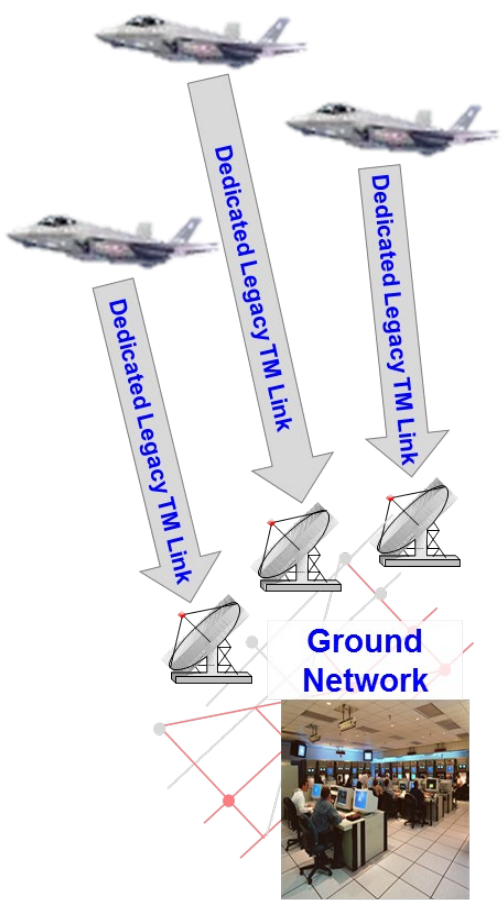
Telemetry Network Standards

Using TmNS Based Systems on the Range

Telemetry Paradigm Shift

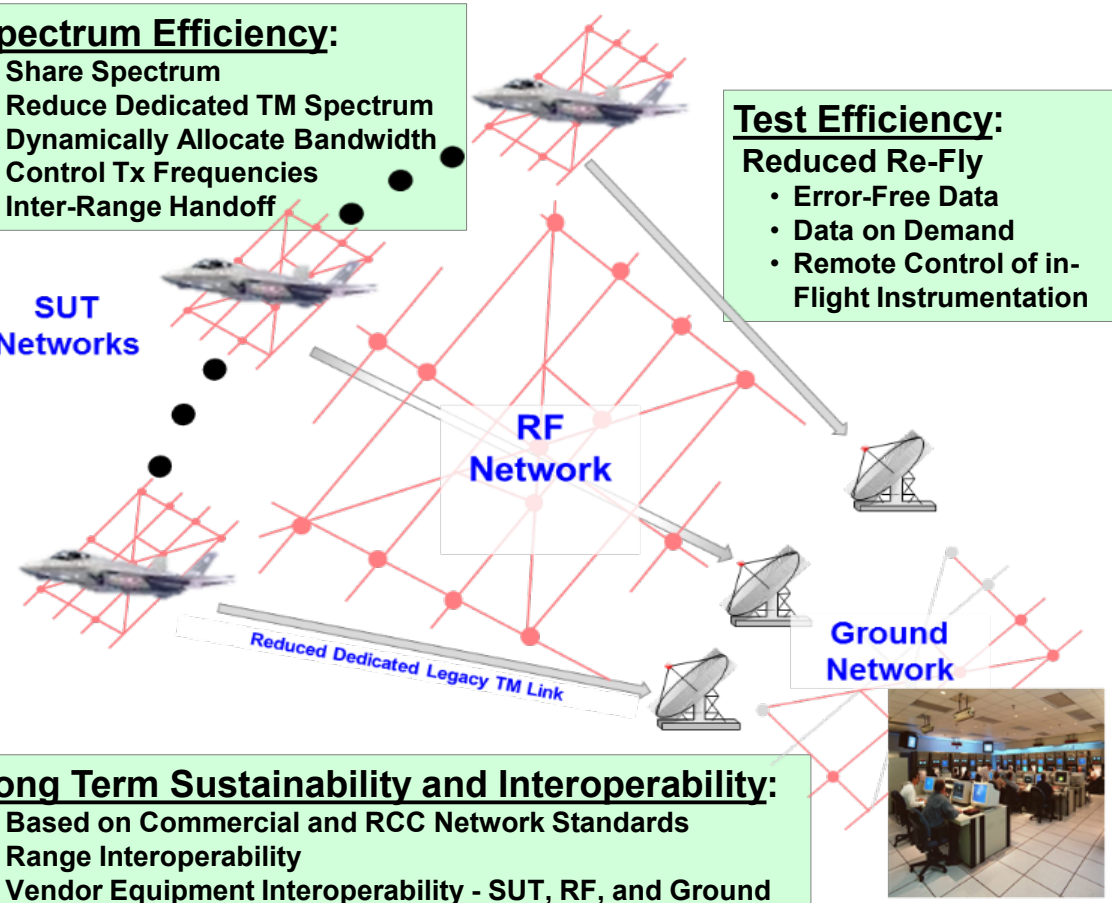
Current Telemetry Paradigm



TmNS Telemetry Paradigm

Spectrum Efficiency:
- Share Spectrum
- Reduce Dedicated TM Spectrum
- Dynamically Allocate Bandwidth
- Control Tx Frequencies
- Inter-Range Handoff

Test Efficiency:
Reduced Re-Fly
- Error-Free Data
- Data on Demand
- Remote Control of in-Flight Instrumentation



Long Term Sustainability and Interoperability:
- Based on Commercial and RCC Network Standards
- Range Interoperability
- Vendor Equipment Interoperability - SUT, RF, and Ground

TmNS Represents a Major Shift in the Telemetry Paradigm

Moving Real-Time Test Data into the Networking Age

Telemetry Enhancements

Network Enabled Instrumentation

- Reconfigurable In-flight
- Ethernet replaces CAIS instrumentation bus
- Generates IP network data
- Reduced cabling & weight
- Open architecture

