ANSI/IEEE N42.42 Standard for Data Format for Radiation Detectors used in Homeland Security

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Purpose of the Standard

- Purpose:
  - ✓ facilitate manufacturer-independent transfer of information from radiation measurement instruments to a standard file format for use in Homeland Security applications.
  - ✓ enable interpretation of data without reference to manufacturer's documentation.
  - ✓ specifies the format of data provided by radiation instruments used for homeland security.
  - ✓ purpose of this data is for analysis and storage of the radiation measurements.
  - ✓ data may consist of raw or unprocessed data, analysis results, device parameters or settings or other measurements needed or applicable to the further analysis or to verify the quality of the results produced by the instrument.

This standard does not address instrument control, data transmission protocols, or the physical media used for communications.

Scope of the Standard

- Scope:

  This standard specifies the data format that shall be used for both required and optional data available at the output of radiation instruments for homeland security applications.

  The performance requirements for these types of instruments are described in other standards; such as, ANSI/IEEE N42.32, ANSI/IEEE N42.33, ANSI/IEEE N42.34, ANSI/IEEE N42.35, and ANSI/IEEE N42.38.

Goals for the Standard

- Readability

  data should be in a format that can be easily accessed and understood by analysts without the need for proprietary software.

- Compatibility

  data should be in a format that is compatible with accepted international standards for data representation to the broadest extent possible.

- Extensibility

  the data format should provide for unforeseen future needs and for as-yet unknown requirements particular to the specific needs of individual manufacturers of instrumentation.

- Impartiality

  the data format should not favor any particular commercial interest by adopting a particular manufacturer’s practices.

General Description

Standard requires that all radiation data instruments shall comply with the following data formats:

1. The data shall be rendered in an XML document in conformance to the W3C XML V1.0 standard. In this standard, an XML document is considered identical to an XML file and the terms will be used synonymously.

2. The data format is to be compatible with the master ANSI N42.42 schema maintained by NIST.

3. Data authentication, when required, shall be provided via XML-Signature.

General Characteristics

1. Radiation instrumentation information is expressed as a hierarchical structure of data items.
2. These data items are formatted as XML elements and attributes.
3. In order to allow the data to be accessed using simple text editors, only the UTF-8 character encoding shall be used.
4. The structure of the data is described by an XML Schema document. This schema defines the standard names for data elements and attributes, whether or not they are optional or required for each class of instrument, and the hierarchical relationships between them. The schema document will be updated in concert with a revision to this Standard.
5. For new types of radiation instruments, or radiation instruments not specifically addressed in this Standard, the ANSI N42.42 data format shall be used to the extent possible. If additional data for those instruments is required, these shall be defined in the performance standard for that type of instrument, via a namespace extending the ANSI N42.42 data format. A schema describing the new data in the new namespace shall be created and made available along with the ANSI N42.42 schema, found at http://physics.nist.gov/Divisions/Div846/Gp4/ANSIN4242/2005/ANSIN4242.xsd.

General Characteristics (cont.)

6. If data elements or attributes are needed by a particular instrument that have not been defined in the ANSI N42.42 data format schema, then the producer of the instrument shall use a unique namespace prefix for the elements and attributes not defined in the ANSI N42.42 data format schema. Custom elements and attributes shall not supplant use of standard elements and attributes.

7. When data in this format is recorded in a file, the data filename extension shall be “N42”, either uppercase or lowercase, to allow for automated recognition.

8. The Standard allows values to be expressed in a variety of units. Use of SI units is encouraged.

9. The Standard gives implementers a great deal of flexibility in deciding what information is to be included or omitted. Implementers should be sensitive to the needs of the users of this information; in particular, providing sufficient raw measurement data to substantiate analysis results.

