STANAG 5066 Edition 2:

Status Update

Presented by

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S'5066 E2 Status

- **Development Roadmap**
  - Presented to BLOSCOMMS AHWG fall 2005
  - Approved:
    - Multiple-annex approach
      - Enhanced media access control mechanisms
      - IP-over-HF architecture
      - Standardized address-allocation plan
    - Focus in 2006 to complete ratification drafts and submit to nations
- **Annex L – submitted to second AHWG review**
  - Comments due and received by Dec 2005
    - Comments reviewed at 01/06 HFIA meeting
- **Annexes J through N (re-) issued at 06/06 BLOSCOMMS AHWG meeting**
- **Annex O to be released by Fall '06**

Agenda Topics

- **Edition 2 Overview / Roadmap**
- **Annex K – CSMA-CA status**
  - spec overview
  - State-machine overview
- **Annex drafts / updates**
  - Annex J – N provided at conclusion of BLOSCOMMs first 2006 meeting
- **Annex O (IP-over-HF) draft topics under development**
- **Status-Summary and Way Ahead**

STANAG 5066
Edition 2 – Proposed Scope

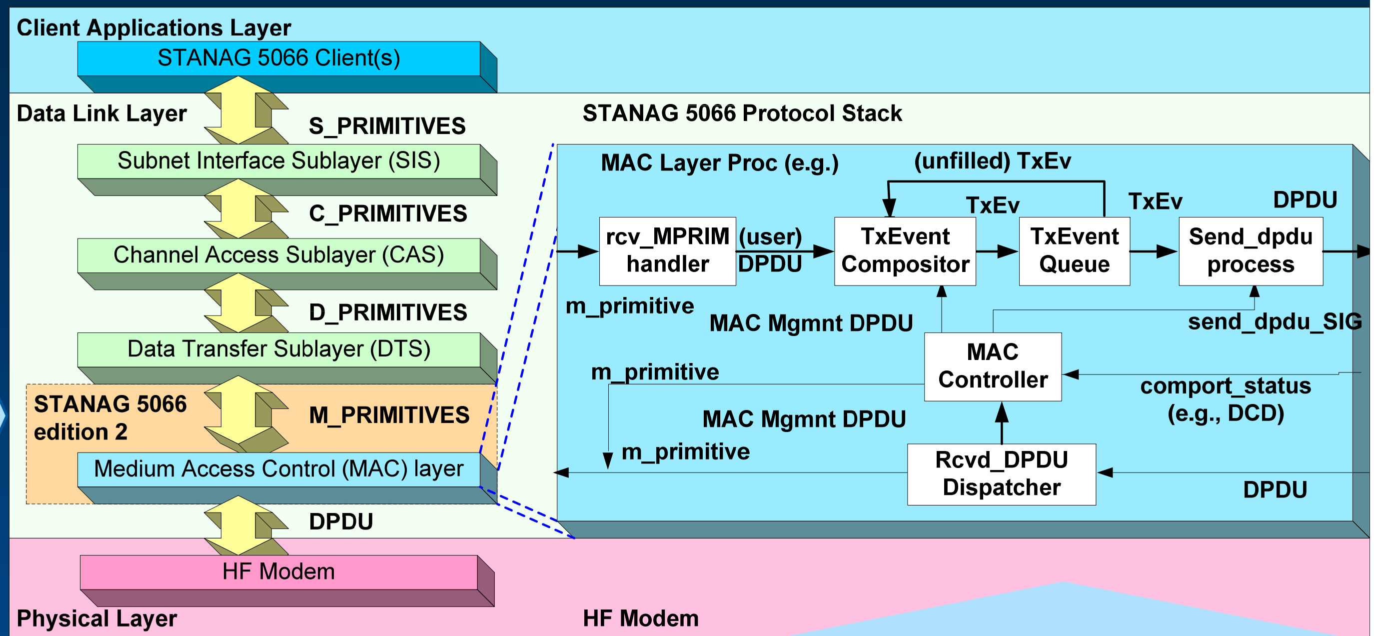
- **Main body provides overview of the structure of the Profile**
- **List of Annexes**
  - A: Subnetwork Interface Sub-layer
  - B: Channel Access Sub-layer
  - C: Data Transfer Sub-layer
  - D: Interface between Data Transfer Sub-l…
    Communications Equipment
  - E: HF Modem Remot…
  - F: Subnetw… …tory)
  - G: … (info only)
  - (info only)
  - …nge (info only)
  - …verview (tbd)
  - …ss Control Protocols (tbd)
  - …gh-Frequency Wireless-Token-Ring-Protocol (tbd)
  - M *unused / reserved* *()*
  - N Addressing Guidance (tbd)
  - O Integration with Internet Protocol (IP) Networks (tbd)

Roadmap Endorsed by BLOS-COMMS AHWG Oct 2005

Edition 2 Overview

Annex F, N, O:
IP-over-HF
Networking

Annex J:
Overview of MAC-layer functionality
Relationship to other layers / annexes



Annexes K, L, M: Tailored MAC-layer functionality for specific requirements:
- Annex K: Random-Access Protocols
- Annex L: HF Wireless Token Protocol (shown)
- Annex M: *reserved (e.g., for adaptive TDMA)*

- ***Proposed annexes provide modularity / opacity for new functions and guidance***