Wireless Telemetry Network

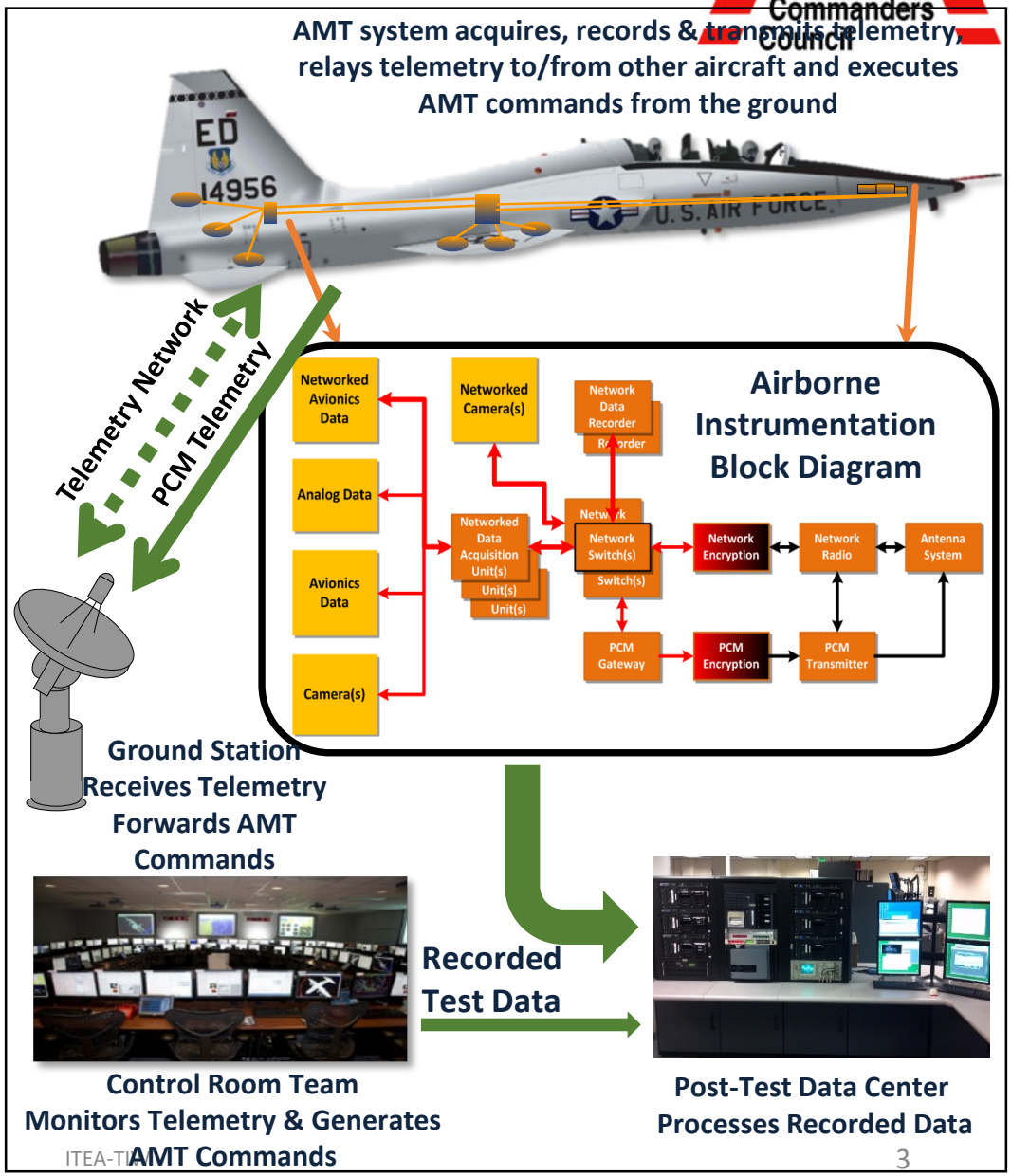
- Multiple test articles share RF spectrum
- Added to existing PCM ground station
- Error correction code increases range
- Remotely manage aircraft instrumentation
- Network Encryption

Control Room Applications

- Secure two-way VoIP "Hot-mike" application
- Modified applications used to process & display network data in the control room
- Store and forward telemetry after dropout
- Change the data that is telemetered

Instrumentation Support Applications

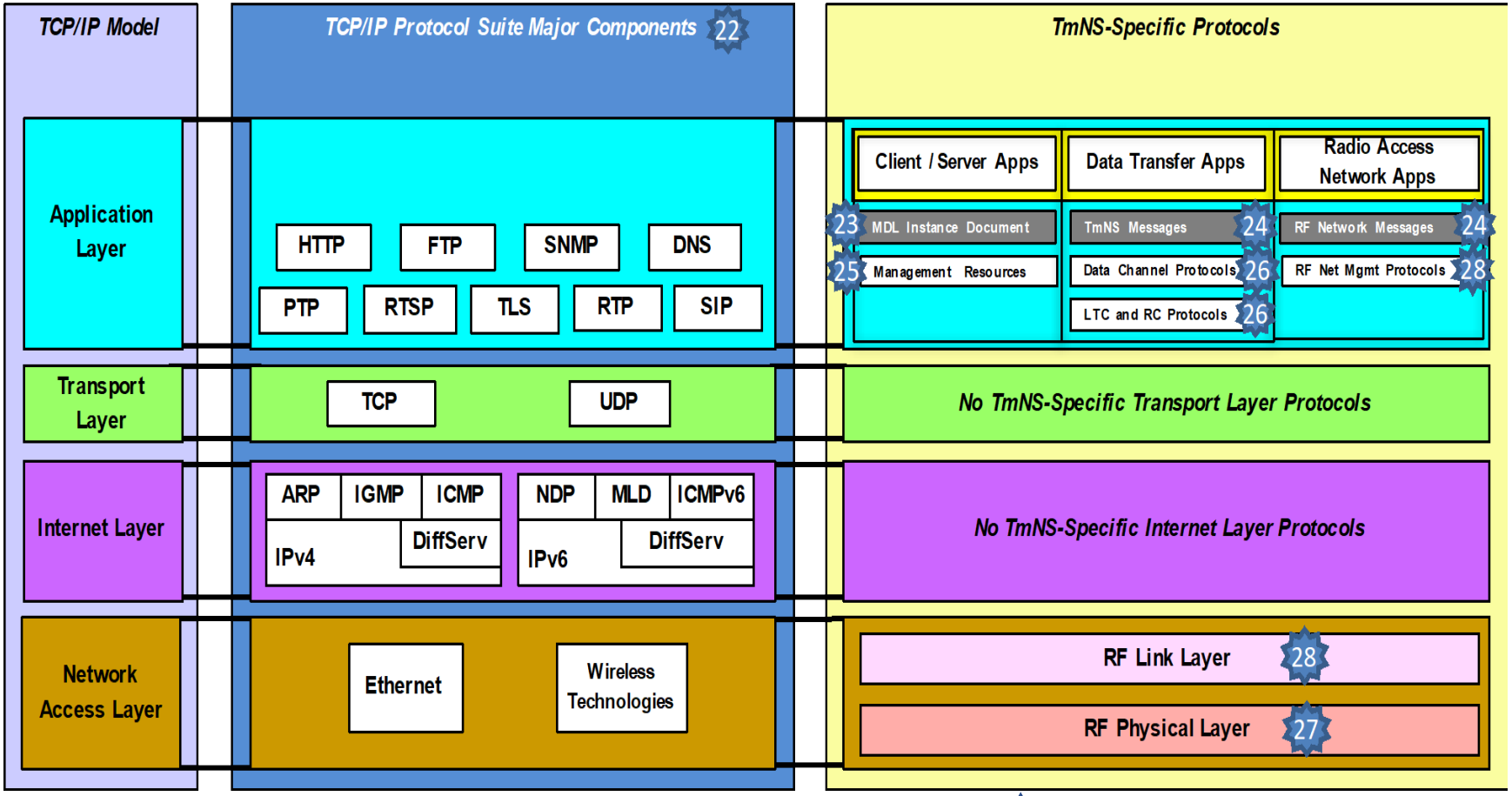
- Instrumentation configuration and control
- Modified AMT ground support applications
- RF Network provisioning & management
- Common metadata for system configuration