Relevant References

- XML – *Extensible Markup Language (XML) 1.0, Third Edition*, 04-Feb-2004. Available at http://www.w3.org/TR/2004/REC-xml-20040204 .
- XML Schema Part 2: Datatypes Second Edition, 28-Oct-2004. Available at http://www.w3.org/TR/2004/REC-xmlschema-2-20041028 .
- ISO/IEC 11578:1996 – Open Systems Interconnect – Remote Procedure Call. Note: the W3C RFC 4122 - UUID URN Namespace - is an equivalent standard covering the format of the UUID.
- ISO 8601:2004 - Data elements and interchange formats - Representation of dates and times
- W3C RFC 3275 - XML-Signature Syntax and Processing
- National Institute of Science and Technology (NIST) ANSI N42.42 XML Schema – http://physics.nist.gov/Divisions/Div846/Gp4/ANSIN4242/2005/ANSIN4242.xsd
- UTF-8 - ISO/IEC 10646-1:1993 - Universal Multiple-Octet Coded Character Set (UCS). Note: the Unicode Consortium's Unicode Standard 4.0 is equivalent to the ISO document.
- W3C RFC 2045 - Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies
- EPSG Map Datum Codes - www.epsg.org
- W3C RFC 1590 - Media Type Registration Procedure

General Organization

The <N42InstrumentData> element is the parent element for all data in the file. It contains one or more <Measurement> elements, the definition of a “measurement” depends on the type of instrument. The <Measurement> element contains various child elements that describe the instrument, the data collected, and the results of the instrument’s analysis of the data:

<InstrumentInformation> element: describes the instrument that performed the measurement.

<MeasuredItemInformation> element: describes the item being measured.

<Spectrum> element: produced by spectrometers, this element contains a PHA or MCS spectrum, the acquisition start and elapsed times, and calibration information. Multiple <Spectrum> elements may be used in a single parent <Measurement> element to represent multiple detectors or background spectra.

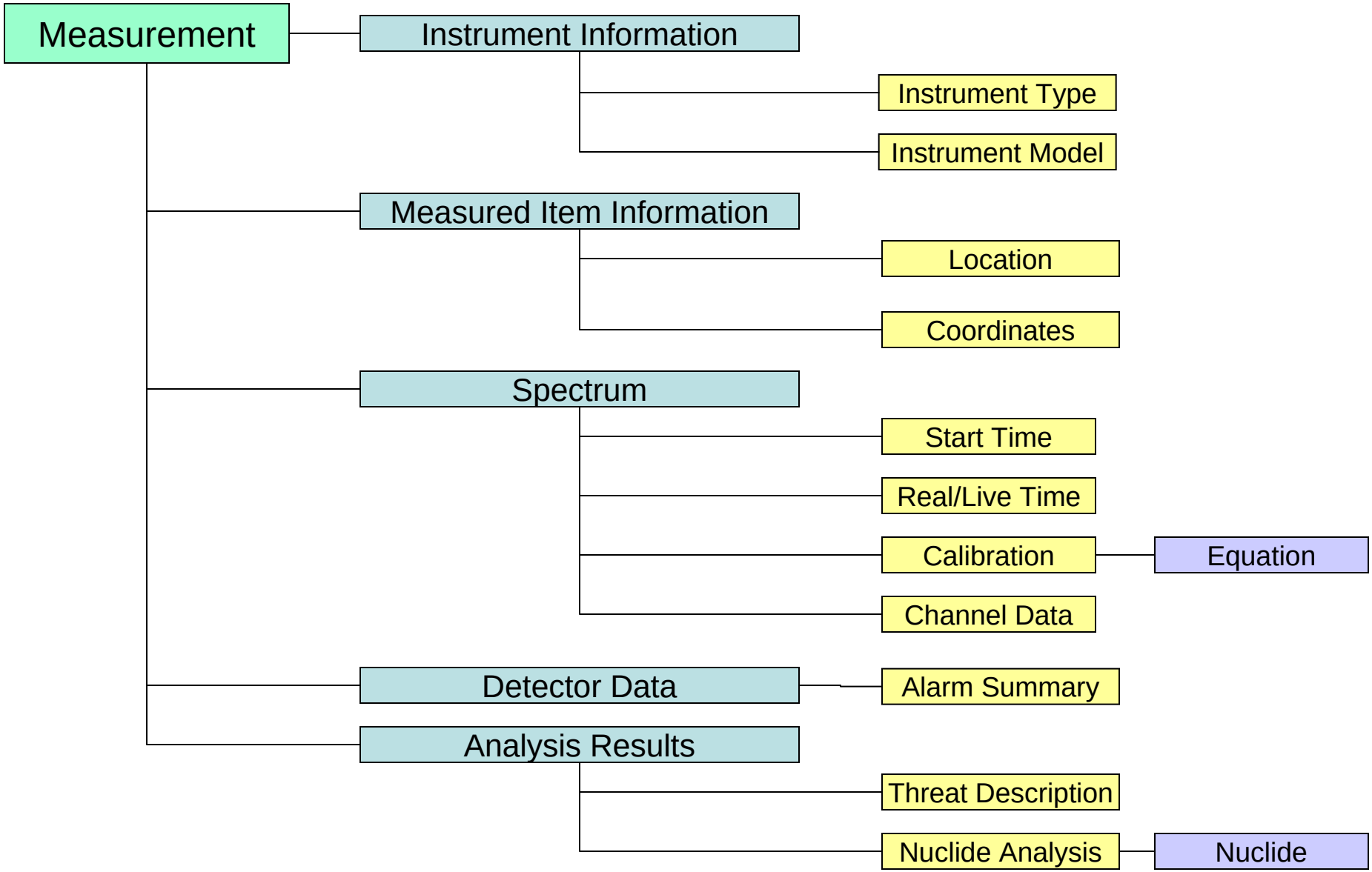
General Organization (cont.)