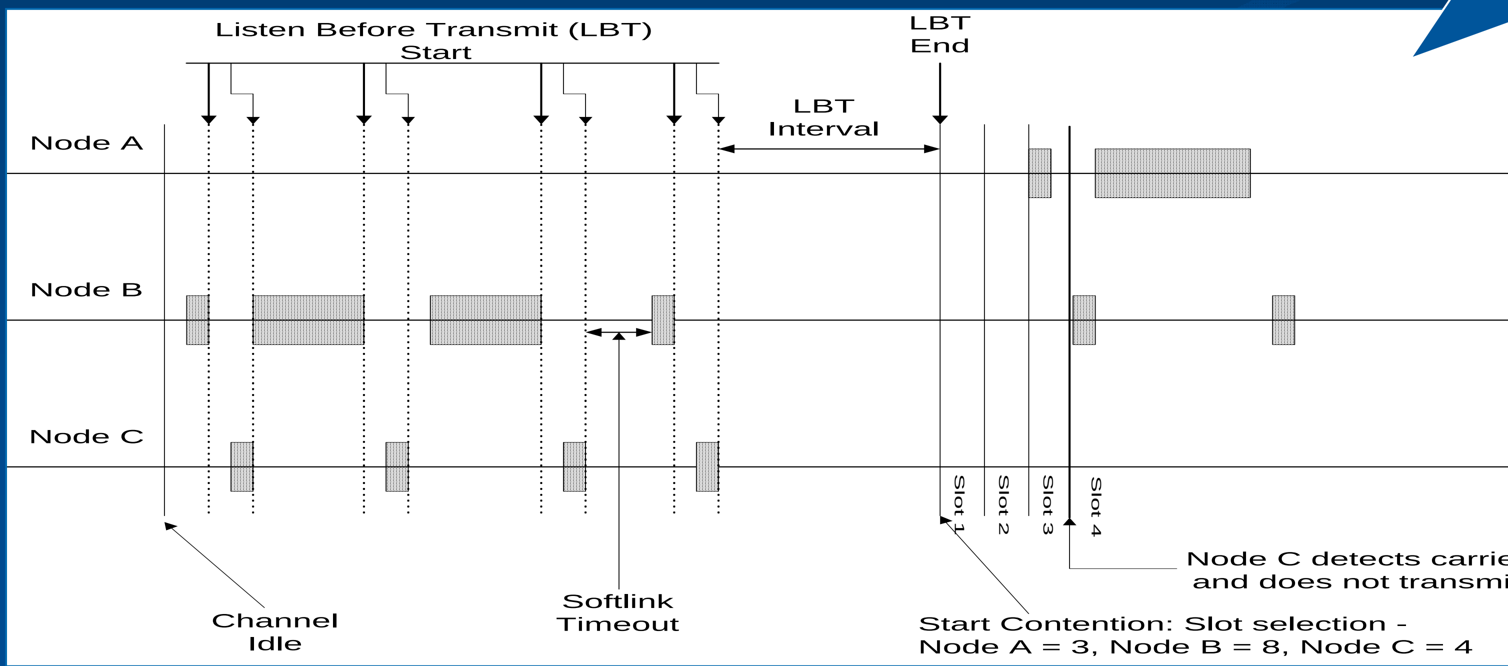
Edition 2 Development Principles

- **Extensibility — New capabilities based on:**
  - Layer opacity – encapsulate new functionality in a new layer to minimize impact on remaining specification;
  - Existing message catalog or
  - New messages based on existing data-elements and message-design rules
- **Backwards Compatibility**
  - Co-existence / non-interference
- **Backwards Interoperability (w / Edition 1)**
  - Capability discovery w/ devolution to lowest-common-denominator
  - Standardization (in Annex K) of vendor practice for CSMA / CA (Edition 1) networks
  - Data-exchange at the most-capable modes held in common.

Annex K – Random Access Techniques

- **Backwards Compatiblity / Interoperability**
- **Intended to formalize current vendor practice with Edition 1, e.g.:**
  - Carrier sense:
    - Real-DCD from modem
    - Virtual-DCD from EOT field
  - Listen-Before-Transmit
  - Slotted response intervals

MacFarland et al, "Collision Avoidance Using STANAG 5066 in a Network Environment", HFIA-ICM, 14 Jan 2002



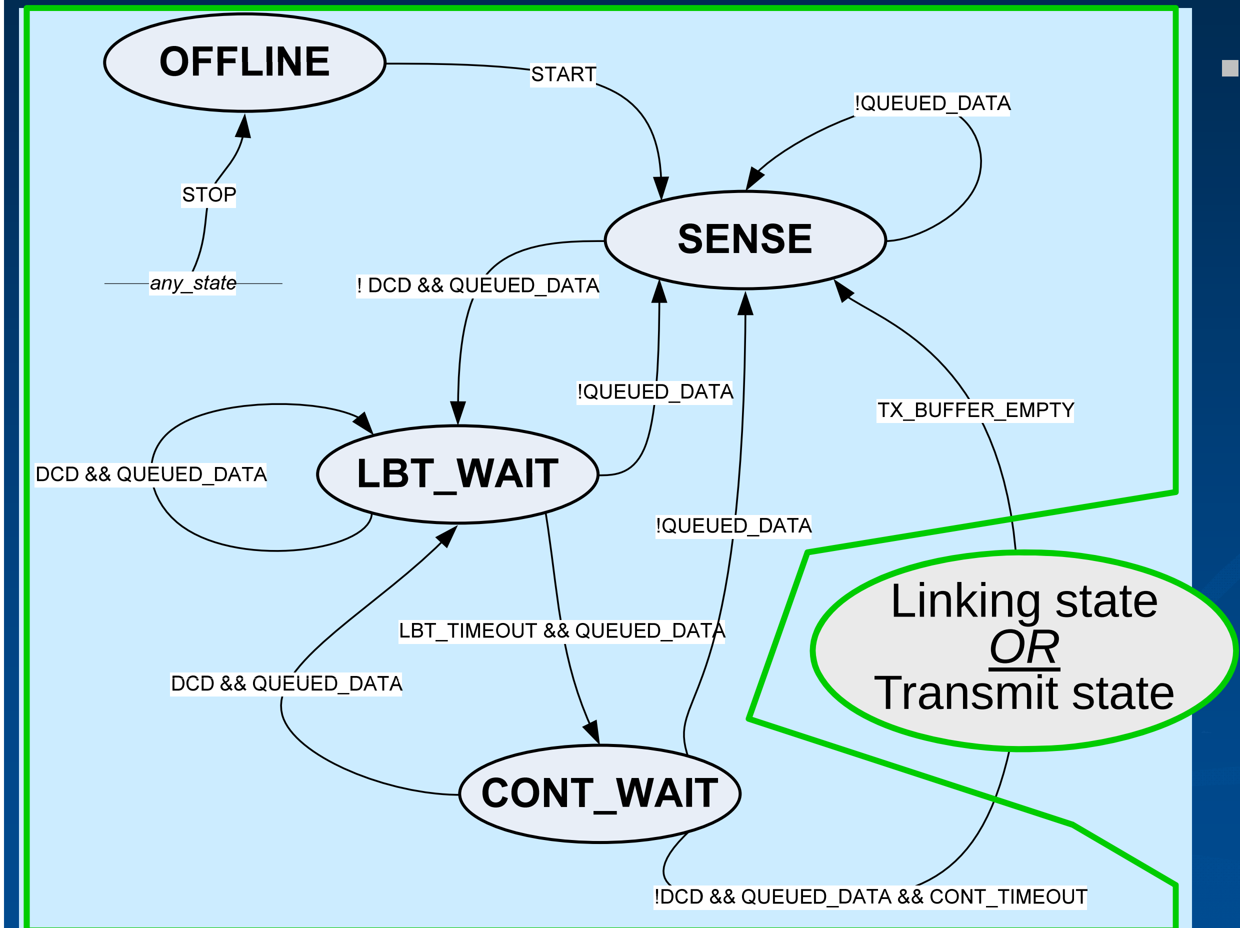
Annex K - Carrier-Sense Mechanism(s)