System Concepts/Considerations

- TmNS builds upon an IP network
  - Reliable peer-to-peer communication
    - Point to multi-point transmissions
    - Unicast, multicast, broadcast are supported
  - Standardized Quality of Service (QoS)
    - Differential Services (DiffServ)
  - Range Network Operations
    - Flight test operations should be relatively seamless
- Network Management Considerations
  - Manage the system/networks as a whole
    - Operational performance/reliability
    - Broad configuration approach
    - Collect/report performance measures
    - Routing dynamic data
    - Network operations visibility
  - Secure communications
    - Cybersecurity considerations
- Data Messaging Considerations
  - Manage asynchronous data sources/sinks
    - Priorities, Latency, Timing, Rates, Delivery order, etc.
  - Identify data sources
    - Packaging, Contents, Size, etc.
  - Communication/described data structures
    - Managing configuration changes on the fly
  - Support efficient data retrieval in real-time
    - Messages, Packages, Measurements

Core TmNS Technologies and TmNS-Specific Protocols



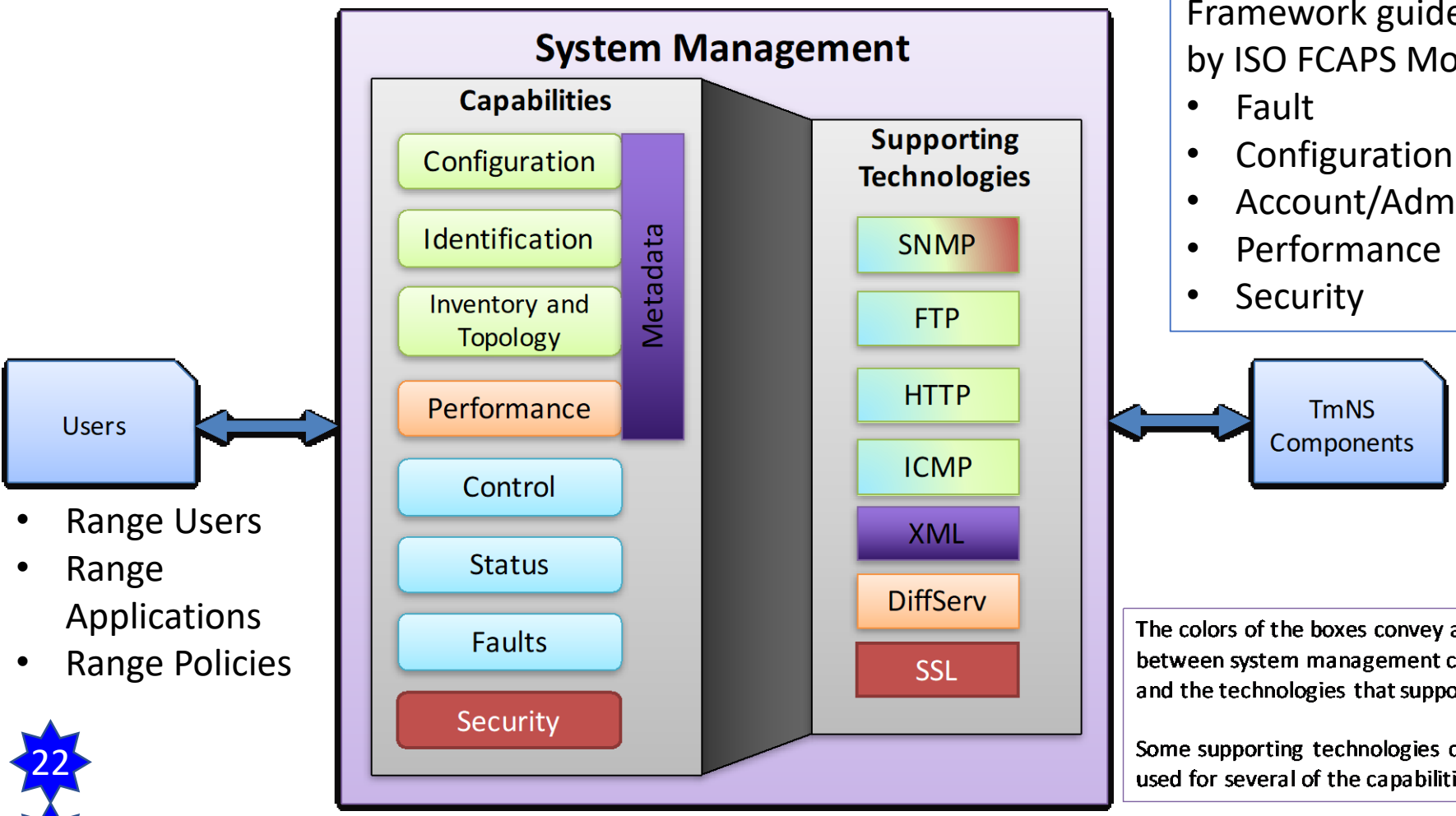
Chapter 21 introduces fundamental concepts and terminology used in the following chapters

Badge number indicates the IRIG 106 chapter that contains information on the associated topic.

System Management Technology Picture

Management Framework guided by ISO FCAPS Model

- Fault
- Configuration
- Account/Admin
- Performance
- Security



- Range Users
- Range Applications
- Range Policies

The colors of the boxes convey a mapping between system management capabilities and the technologies that support them.