<DetectorData> element: typically produced by portal monitors, this element contains a series of gross count and/or spectroscopic ”samples” from one or more detectors, along with other information associated with each sample, such as sampling duration and monitor occupancy status. A series of monitor occupancies could be represented by multiple <DetectorData> elements in a single <Measurement> element; alternatively, each occupancy could be represented by a <Measurement> element containing a single <DetectorData> element.

<CountDoseData> element: produced by radiation pagers or survey meters, this element contains a series of count rate, dose, and/or dose rate values.

<AnalysisResults> element: this element represents the information presented to the operator by the instrument as a result of its analysis of the data. For spectrometers, this consists of the nuclides identified by the instrument and an indication of the confidence that they are present.

Portal Monitor ANSI N42.42 XML File



Example Spectrum ANSI N42.42 XML File


```
<?xml version="1.0" encoding="UTF-8"?>
<N42InstrumentData xmlns="http://physics.nist.gov/Divisions/Div846/Gp4/ANSIN4242/2005/ANSIN4242"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://physics.nist.gov/Divisions/Div846/Gp4/ANSIN4242/2005/ANSIN4242
http://physics.nist.gov/Divisions/Div846/Gp4/ANSIN4242/2005/ANSIN4242.xsd" >
  <Measurement>
    <Spectrum Type="PHS">
      <StartTime>2002-10-25T13:25:32</StartTime>
      <LiveTime>PT300S</LiveTime>
      <RealTime>PT300.850006103516S</RealTime>
      <Calibration Type="Energy">
        <Equation Model="Polynomial">
          <Coefficients>0.2757 1.0002609 0</Coefficients>
        </Equation>
      </Calibration>
      <ChannelData>
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 932 1264 1088 791 826 661 722 803
1197 2074 2192 1261 786 564 614 696 799 849 897 961
1054 1223 1691 2527 3793 3821 2171 1264 1012 1169 1201 1256
...
1 0 6 3 1 5 6 11 9 7 7 1
4 0 0 1 1 2 0 0 0 0 2 2
1 2 0 1
      </ChannelData>
    </Spectrum>
  </Measurement>
</N42InstrumentData>
```

