Network Coding and Satellite Communications
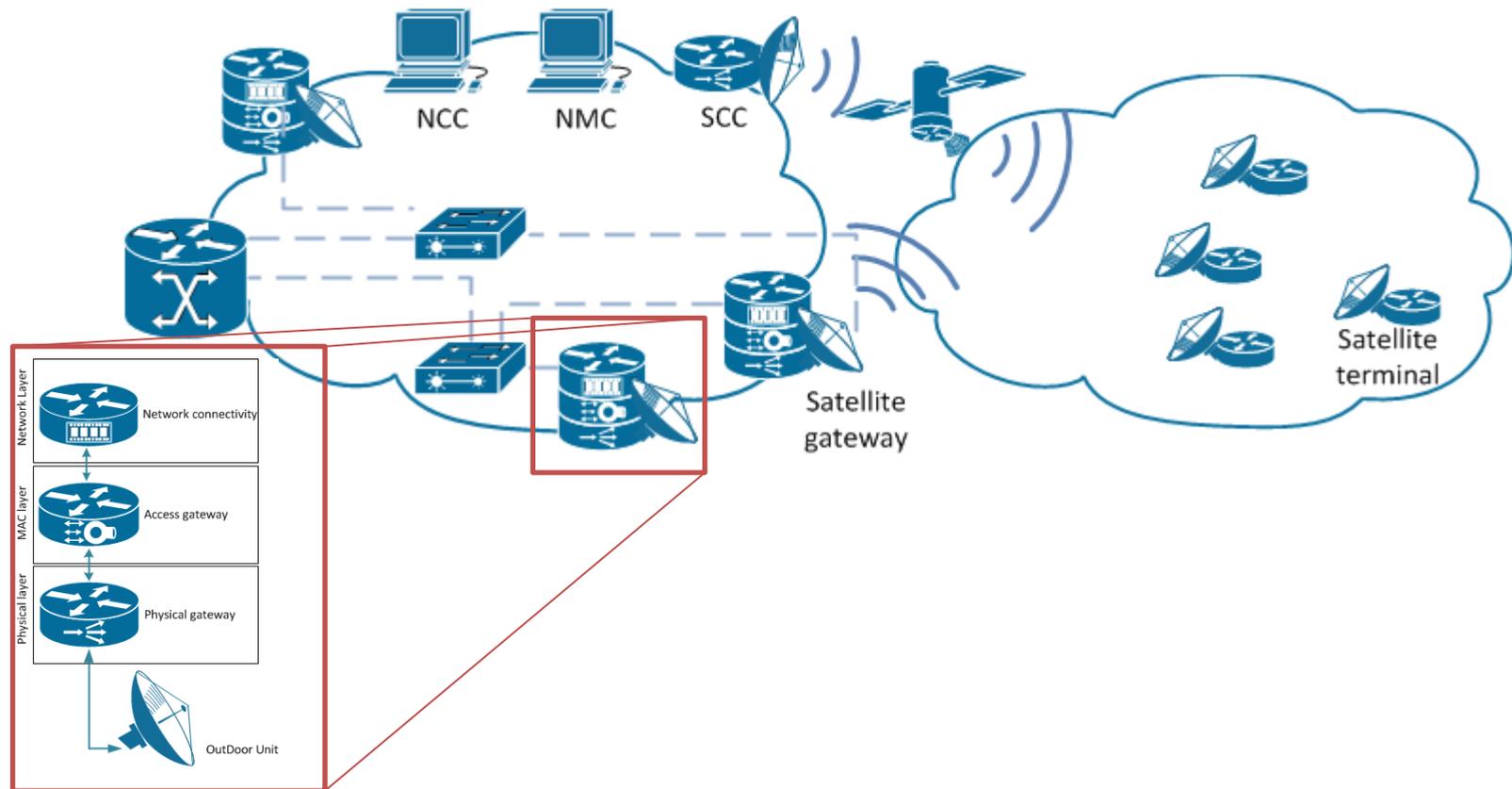
`draft-kuhn-nwcrg-network-coding-satellites-00`

