

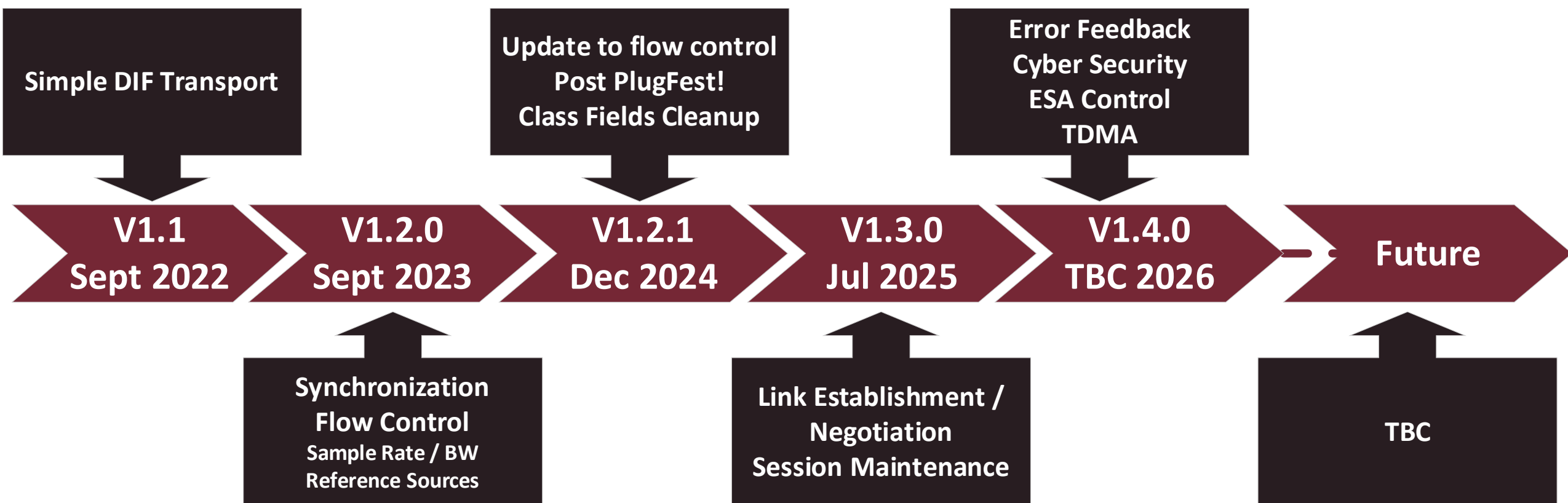
# DIFI Specification Progression 1.3.0 and Beyond

MILCOM 2026 DIFI Workshop  
Simon Swift – SWG Chair  
Director of Digital Technologies - ETL Systems

# Release Roadmap



## IEEE-ISTO Std 4900-2021: Digital IF Interoperability Standard



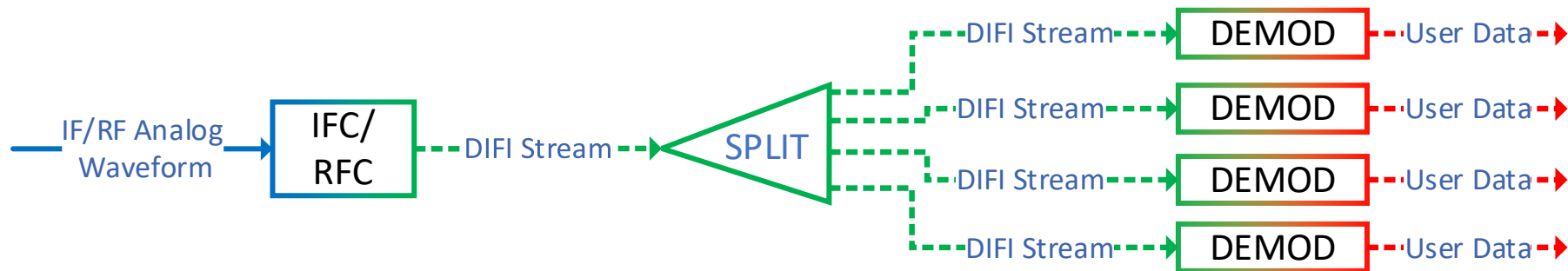
# DIFI v1.3 Overview

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- Link Establishment / Negotiation
  - Including facilities for network delay estimation
- New Information and Packet Classes
- General Class Fields Cleanup