Some supporting technologies can be used for several of the capabilities.

22

25

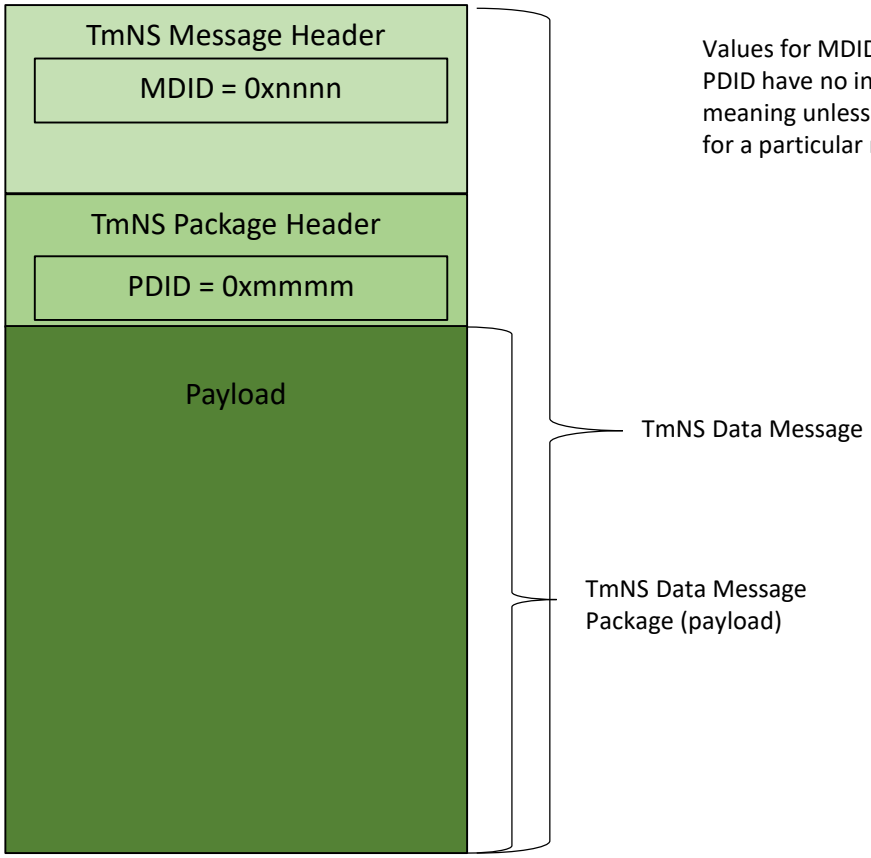
Configuration Exchange Language

23

- Metadata Configuration
  - Describes system shape/information/data for TmNS-based systems
    - Provides the logical and physical interrelationships in a common fashion
  - Provides the means for describing the configuration of the components
    - Vendor neutral fashion
  - Metadata Description Language (MDL)
    - MDL provides a common exchange language that facilitates the interchange of configuration information between telemetry system components
    - MDL syntax defines vocabulary and sentence structure, while the MDL semantics provide meaning
- System wide configuration management/description
  - System Manager software guides the user and provides intuitive interaction
    - networking and data delivery aspects are coordinated system-wide
      - Such as message shapes, sample rates, data word sizes, delivery characteristics, …
    - Designed with iterative development in mind
  - Shared Resources from multiple test missions
    - Configurations (MDL files) provide a unified TmNS system view
  - TmNS devices are configured with MDL
    - Requirements vs. Implementation supports vendor interoperability
    - Changes in configuration are tracked with MDL

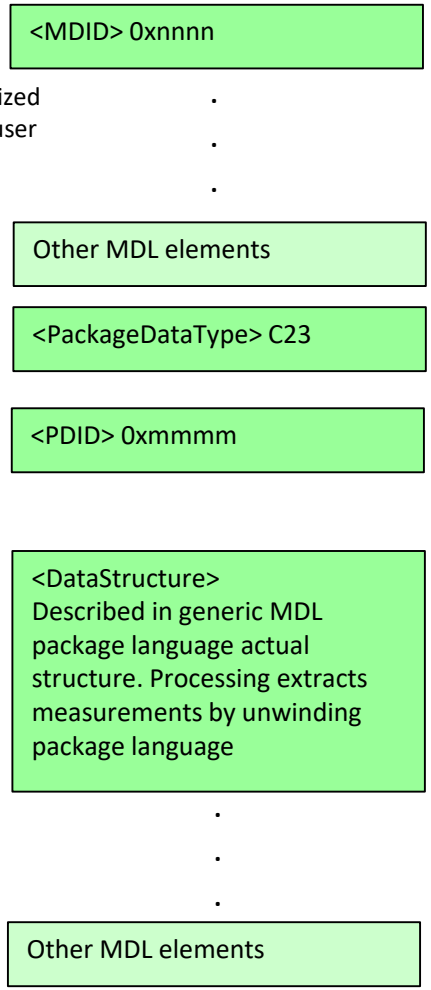
Message Format Documentation

24 Message Format



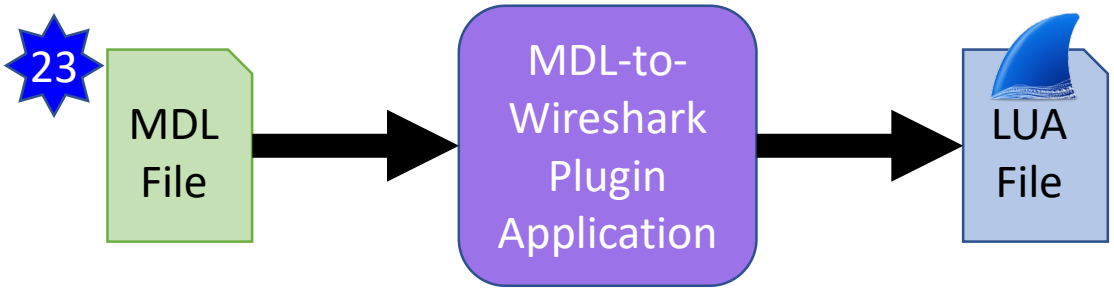
23 MDL instance document

Values for MDID and PDID have no inherent meaning unless standardized for a particular range or user