IETF'99 July 2017
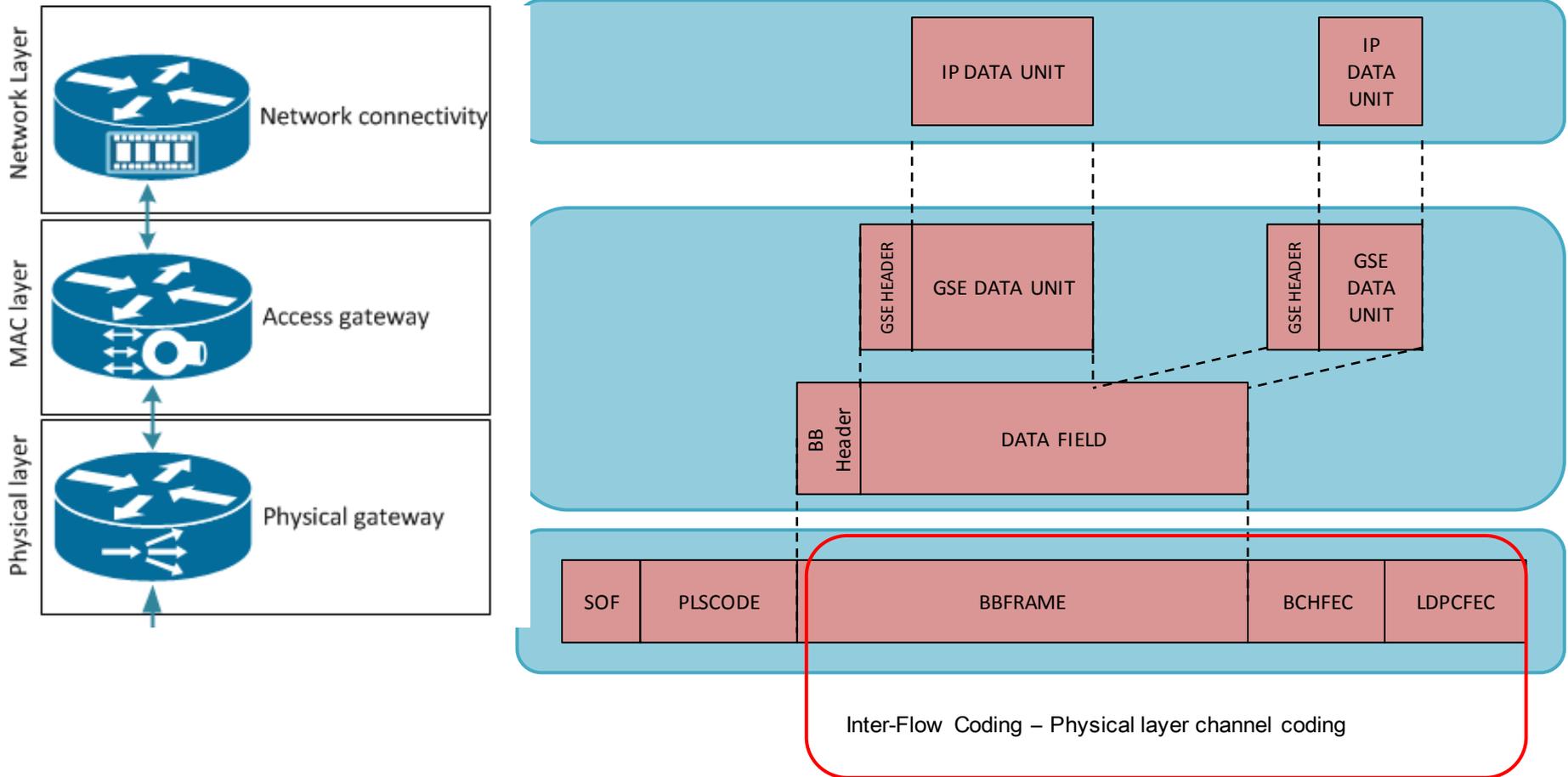N. Kuhn (CNES) – E. Lochin (ISAE)

Objectives of the draft (1/4)

- **SoA** on the current deployment of network coding schemes within satellite systems
    - DVB-* standards, ...

Objectives of the draft (2/4)

- **SoA** on the current deployment of network coding schemes within satellite systems
    - DVB-* standards, ...

Objectives of the draft (3/4)

- **Identifying opportunities** for further usage of network coding in satellite systems
  - Based on real deployment of NC schemes
  - Feedback from EU or national projects, companies, …
    - See example below (NetCoP)
  - Other

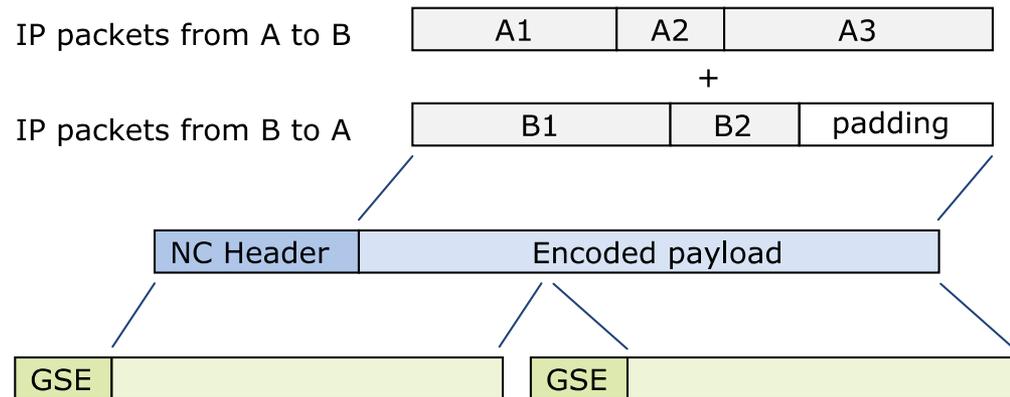# Network Coding Protocol (NetCoP) - General