# Link Establishment / Negotiation

- The DIFI link establishment process allows the setup of streams between devices across the DIFI protocol, negotiating parameters in-band and enabling packet flow without user intervention.
- Assumptions:
  - Once connected, each set of two devices will negotiate the operational parameters of the link
  - The system designer is responsible for ensuring appropriate IP connectivity
- Example:



- IFC/RFC provides full bandwidth (500 MHz) to Splitter (1:1 negotiation)
- SPLIT can provide a subset of the full bandwidth to downstream devices
- Each DEMOD requests a particular section of spectrum from SPLIT

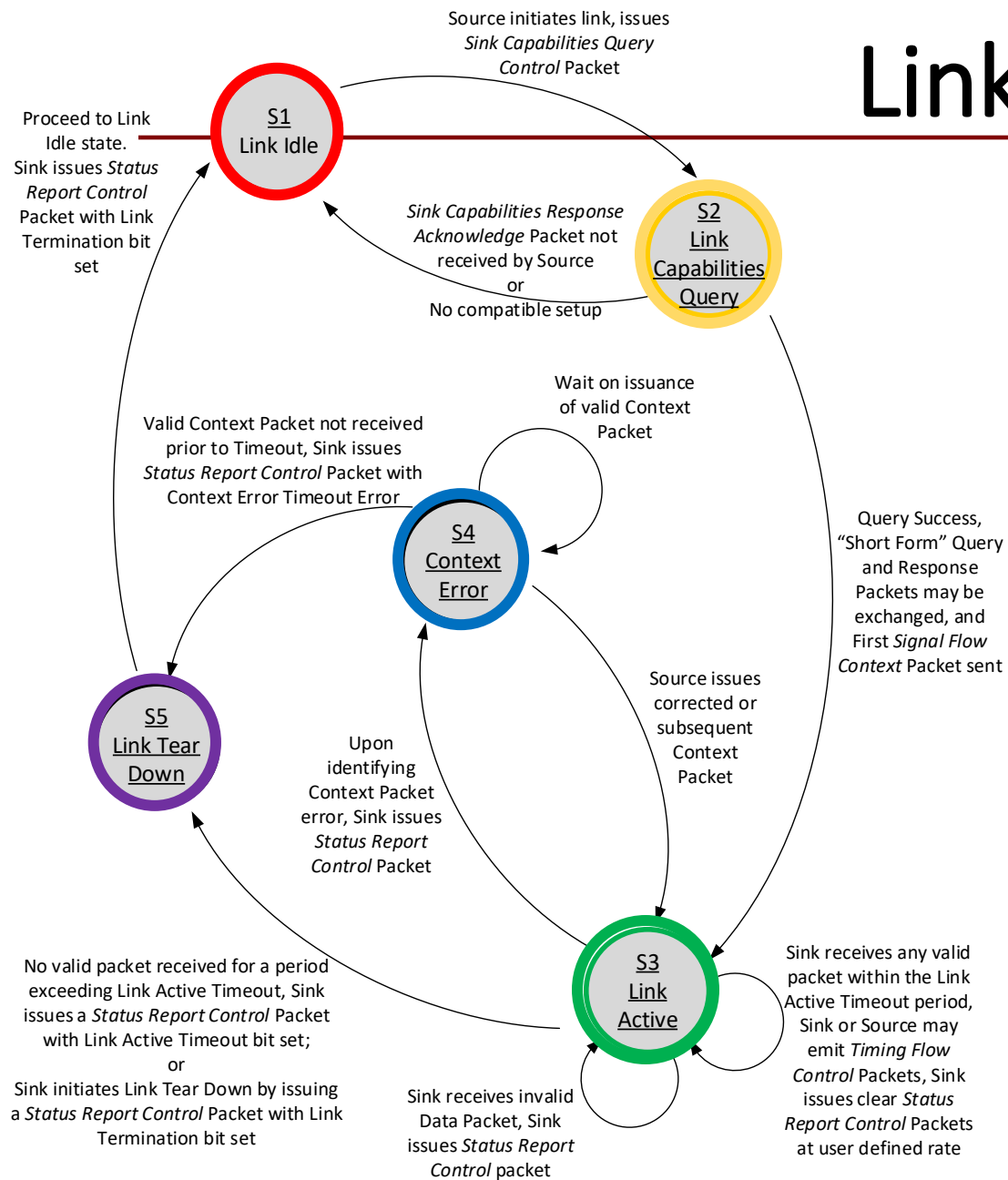
# Link Establishment Process Overview

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- Five states for the link that capture activation -> teardown
- Negotiate parameters before link initializes
- While active, sink can report on link status
- Multiple options for link teardown
  - Source-initiated
  - Sink-initiated



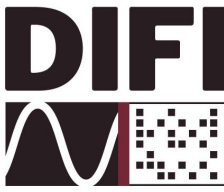
# Link Establishment Process



- Link Initiation and Activation
  - **S1** – Link Idle
  - **S2** – Link Capabilities Query
  - **S3** – Link Active
- Link Error Handling and Teardown
  - **S4** – Context Error
  - **S5** – Link Tear Down
  - **S1** – Link Idle

# Information Classes

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- Existing in v1.2.0

- Info Class 0x0 (Basic Data Plane)
- Info Class 0x1 (Version Flow)
- Info Class 0x2 (Flow Control, Sample Count)
- Info Class 0x3 (Flow Control, Real Time)

- New in v1.3.0

- Info Class 0x100 (Basic Data Plane)
- Info Class 0x101 (Link Establishment)
- Info Class 0x102 (Flow Control, Sample Count, with Link Establishment)
- Info Class 0x3 (Flow Control, Real Time, with Link Establishment)

# DIFI v1.4 Preview

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- Error Feedback
- Cyber Security
- Enhanced ESA Support
- TDMA Bandwidth Reduction
- Errata



# Error Feedback

| Packet Errors |                                     |                                    |                          |                          |                                   |                                       |                                         |                                                 |                          |                                                       |                                                    |                                |                                     |                         |                                         |                                     |                                         |                                     |                                    |                                 |                              |                          |                                           |                       |                               |                                       |          |          |          |          |          |          |
|---------------|-------------------------------------|------------------------------------|--------------------------|--------------------------|-----------------------------------|---------------------------------------|-----------------------------------------|-------------------------------------------------|--------------------------|-------------------------------------------------------|----------------------------------------------------|--------------------------------|-------------------------------------|-------------------------|-----------------------------------------|-------------------------------------|-----------------------------------------|-------------------------------------|------------------------------------|---------------------------------|------------------------------|--------------------------|-------------------------------------------|-----------------------|-------------------------------|---------------------------------------|----------|----------|----------|----------|----------|----------|
| Word 1        | 31                                  | 30                                 | 29                       | 28                       | 27                                | 26                                    | 25                                      | 24                                              | 23                       | 22                                                    | 21                                                 | 20                             | 19                                  | 18                      | 17                                      | 16                                  | 15                                      | 14                                  | 13                                 | 12                              | 11                           | 10                       | 9                                         | 8                     | 7                             | 6                                     | 5        | 4        | 3        | 2        | 1        | 0        |