- **Data-Carrier Detect (DCD) Signal**
  - Hardware-provided, e.g., RS-232 Received-Line Signal Detector
  - Requires signal continuity from detection element (e.g., modem) through the equipment chain
    - Problematic with some equipment & cable infrastructure
    - Can introduce unknown delays
- **Virtual DCD (VDCD) Signal**
  - Based on detection of received DTS Protocol Data Units (DPDUs)
  - Uses DPDU End-of-Transmission (EOT) field for 'fly-wheel' tracking and prediction of DCD loss.

Communications Equipment Interface (e.g.)

RS232-C	Description	Circuit EIA	Circuit CCITT	RJ45	TIA 457
1	Shield Ground	AA			
7	Signal Ground	AB	102	4	5
2	Transmitted Data	BA	103	6	3
3	Received Data	BB	104	5	2
4	Request To Send	CA	105	8	7
5	Clear To Send	CB	106	7	8
6	DCE Ready	CC	107	1	6
20	DTE Ready	CD	108.2	3	4
22	Ring Indicator	CE	125	1	9
8	Received Line Signal Detector	CF	109	2	1
23	Data Signal Rate Select (DTE/DCE Source>	CH/CI	111/112		
24	Transmit Signal Element Timing (DTE Source)	DA	113		
15	Transmitter Signal Element Timing (DCE Source)	DB	114		
17	Receiver Signal Element Timing (DCE Source)	DD	115		
18	Local Loopback / Quality Detector	LL	141		
21	Remote Loopback	RL/CG	140/110		
14	Secondary Transmitted Data	SBA	118		
16	Secondary Received Data	SBB	119		
19	Secondary Request To Send	SCA	120		
13	Secondary Clear To Send	SCB	121		
12	Secondary Received Line Signal Detector/ Data signal Rate Select (DCE Source)	SCF/CI	122/112		
25	Test Mode	TM	142		
9	Reserved for Testing				
10	Reserved for Testing				
11	Unassigned				

Annex K - Carrier-Sense Multiple Access – Collision Avoidance

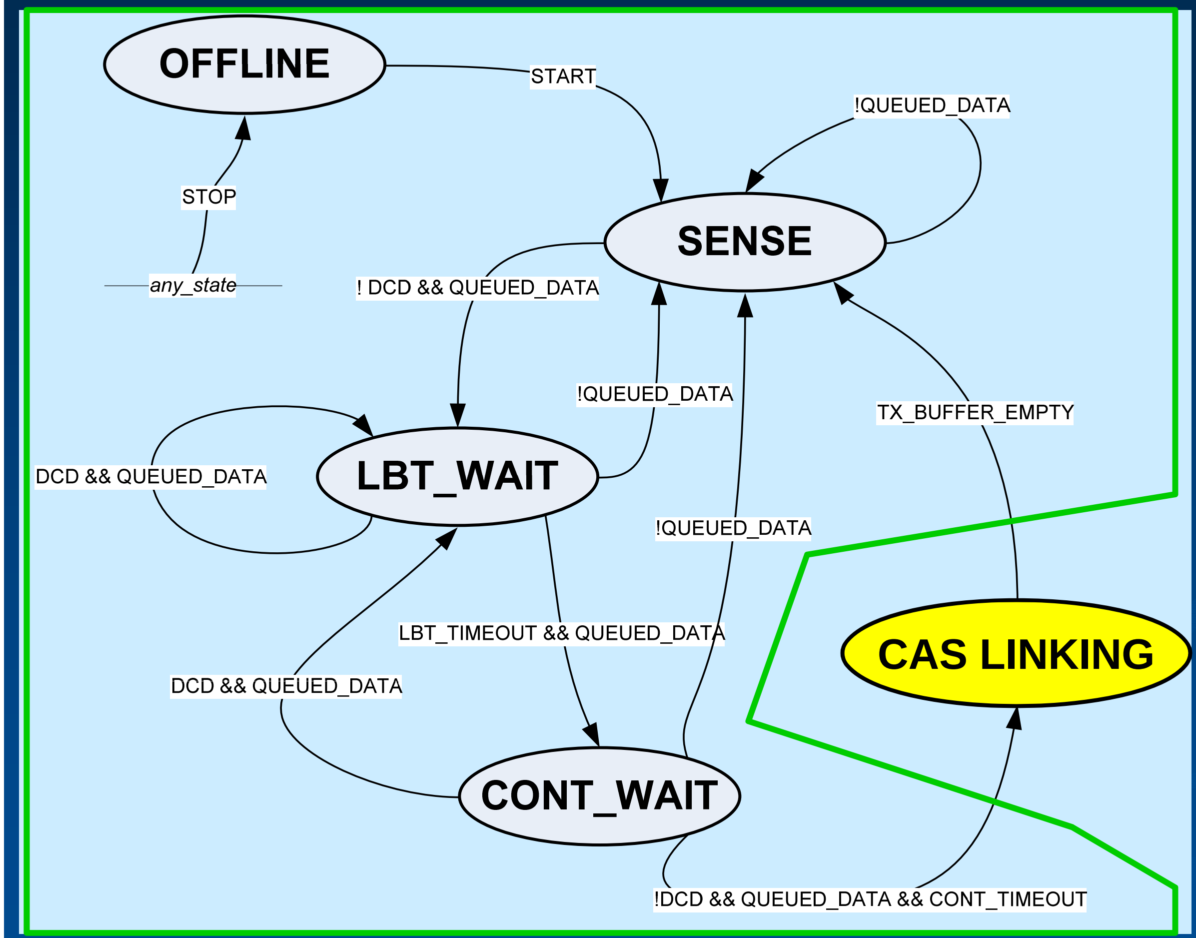


- **State Diagram**
  - ***two approaches:***
  - applied to control initiation of the CAS-linking protocol
  - ***OR***
  - applied to initiation of each transmission event