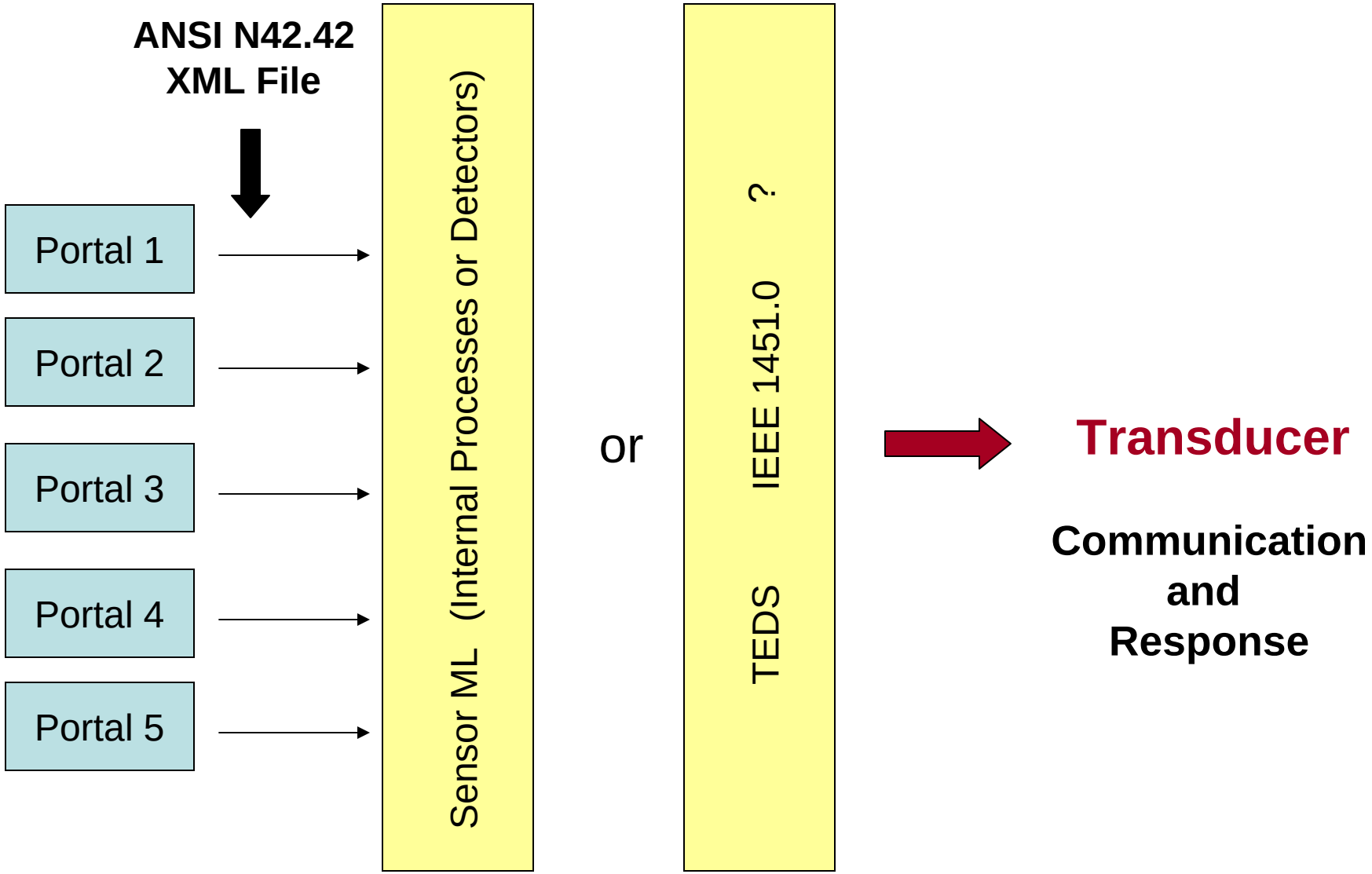
Portal Monitors Integration

Ports

Buildings

Weigh Stations

Border Crossings and Tunnels

Railways

Portal Monitors Integration (cont.)