MDL Parsing Example: Wireshark Decoder

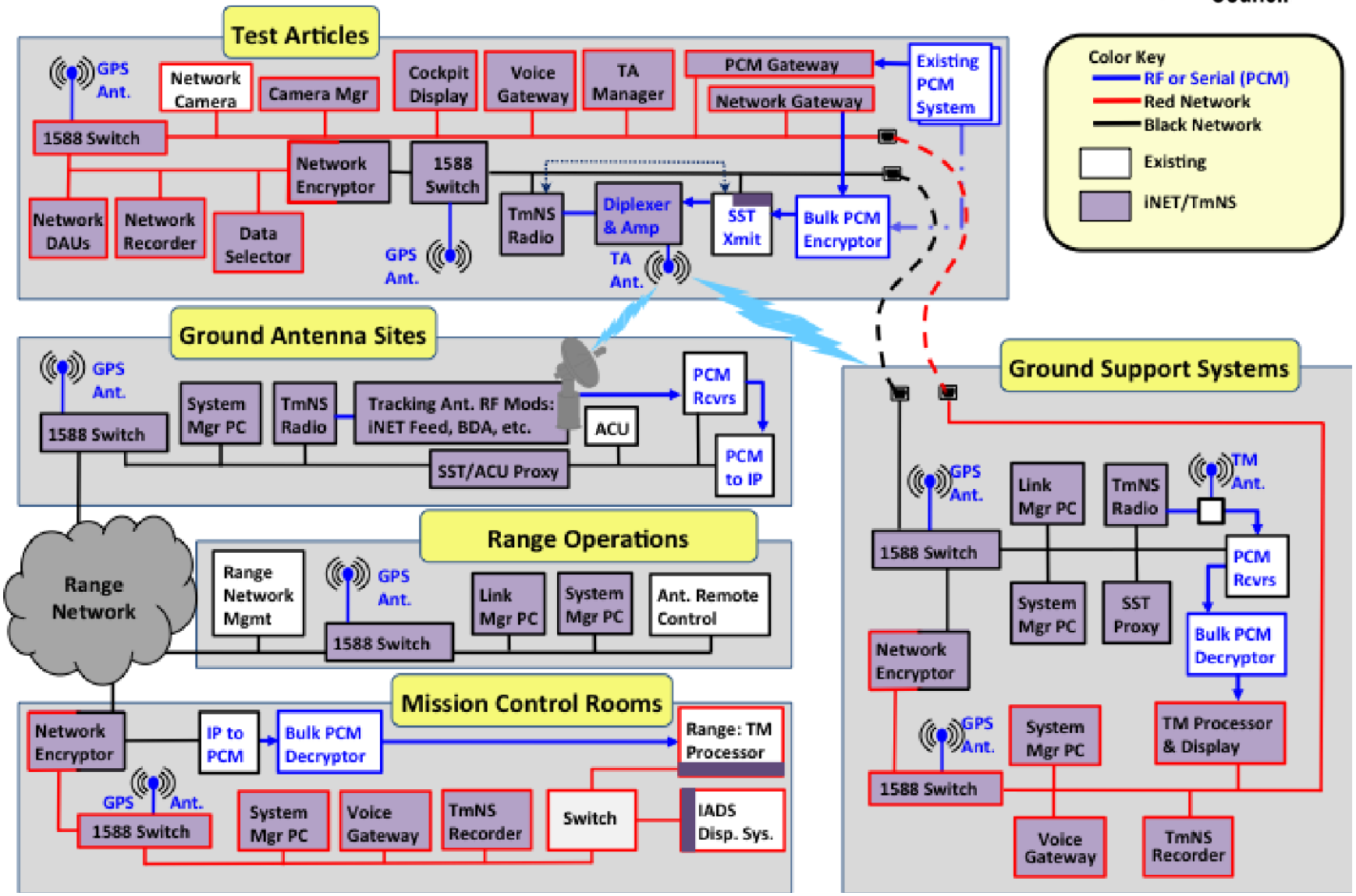
- System Manager builds a Wireshark plugin for TmNS Data Messages that is MDL-aware



Application can be done in <500 lines of code.

- As the TmNS data messages are captured within Wireshark it is decomposed the traffic into messages, packages, and measurements

Example: TmNS-Based System



Breaking Down Implementations

- Two Basic Groupings
  - RF Network Capabilities
  - Mission Data Capabilities
- RF Network Capabilities
  - Provides the IP communications between the aircraft and ground
    - Communicates one to many
  - Builds off existing range infrastructure
    - Modifications to existing dish antennas; feed
      - Adding TmNS Radio
    - Reconfigure/modifications of the range network
      - Do not need to change out network infrastructure to support IEEE-1588
- Mission Data Capabilities
  - Provides standardize means to manage data acquisition systems
    - Interoperability among acquisition components
      - DAUs, Recorders, Gateways, Switches, etc.
  - Data Acquisition Units
    - Able to reuse existing data acquisition modules
  - Data Processing
    - New applications for gaining access and processing dynamic messages
    - Real-time access to any/all instrumented data
      - Noise-free data sets`

Guidelines Moving Forward

- Use TmNS for network data transport
  - Standards-based management and control of resources
  - Comprehensive system-wide, distributed architectural perspective
- Use Chapter 23 for metadata
  - Preserves existing processing infrastructure while creating a bridge to format-agnostic processing
  - Look at migrating away from TMATS
- Streaming services need to be fully TmNS compatible
  - Managed node on a manage network
  - Ch10 streaming limited to recorder playback for off loading