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Network Coding Protocol (NetCoP) - General

- Communication protocol for bi-directional communication
- A central Hub (or on-board processor) combines messages from the two communication partners
- Multicast on the FL
- Up to 50% bandwidth or power saving in the forward link
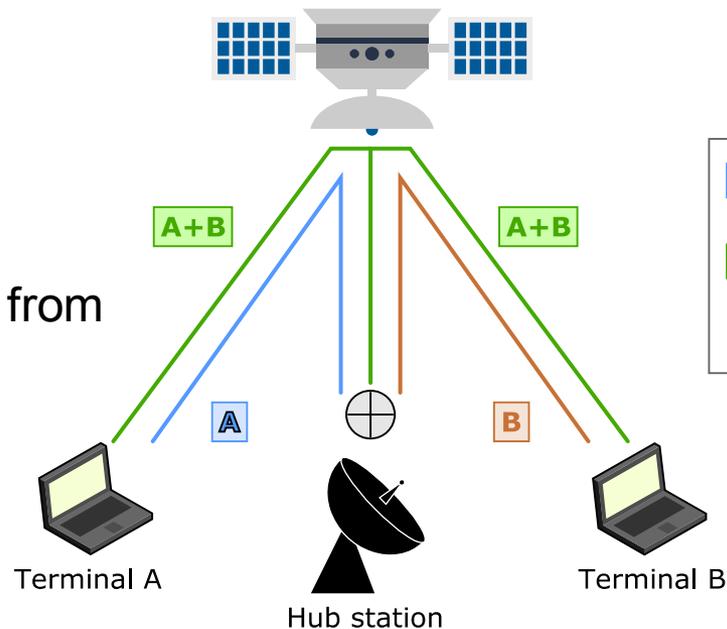
- Encapsulation of IP packets in NC packets
- Testbed implementation on DVB-S2/RCS2 available

A+B

A+B

A

B

| A | B | IP packets, encapsulated with RLE |

| A+B | NETCOPv2 packets, encapsulated with GSE |

⊕ XOR Operation

Terminal A

Terminal B

Hub station

IP packets from A to B | A1 | A2 | A3 |

+

IP packets from B to A | B1 | B2 | padding |

| NC Header | Encoded payload |

| GSE | | GSE | |

Network Coding Protocol (NetCoP) – Header Format

0		8		16		24	32
vsn	flags			address0			
		address1				def_proto0	
def_proto0		def_proto1			pcnt0		
pcnt1		packet_info_block					
			...				
	...				crc		

- Vsn: Version
- Flags: Indicate presence of address and def_proto fields
- Address: 24bit address of terminals
- Def_proto: Default Ethertype value
- Pcnt: Packet count
- Packet_info_block: Length and CRC of each encoded packet

- CRC is used to identify the packets on encoder and decoder side

Objectives of the draft (4/4)

- We seek a **global vision**
  - To **synthetize numerous activities** in this context
  - With the aim to provide input to build an **architecture-oriented document**
- In other words
  - The best way to use NC and where to put it in a satcom context
  - Contributing to a more generic document
    - We do not seek a taxonomy-like draft
    - We do not promote any solution or architecture