- ***Approaches have different properties and performance characteristics***

Annex K - Carrier-Sense Multiple Access – Collision Avoidance

- *Approach 1: CSMA-CA applied <u>only</u> prior to the CAS-linking protocol*

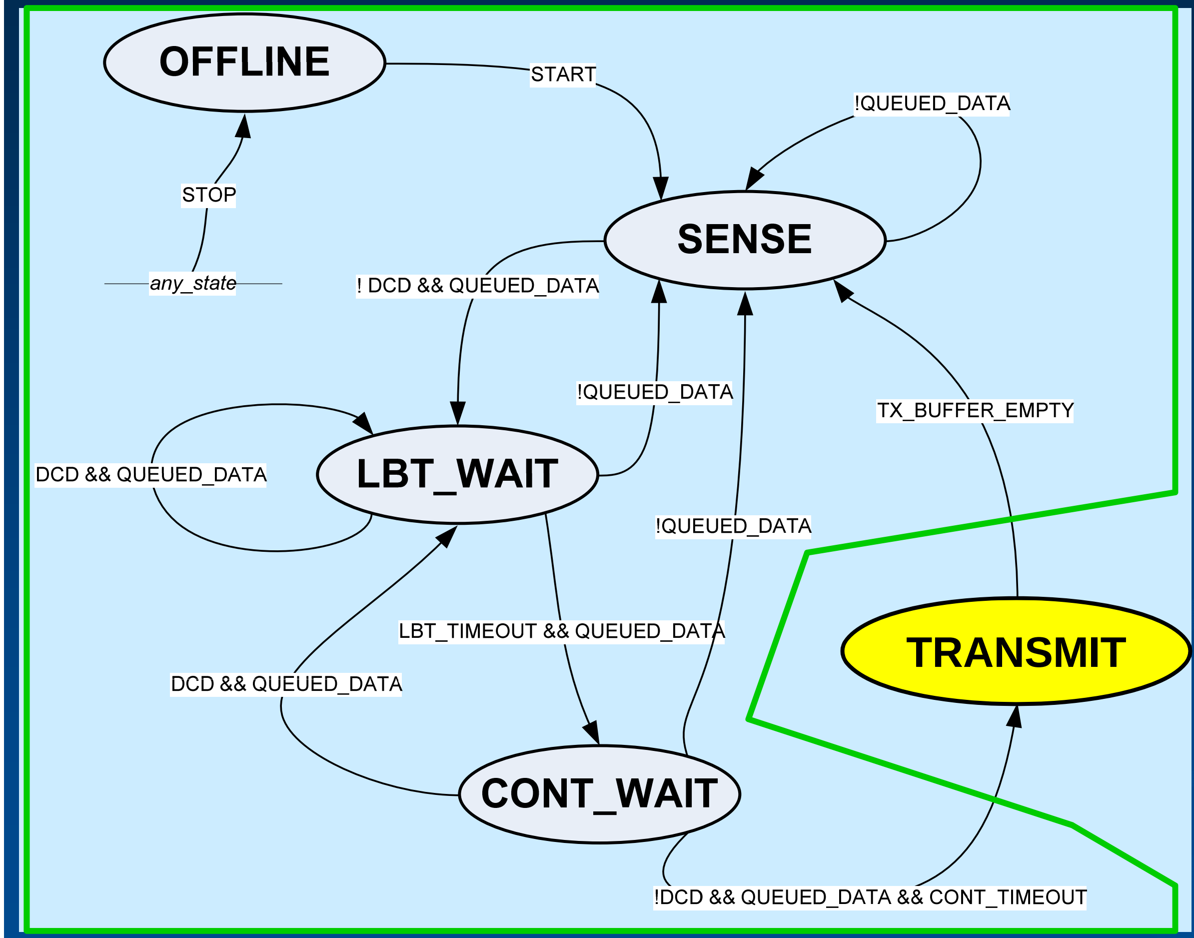


- **Provides more efficient use of the channel when the physical link is in place.**
- ***<u>BUT</u>*:**
- **Effectively limits channel access to a single physical link for the duration of the information-exchange requirement**

- ***<u>Approach 1 is the apparent implementation mode in commercial products</u>***