BACKUP

Miscellaneous slides

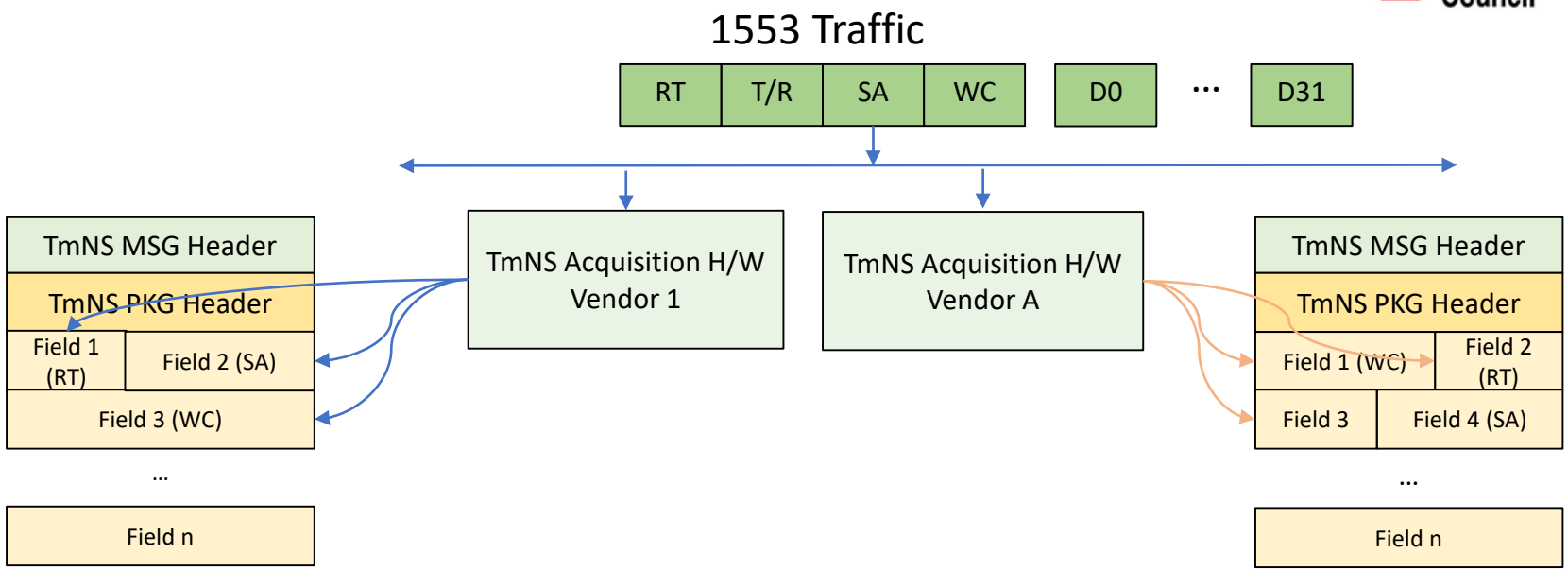
Telemetry Network Standard's

- Chapter 21: Telemetry Network Standards Introduction
  - Introduces fundamental concepts and terminology used in the chapters
  - Provides guidance or framework for other chapters
- Chapter 22: Network-Based Protocol Suite
  - Identifies existing Internet Protocols which serve as the core set of communication protocols
  - Large portion of the TCP/IP Protocol Suite plus other supporting technologies
- Chapter 23: Metadata Configuration
  - Describes system configuration data for TmNS-based systems
  - Provides the means for describing the configuration of the components in a telemetry system, as well as their logical and physical interrelationships in a common fashion
  - Defines a language, the Metadata Description Language (MDL)
  - MDL provides a common exchange language that facilitates the interchange of configuration information between telemetry system components
  - MDL syntax defines vocabulary and sentence structure, while the MDL semantics provide meaning
- Chapter 24: Message Formats
  - Describes the message formats of TmNS-specifc messaging

Telemetry Network Standard's

- Chapter 25: Management Resources
  - Defines Management Resources as resources that contain application-specific data accessible via an application layer protocol
  - Provides the details concerning the standardized application resources
- Chapter 26: TmNS Data Message Transfer Protocol
  - Defines how TmNS-specific messages (TmNS Data Messages) are transferred between TmNS Applications
- Chapter 27: RF Network Access Layer
  - Defines the standard for managing the physical layer of RF links with the RF Network
- Chapter 28: RF Network Management
  - Defines the mechanisms and processes for managing RF links within the RF Network

