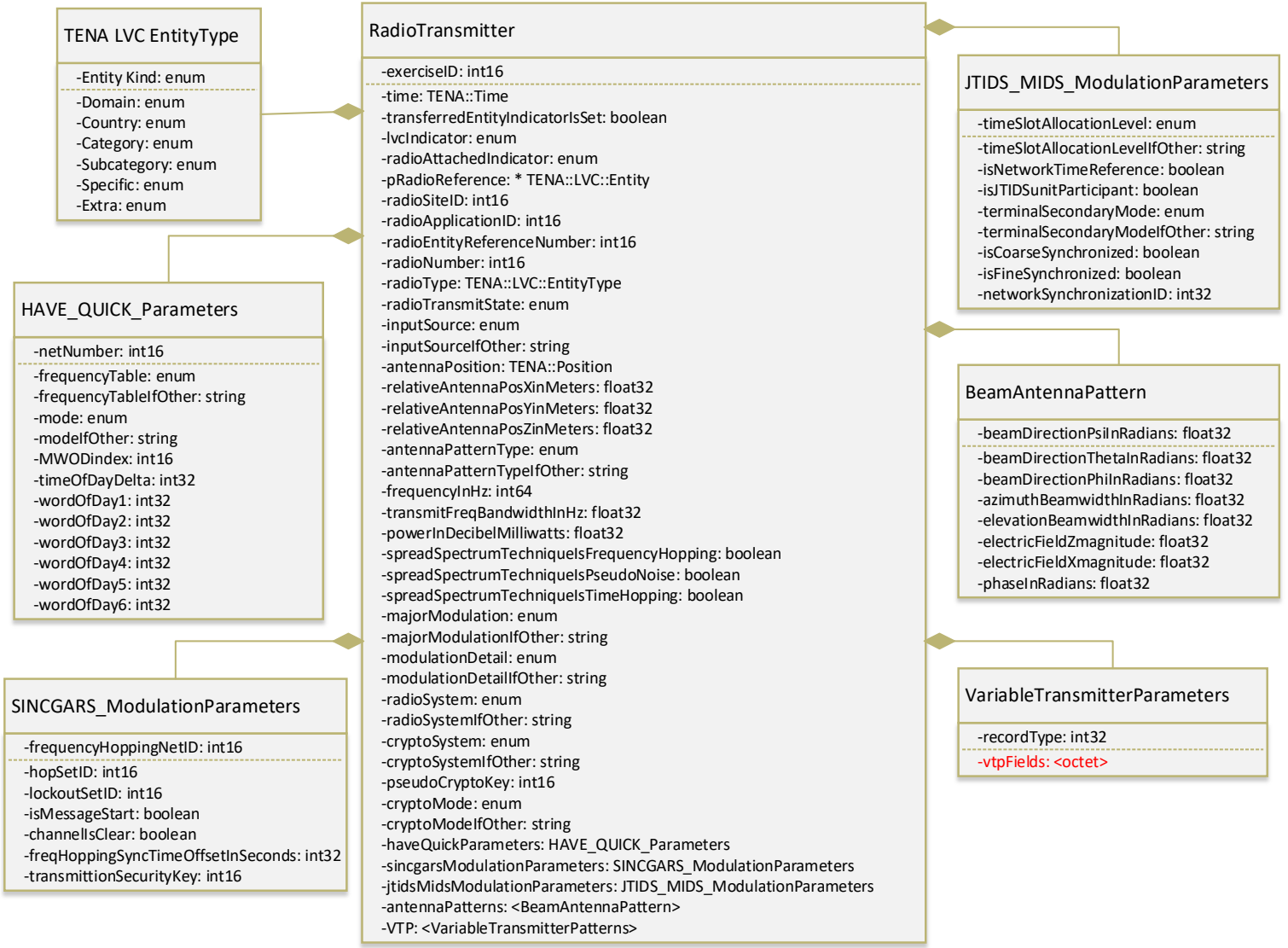


The ParametricEmissions class is used for emitters that are defined according to the Electronic Warfare Integrated Reprogramming Database (EWIRDB). The EWIRDB is the primary Department of Defense source for the technical parametric and performance data on non communication electronic emitters and associated systems. The EWIRDB is the product of merged data from a number of different sources and it uses the NSA managed ELINT Notation (ELNOT) system as the primary label for a non communications emission. This database includes emitter files that provide parametric data, references, and comments describing the electronic equipment that generates an electronic emission.