Annex K - Carrier-Sense Multiple Access – Collision Avoidance

- *Approach 2: CSMA-CA applied prior to each transmit opportunity*

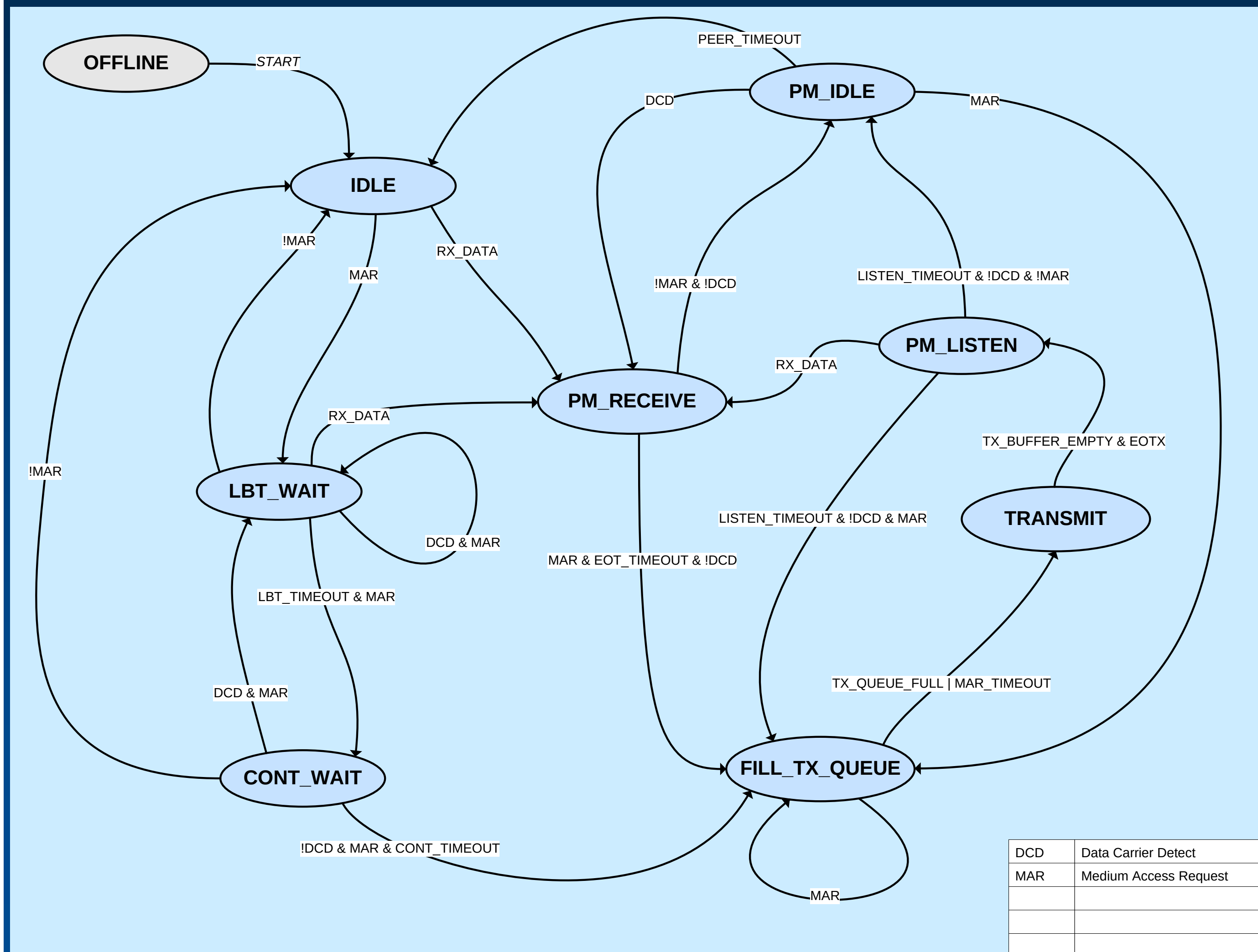


- **Allows multiple soft-link/physical-link operation in a network environment,**
- ***BUT***
- **Has higher overhead, as collision-avoidance delays occur more frequently.**

- ***No apparent vendor implementations of Approach 2***

Annex K - Carrier-Sense Multiple Access – Collision Avoidance

- *Composite Approach: CSMA-CA applied prior to linking, but may be applied if multiple nodes on the channel are detected*



- **Provides efficient use of the channel with a single physical link.**

AND

- **Allows multiple soft-link/physical-link operation in a network environment,**

BUT

- **Reverts to higher overhead in multi-link mode, as collision-avoidance delays occur more frequently.**

CSMA-CA: Protocol Controls

Scalar Control Parameters:

Parameter Name	Default Value	Units	Com-puted	Default-Value Name; Comments
CONT_SLOT_WIDTH	3	secs	no	DEFAULT_ CONT_SLOT_WIDTH; optimization of this value requires that it be a function of the modem preamble duration, data-rate, interleaver duration.
NUM_CONT_SLOTS	16	integer	No	DEFAULT_NUM_CONT_SLOTS; the value selected is a balance between probability of one and only one node selecting the winning slot and acceptable delay (eg. 3 nodes, 90%probability, 16 slots)

Timers:

Timer Name	Default Value	Units	Com-puted	Default-Value Name; Comments
LBT_WAIT_TIMER	30	secs	No	
CONT_WAIT_TIMER	RAND[0 … NUM_CONT_SLOTS – 1)] * CONT_SLOT_WIDTH	secs	Yes	computed as a function of the contention-slot width and the randomly selected contention-slot number for the access attempt.

Edition 2 Overview: Annex L Intro

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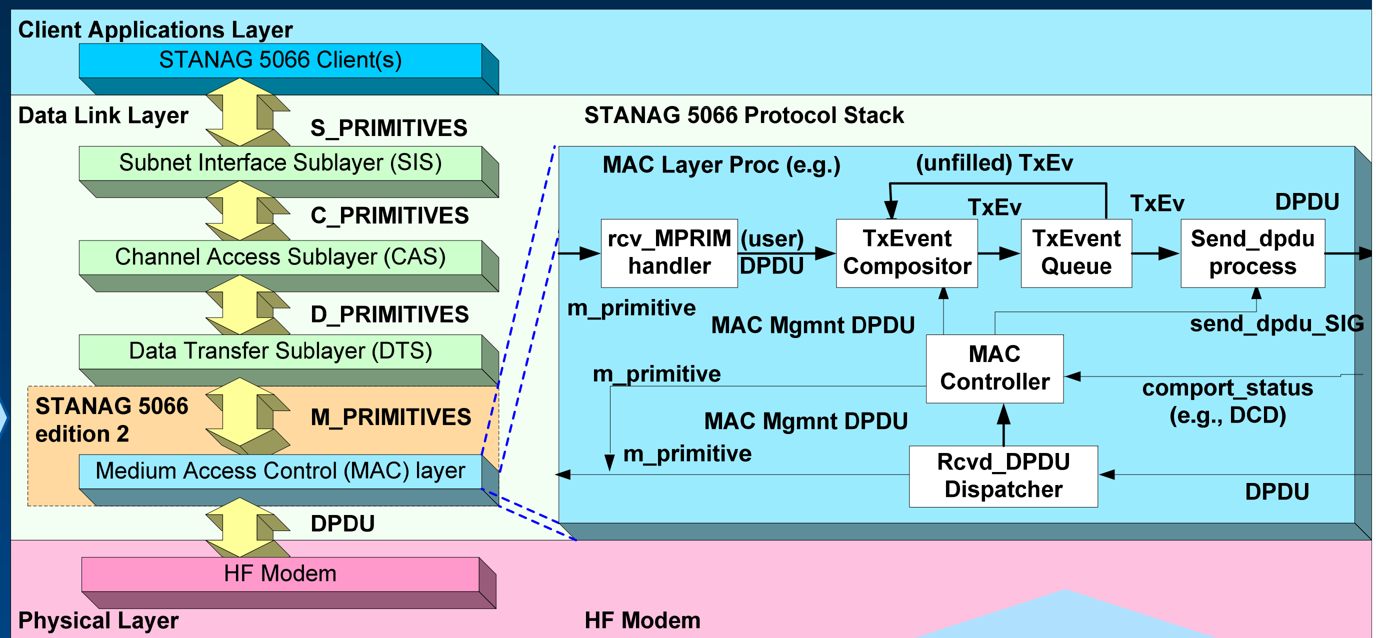
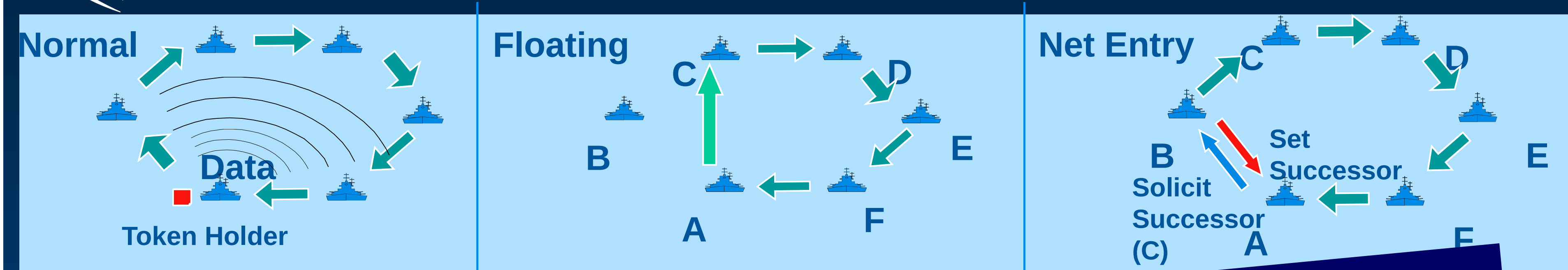