MDL Simplified Example - Acquisition

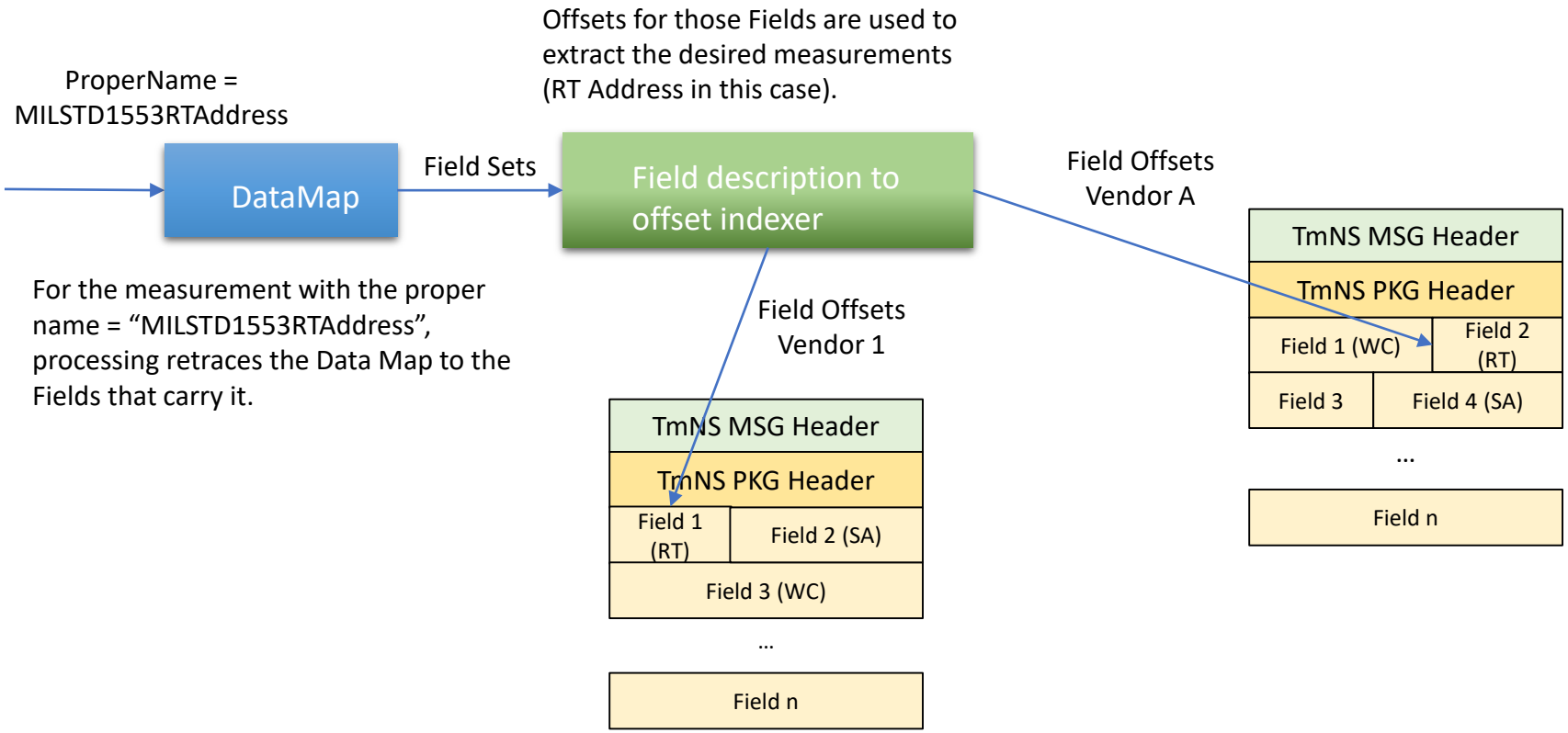


- Two vendors acquire the same message and place its contents into their own (different) formats.
- As part of the configuration process, each vendor generates MDL to describe the package shape. The description contains fields among other aspects.
  - Fields include; length, Offset from start, How / if it repeats, etc
- MDL describes where each part of the acquired data will be placed into the packages with a “data map”. Well-know data structures of the message (e.g. Remote Terminal Address) are recognizable in MDL as “proper names”.
  - Proper names carry more significance than user-assigned text because they are taken directly from the source’s terminology e.g. 1553 Designer’s Guide.

MDL Simplified Example - Extraction

Suppose a user wants to extract the Remote Terminal address captured as on the previous slide?

Their processing software can accomplish this from either vendor's structure by following the SAME process.



MDL Simplified Example – Extraction (cont.)

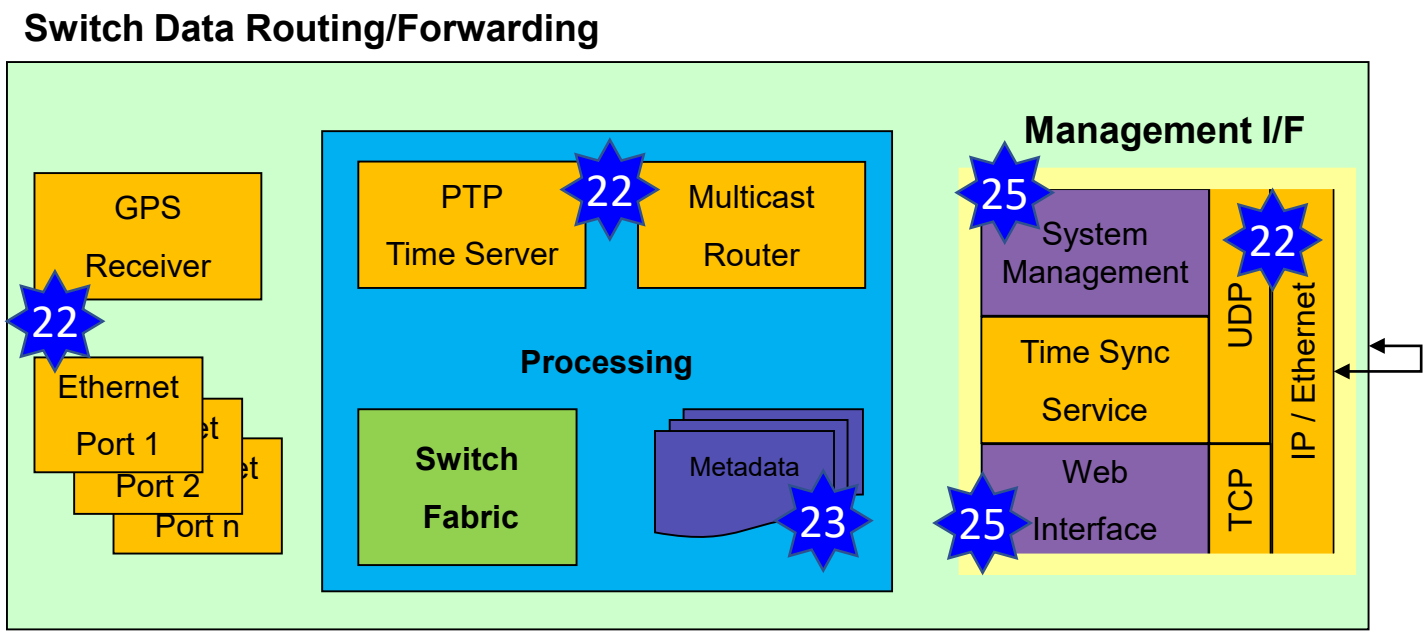
- Processing software is configured by the MDL generated by each vendor to perform decoding according to the Message Definition ID and Package Definition ID for each message

- This process is the same regardless of the "actual" format of the package i.e. it works whether the package contains a collection of 1553 messages or even PCM frames because the MDL grammar doesn't change. Once the processing software can process the grammar, it can do it for any format. The format need not be the same or predetermined.