|               | Selected Packet Type not defined    | Selected TSM not allowed           | Selected TSI not allowed | Selected TSF not allowed | Incorrectly Specified Packet Size | Specified Pad Bit Count not permitted | Specified Information Class not defined | Specified Packet Class not in Information Class | Packet Class not defined | Late Context Packet arrival (TSI/TSF Timestamp error) | Late Data Packet arrival (TSI/TSF Timestamp error) | Reference Point not recognized | Bandwidth too large for sample rate | Fractional Hz specified | IF Reference Frequency resolution error | IF Reference Frequency out of range | RF Reference Frequency resolution error | RF Reference Frequency out of range | IF Offset too large                | Reference Level Mismatch        | Sample rate resolution error | Sample rate out of range | Data Payload Config incorrectly specified | Unsupported Bit Depth | Frequency Allocation Conflict | Simultaneous Stream Capacity Exceeded | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
|               | Sink Errors                         |                                    |                          |                          |                                   |                                       |                                         |                                                 |                          |                                                       |                                                    |                                |                                     |                         |                                         |                                     | Warnings                                |                                     |                                    |                                 |                              |                          |                                           |                       |                               |                                       |          |          |          |          |          |          |
| Word 2        | 31                                  | 30                                 | 29                       | 28                       | 27                                | 26                                    | 25                                      | 24                                              | 23                       | 22                                                    | 21                                                 | 20                             | 19                                  | 18                      | 17                                      | 16                                  | 15                                      | 14                                  | 13                                 | 12                              | 11                           | 10                       | 9                                         | 8                     | 7                             | 6                                     | 5        | 4        | 3        | 2        | 1        | 0        |
|               | Frequency LOL causing data stoppage | Timebase LOL causing data stoppage | Buffer Underflow         | Buffer Overflow          | Link Active Timeout               | Context Error Timeout                 | Link Termination                        | Reserved                                        | Reserved                 | Reserved                                              | Reserved                                           | Reserved                       | Reserved                            | Reserved                | Reserved                                | Reserved                            | Probable Packet Drop - Context          | Probable Packet Drop - Data         | Nearly Late Context Packet arrival | Nearly Late Data Packet arrival | Reserved                     | Reserved                 | Reserved                                  | Reserved              | Reserved                      | Reserved                              | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