Draft structure

2. A note on satellite topology

    → *Describe the reference architecture*

3. Status of network coding in actually deployed satellite

    → *SoA*

4. Opportunities for more network coding in satellite systems

    → *Feedback from EU or national projects, companies, …*

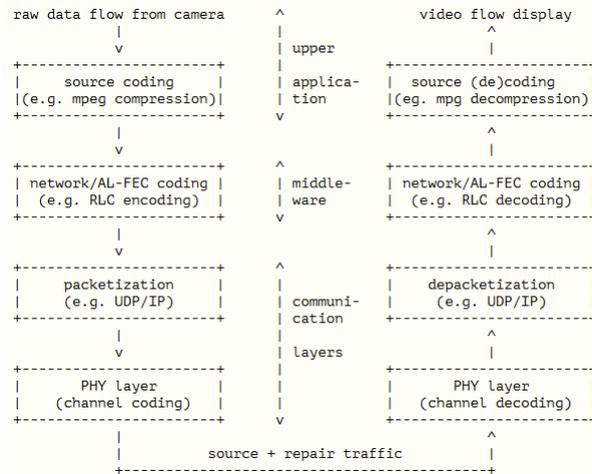5. Deployability and related use cases

    → *usecase*

5.1. Network coding as a VNF

5.2. Network coding and PEP

    → *your proposals ?*

Strategie – Status of network coding in actually deployed satellite

```
raw data flow from camera        ^            video flow display
           |                     |                  ^
           v                     | upper            |
+------------------------+       | applica-  +------------------------+
|    source coding       |       | tion      |    source (de)coding   |
|(e.g. mpeg compression) |       |           |(eg. mpg decompression) |
+------------------------+       v           +------------------------+
           |                     ^                       ^
           v                     |                       |
+------------------------+       | middle-   +------------------------+
| network/AL-FEC coding  |       | ware      | network/AL-FEC coding  |
| (e.g. RLC encoding)    |       v           | (e.g. RLC decoding)    |
+------------------------+       ^           +------------------------+
           |                     |                       ^
           v                     |                       |
+------------------------+       |           +------------------------+
|    packetization       |       |           |    depacketization     |
|    (e.g. UDP/IP)       |       | communi-  |    (e.g. UDP/IP)       |
+------------------------+       | cation    +------------------------+
           |                     |                       ^
           v                     | layers                |
+------------------------+       |           +------------------------+
|    PHY layer           |       |           |    PHY layer           |
|  (channel coding)      |       v           |  (channel decoding)    |
+------------------------+       ^           +------------------------+
           |                     |                       ^
           |   source + repair traffic                   |
           +-------------------------------------------------+
```

$+$

```
End-to-End Coding:  A system where coding is performed at the source
        or (coding) middlebox, and decoding at the destination(s) or
        (decoding) middlebox.  There is no re-coding operation at
        intermediate nodes.  This is the approach followed in the
        FLUTE/ALC [RFC6726][RFC5775], NORM [RFC5740] and FECFRAME
        [RFC6363] protocols.

Network Coding:  A system where coding can be performed at the source
        as well as at intermediate forwarding nodes (all or a subset
        of them).  End-to-End Coding can be regarded as a special
        case of Network Coding.  Depending on the use case,
        additional assumptions can be made: for instance the
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damson, et al.          Expires January 4, 2018              [Page 7]
nternet-Draft           Network Coding Taxonomy               July 2017

        knowledge by the destination of the coding node topology and
        coding operations can help during decoding operations.

Intra-Flow Coding, or Single Source Network Coding:  Process where
        incoming packets to the Coding Node belong to the same flow.

Inter-Flow Coding, or Multi-Source Network Coding:  Process where
        incoming packets to the Coding Node belong to different
        flows.

Single-Path Coding:  Network Coding over a route that has a single
        path from the source to each destination(s).  In case of
        multicast or broadcast traffic, this route is a tree.  Coding
        may be done end-to-end and/or at intermediate forwarding
        nodes.

Multi-Path Coding:  Network Coding over a route that has multiple (at
        least partially) disjoint paths from the source to each given
        destination.  Coding may be done end-to-end and/or at
        intermediate forwarding nodes.
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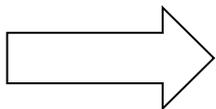
```
+------+-------+--------+----------------+-------+
+      | Upper | Middle | Communication layers  |
+      | Appl. | ware   |                |       |
+      +-------+--------+----------------+-------+
|      |Source | Network| Packetization  | PHY   |
|      |coding | AL-FEC | UDP/IP         | layer |
+------+-------+--------+----------------+-------+
|E2E   |   x   |        |                |       |
|NC    |       |        |                |   x   |
|IntraF|       |        |                |       |
|InterF|       |        |                |       |
|SP    |       |        |                |       |
|MP    |       |        |                |       |
+------+-------+--------+----------------+-------+
```

Figure 1: Network coding and satellite systems

Strategie – Opportunities for more network coding in satellite systems

Figure 1: Network coding and satellite systems

SoA

+

Feedback from EU or national projects, companies

Figure 1: Network coding and satellite systems

What do we need ?

- Step #1
  - Be volunteer to be a contributor and contribute...
    - Input needed in particular for sections 4 and 5 (project, company, etc.)
  - Collect other sub items in section 5
- Step #2
  - Agree with contributors for the plan
  - Nominate a contributor for each given part ?
- Step #3
  - Classification to better map with the taxonomy organization

How to contibute ?

- Send on the mailing-list your contributing text and relevant pointers to be included in the draft
- Do not send us
  - Link to EU project without text description
  - Raw slides
- Organization
  - We will organize remote meetings to integrate/validate each contributions

Questions ?

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