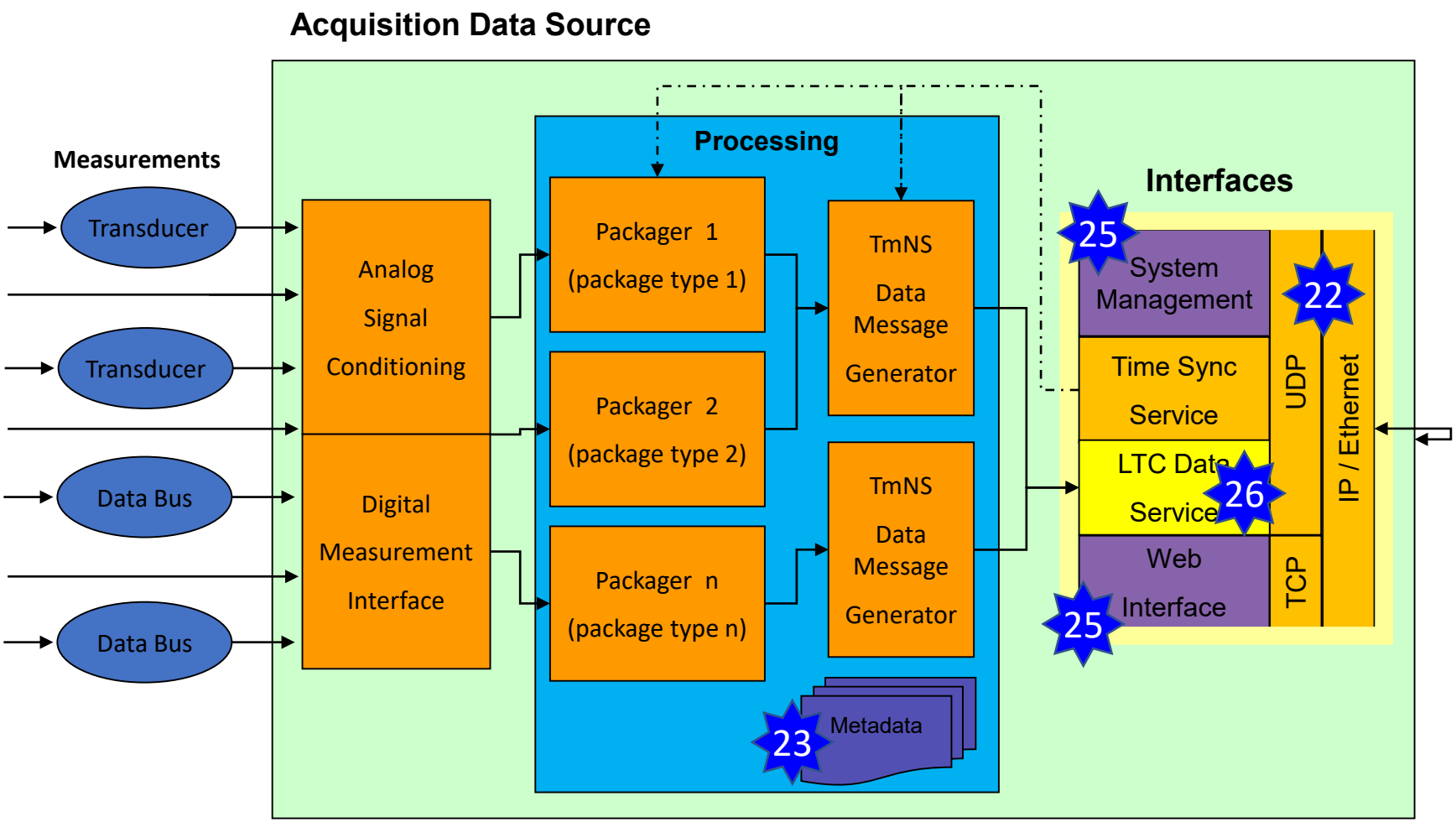
- Packages can have Fields defined that are redundant and / or overlap for convenience. For example one could describe the 1553 message with RT, TR, SA, and WC as individual fields as well as the combination of those Fields to which Command Word is mapped. Then processing could extract whichever was desired.

- This simplified example does not delve into the details of combining syllables, embedded counters etc, however, MDL accounts for them.

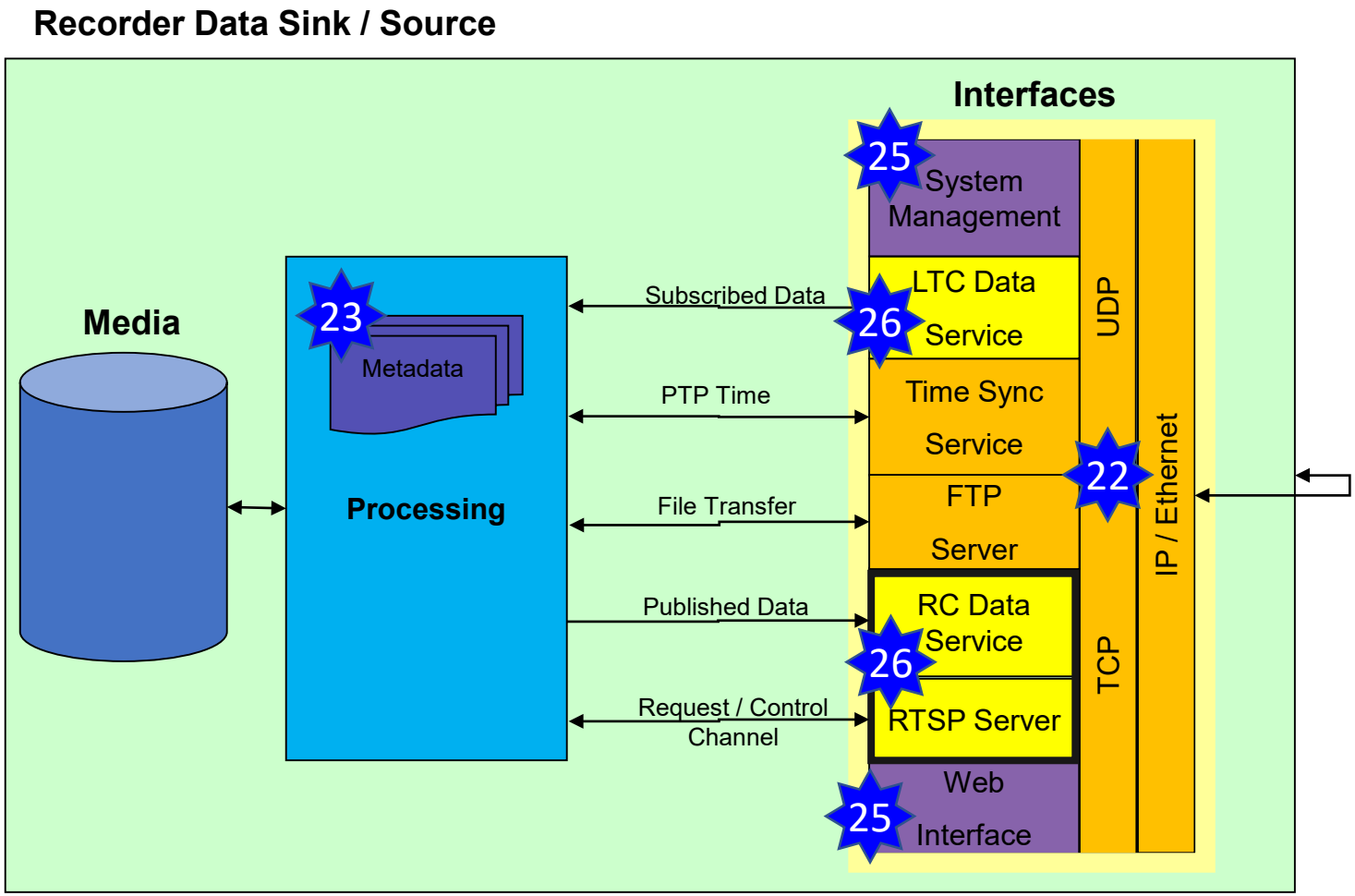
Example: iNET Network Switch



Example: iNET Data Acquisition Unit



Example: iNET Data Recorder



Example: Soft-Coded CH11 Data Type
(Transitional)