Annexes K, L, M: Tailored MAC-layer functionality for specific requirements:
Annex K: Random-Access Protocols
Annex L: HF Wireless Token Protocol (shown)
Annex M: *reserved (e.g., for adaptive TDMA)*

HF Wireless Token-Ring Passing: WTRP Operational Concepts (UCB via NMSU *)

(* UCB = Univ. of California at Berkeley; NMSU = New Mexico State University)



Merging Rings (detected)

Partially validated –

- Normal, floating, net-entry in partial-mesh topologies - √
- Merging rings – prototype implementation deferred
- Linear/'spiky'-topologies – prototype implementation handles single-relay linear case only
- Token-placement / operation - √
- Token-definition: minor revisions completed, and used in prototype auto-configuration capability

Annex L - HF WTRP Token

- **Token as new Type-6 DPDU EOW:**
  - Subtype 15
  - Contents based on the UCB WTRP IERs, w/ S'5066 addresses vice Ethernet MAC addresses
  - Forward-looking design anticipates use of EOW w/ body part for IP-address auto-configuration
- **Notes:**
  - (1) field-values corresponding to the enumerated frame-control functions as defined herein
  - (2) the given value are based on the use of 4-byte fields are required for SEQUENCE and GENERATION_SEQUENCE, but see the text for further discussion.
  - (3) to reduce complexity in message parsing, these fields are encoded as a full fixed-length address fields following the STANAG 5066 rules, regardless of the encoding of the SA and DA fields

Byte/ Bit Num.	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*	*Field encoding per S5066 Annex C, as amplified below*
	The two-byte message preamble is not shown;								
0	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	DPDU_TYPE = 6, per S5066 Annex C; **EOW_TYPE = 15**
1	**FC field [1] ∈ {Token, Solicit Successor, Set Successor, Set Predecessor, … }**								**EOW_DATA = HFTRP Frame-Control**
2	**END_OF_TRANSMISSION (EOT)**								encoded per S5066 Annex C
3	**SIZE_OF_ADDRESS (m ∈ {1 … 7})**			**SIZE_OF_HEADER[2] (k = 28)**					*m, k in bytes,* encoded per S5066 Annex C
3 + m	**SOURCE_AND_DESTINATION_ADDRESS**								Field-length = m bytes; encoded perS5066 Annex C; **These fields correspond to the HFTRP DA and SA fields**
4+m		**NOT_ USED_1**			**HAS_ BODY = 0**	**EXT MSG = 1**	**VALID MSG = 1**	**ACK**	This is the extended form of the ID Mgmt EOW message; encoded per S5066 Annex C
5+m	**MSB -**	**-- MANAGEMENT FRAME ID NUMBER --**						**- LSB**	encoded per S5066 Annex C
6+m	**Reserved for future use (2-bytes) (e.g., to-designate the length of any management-message payload)**								**Potential HFTRP-required field (e.g., payload size)**
8+m	**RA - RING_ADDRESS (4-bytes, in the address format of STANAG 5066 Annex A)**								**HFTRP-required field [3]**
12+m	**SEQ - SEQUENCE_ID (4-bytes, per the HFTRP requirement)**								**HFTRP-required field**
16+m	**GEN - GENERATION_SEQUENCE_ID (4-bytes, per the HFTRP requirement)**								**HFTRP-required field**
20+m	**NS - NEW_SUCCESSOR_ID (4-byte, context-dependent format, per the HFTRP requirement)**								**HFTRP-required field**
24+m	**NON - NUMBER OF NODES (2-bytes, per the HFTRP requirement)**								**HFTRP-required field**
CRC_H_1	**CRC_ON_HEADER**							**MSB**	encoded per S5066 Annex C
CRC_H_2	**LSB**								

Annex L – IP-Autoconfiguration Implementation Issues

- **SSC Prototype Implements IP-Autoconfiguration**
  - Type-6 Management DPDU may convey a payload part:
    - List of STANAG 5066 addresses
    - List of available IP-subnet addresses in use
  - Every Right-to-Transmit Token conveys the payload
  - Nodes Joining the network select an unused IP address, pair it with their own STANAG 5066 address, and add the pair to the list when they join the network.
  - A management client can query the HF subnetwork, determine the IP address that was selected, and configure the IP client appropriately.
- **NC3A position:**
  - supports concept and requirement for IP-autoconfiguration
  - Would prefer to see IP-autoconfiguration as an on-demand capability (e.g., embedded in the solicitation and set-successor tokens)
  - recommendation under study for next-draft Annex-L release

Annex M – Reserved for future use

- **Reserved for:**
  - Time-division multiple access approaches ???
    - Fixed TDMA ?
    - Adaptive TDMA ?