Tested against Plugfest 2025  
Error Scenarios

# Enhanced ESA Support

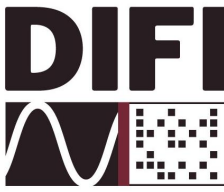
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- Support for Open AMIP
- A number of approaches examined closely by ESA WG with support from SWG
- Agreed approach with ESA WG to encapsulate open AMIP
  - Possibly into DIFI Command Packets
- Optional Information Class from a certification perspective



# Cyber Security

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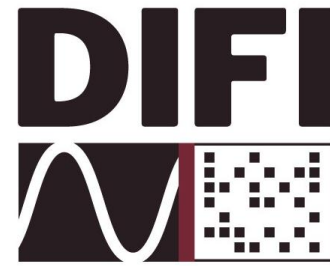


- Considerable discussions on this topic
- Considered 3 options:
  - Fully encrypted information Class
  - Metadata only encryption
  - External (Ethernet Appliance) encryption device



# Encryption Options

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- Full encryption required in DIFI devices (and applications)
  - Not considered desirable due to processing overhead
  - Increase cost of DIFI devices
  - Signal Data Packets can be considered encrypted at source (where this is necessary)
    - What is transmitted over the DIFI link is the same as what would be radiated
    - However, increased signal activity could aid pattern of life analysis

# Encryption Options

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- Encryption of only Context (and Command) Metadata
  - This data could be considered more sensitive
    - F/H data in context packets
  - Lower processing overhead, but still requires implementation and testing

# Encryption Options

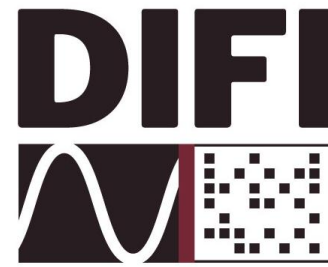
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- Encryption provided by an external (non-DIFI) network appliance
  - Internal communications considered “safe”
  - Only when DIFI packets leave controlled area
  - Issue with remote teleports with shared networking
  - Need to carefully evaluate delays, and lost packets
  - Can tailor to meet govt requirements
  - Needs to consider dynamics of DIFI protocol, and be suitable for streaming environment

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**This was approved due to considerations of:**

- **Diversity of encryption algorithms for different governments**
- **Not needed in all scenarios**
- **IP Security best left to network appliances**

# TDMA Bandwidth Reduction

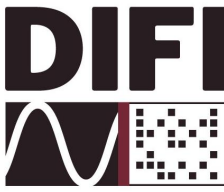
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- Question currently under discussion:
- Given F/H TDMA, how can the protocol efficiently support:
  - Bursts of indeterminate length
  - With tight turnaround between knowledge of next frequency and burst transmission time



# Errata

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- Feedback from implementers...



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# Questions