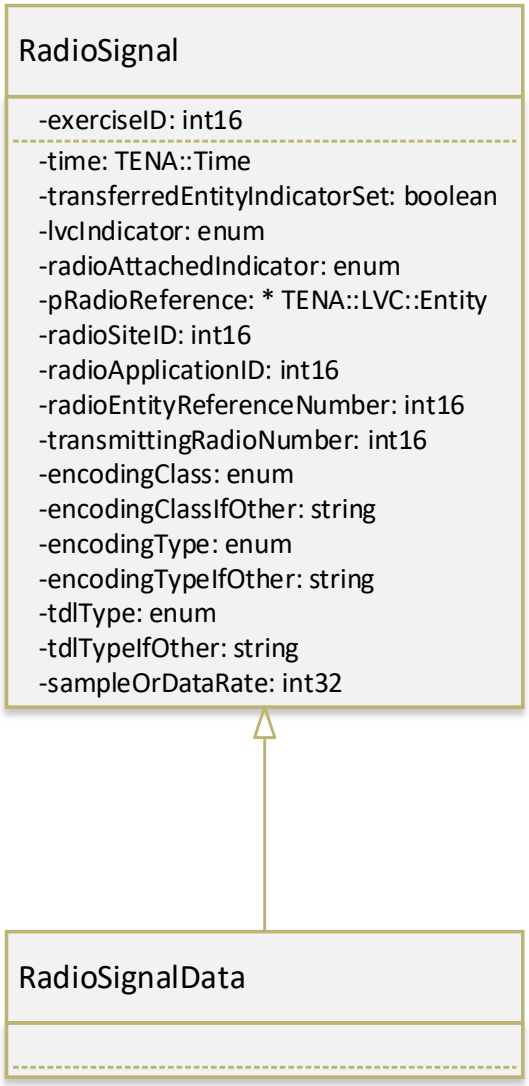
TENA::LVC::IFF (Partial UML Diagram)



TENA::LVC::RadioTransmitter (Partial UML Diagram)



TENA::LVC::RadioSignal (Partial UML Diagram)



JTEX-04 Summary

- **An Object Model Tech Exchange (OMTE) was conducted on the TENA LVC OM Collection**
  - All OMs reviewed in excruciating detail
  - User community agreed to advance TENA-LVC-Entity, -Fire, -Detonation, -IFF, -EntityType as TENA Standard OM candidates in the Collection
  - TENA-LVC-Emission requires further review
    - Although OM aligns with the DIS Standard, it does not represent how users model and test Emissions today
    - Need use cases of how emissions testing is performed and what it takes to model this properly
  - TENA-LVC-RadioCommunications requires further review
    - The DIS 1278.1-2012 specification defines a Signal PDU with a bitbucket
    - Need more of an interface control / data contract representation
    - What signals need to be represented / modeled?

In Summary

- **This is the first of many foreseeable drafts of the TENA LVC OM Collection**
  - Really need the user community to engage and tell us what is wrong, what needs improvement, what should be changed, etc
- **The TENA LVC OM Collection is NOT intended to support only DIS users**
  - DIS support is just the first phase
  - The goal is to support how LVC testing is performed today
- **Are there any other OMs we should consider developing?**
- **We plan on holding additional reviews with participation from the user community to help turn these draft OMs into candidates for consideration as TENA Standard OMs**
  - JTEX-05, December 9 – 12, Charlotte, NC