Annex N – STANAG 5066 Addressing Guidance

- **Proposal:**
  - Incorporate within S'5066 E2 the addressing plan adopted and promoted by the US in their Battle-Force E-Mail (BFEM'66) system
- **Plan Overview**
  - Partition of Address-Space into compact blocks
  - Allocation of blocks to regional / national / service-oriented control authorities
  - Devolution of address-allocation to identified control authorities
    - *Identified control authorities TBD …*

Annex N - S'5066 Address-Management Guidance

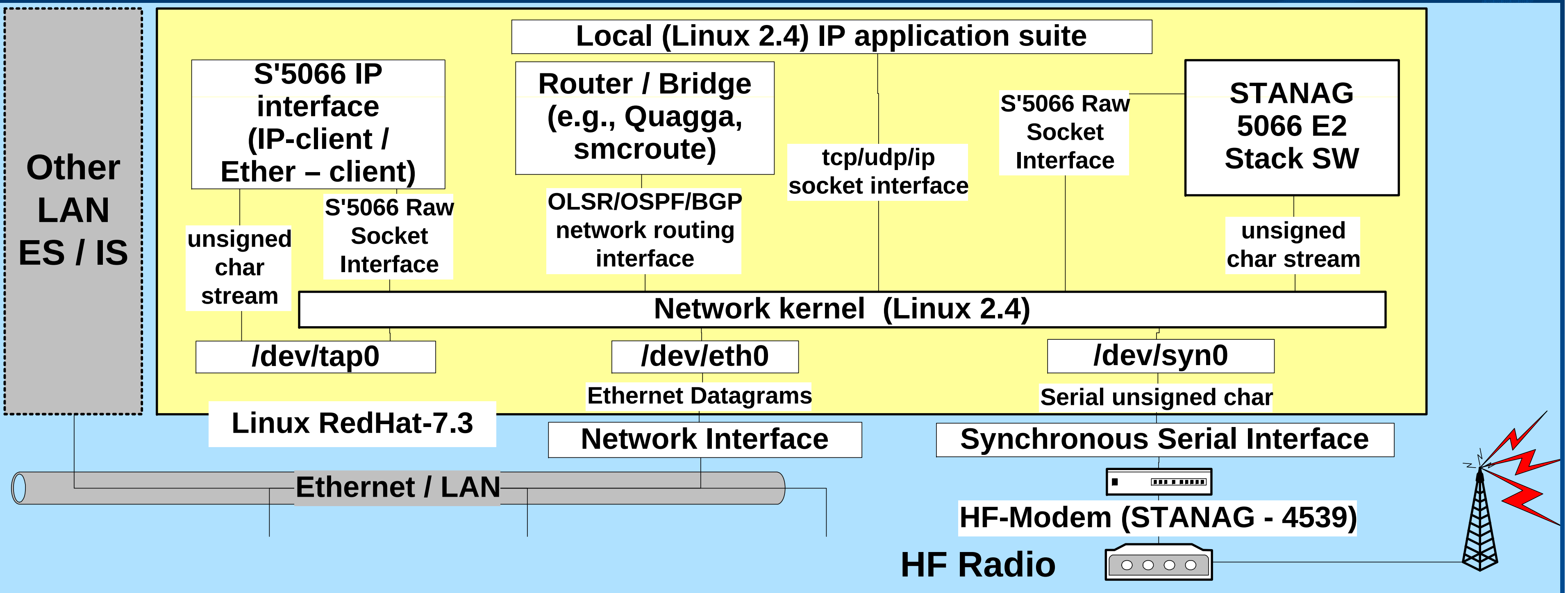
- **Current US/Coalition assignments defined for BFEM'66**
  - provided by US to the MWG (AC/322-SC/1-WG/3); forwarded to NACOSA for action
- **Address block pre-assignment and reservation by organization/region**
  - only full-length addresses are managed
  - variable-length addresses (less than full-length) left unmanaged for ad-hoc use
  - management devolution to organizations (most TBD)
- **Currently Assigned Blocks:**

range	assignee	block size .
1.x.y.z	US government agencies (DoD, FEMA, etc.)	16,581,375
2.x.y.z - 3.x.y.z	North America	33,162,750
4.x.y.z - 5.x.y.z	South America	33,162,750
6.x.y.z - 7.x.y.z	Europe	33,162,750
8.x.y.z - 9.x.y.z	Asia	33,162,750
10.x.y.z - 11.x.y.z	Africa	33,162,750
12.x.y.z - 13.x.y.z	Australiasia	33,162,750
14.x.y.z	Oceana	16,581,375
15.x.y.z	NGOs (e.g., ICRC)	16,581,375

- **Assignment of Top-level and Devolved Management responsibilities TBD**
  - determination of NATO managed range TBD (as European or North American Subset? as an amalgamation of the nationally provided resources? Within the NGO block?)

Annex O - Integration with Internet Protocol (IP) Networks

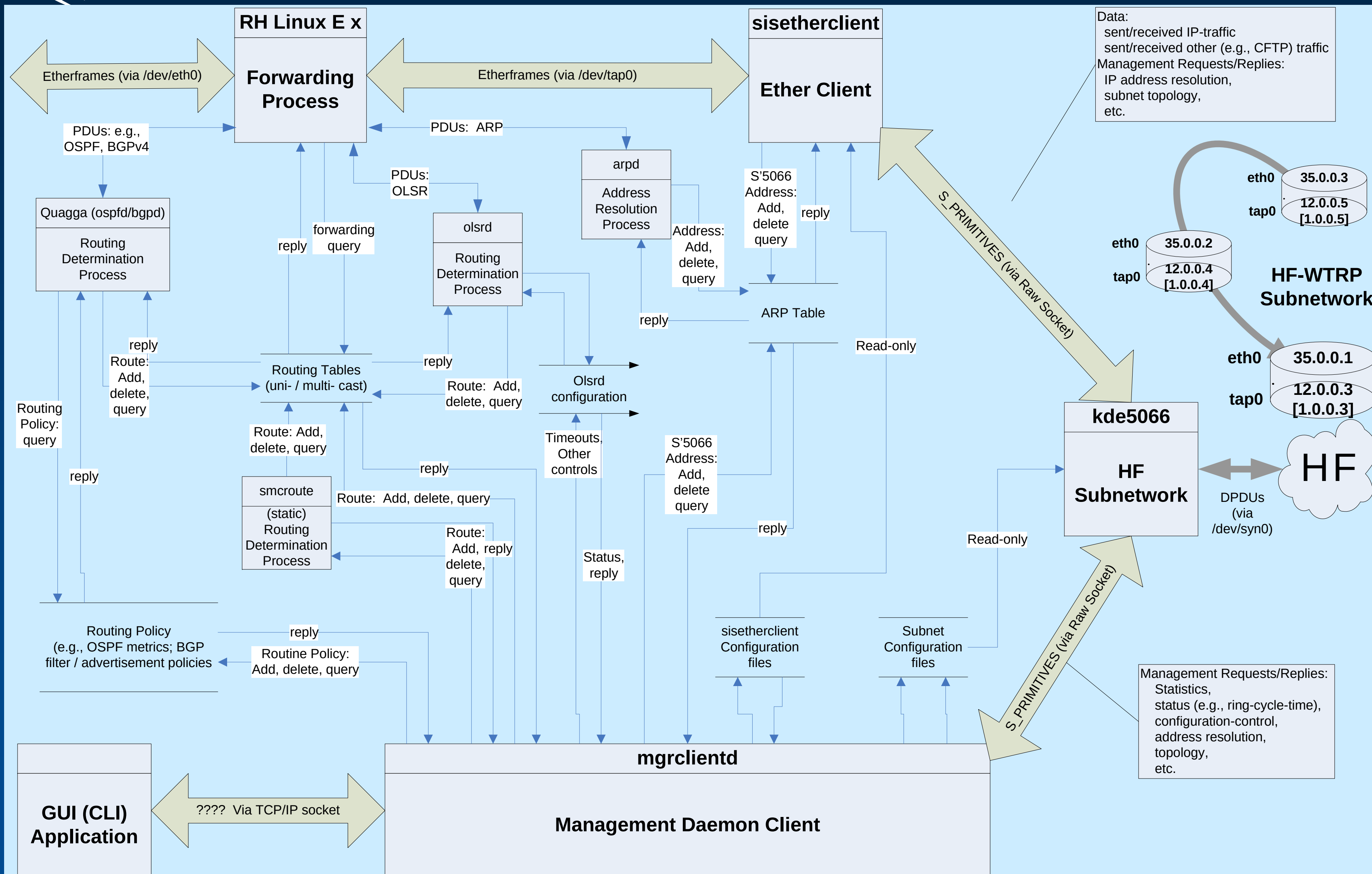
- **Formalize requirements and guidelines for:**
  - End-system (ES) and Intermediate-System (IS)
  - IP address assignment, auto-configuration
  - Multi-protocol support
  - Routing (protocols for MANET operation), bridging / filtering
  - Edge proxies (e.g., SCPS / CFTP) for efficiency and performance



Annex O: IP-over-HF Functionality

- **Net-ready Interface for legacy radio (e.g., Maritime / Deployed wireless systems)**
  - IPv4/IPv6/ARP multi-protocol interface
  - Self-organizing distributed/master-less ad-hoc network management
  - Multi-hop routing (OSPF / OLSR)
  - Wireless Token-Ring or CSMA/CA media access control
  - Intra-task-force and BLOS connectivity (up to 1800+ km)
  - Demonstrated Support for a range of delay-tolerant IP applications:
    - Chat, Informal/Formal Messaging, JPIP-image transfer, DB replication, COP (using MCCIS)
- **Low-end/low-cost entry to NNEC using legacy assets and software appliqué**
  - Architecture and functionality demonstrably compatible with existing HF and VHF radio systems

Annex O: IP-Management Concept



Guidelines on S_MANAGEMENT_REQUEST & S_MANAGEMENT_INDICATION Extensions

<u>*Per Annex A*</u>

<u>*Per Annex A A.2.2.19, implementation-dependent encoding of Type and Body*</u>

Bytes 0-4	Byte 5	Byte 6	Byte 7	Bytes 8 - (N-1)
SPRIM_HDR	SPRIM_TYPE	MGMNT_TYPE	OBJ_TYPE	OBJECT_DATA
	{REQUEST, INDICATION, ...}	{GENERIC, SET, RESET, GET, SHOW, ...}	{CSTRING, RAW_SOCKET, SISLAYER, SLMGR, SLATTREC, CASLAYER, PLMGR, PLATTREC, DTSLAYER, AQRMGR, ARQARRTREC, MACLAYER, COMPORT, OWN_NODE, REM_NODE, ...}	{<NULL-TERMINATED CHARACTER ARRAY>, <OBJ_TYPE-dependent field specification>, ... }

Encoding proposed for Management-message types

Encoding proposed for Managed-Object Types

Summary – Way Ahead

- Annex J   Media Access Control Overview
  - Working Draft 1 to-be supplied AHWG 1 – *at first 06 meeting*
- Annex K   Random-Access Control Protocols
  - Working Draft 1 to-be supplied to AHWG 1 – *at first 06 meeting*
- Annex L   High-Frequency Wireless-Token-Ring-Protocol
  - Working Draft 2 distributed under silence period at AHWG 1 – *at second 05 meeting*, comments received, reviewed; draft 3 to be provided prior to
- Annex M   *unused / reserved*
  - *Determine relevance – intended as placeholder for (adaptive) TDMA approaches*
- Annex N   Addressing Issues
  - Working Draft 1 to-be supplied to AHWG 1 – *at first 06 meeting*
- Annex O   Integration with Internet Protocol (IP) Networks
  - Working Draft 1 to-be supplied to AHWG 1 – *prior to second 06 meeting*

Questions?

STANAG 5066 Edit... 2

Progr...

...on

...perative Meeting

..., 2... – San Diego, US

by:

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Transmission and Networking Systems Resource Centre
Communication and Information Systems Division
NATO Consultation, Command and Control Agency

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