

# MPLS NETWORK ACTION (MNA) SUB-STACK SOLUTION (DRAFT-IETF-MPLS-MNA-HDR-01)

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# ABBREVIATIONS

<b>Abbreviations</b>	<b>Meaning</b>
AD	Ancillary Data
HBH	Hop-By-Hop Scope
I2E	Ingress-To-Egress Scope
IHS	Ingress-To-Egress, Hop-By-Hop, Select Scope
ISD	In-Stack Data
LSE	32-Bit Label stack Entry
MNA	MPLS Network Action
NA	Network Action
NAI	Network Action Indicator
NAL	Length of Network Action in number of LSEs
NASL	Length of Network Action Sub-Stack in number of LSEs
NAS	Network Action Sub-Stack
NASI	Network Action Sub-Stack Indicator
U	Unknown Opcode Handling

# AGENDA

- Scope
- High Level Solution
  - Network Action Sub-Stack Header
  - Network Action LSE Formats
  - Network Action Sub-Stack Examples
- Reserved In-Stack Network Action Opcodes
- Next Steps

# SCOPE

- Solution for MNA Encoding Formats Carried in MPLS Label Stack
- Address MNA Requirements [draft-ietf-mpls-mna-requirements]
- Align with MNA Framework [draft-ietf-mpls-mna-fwk]

## Note:

- Post-Stack Network Action defined in [draft-jags-mpls-ps-mna-hdr]

# HIGH-LEVEL SOLUTION

MPLS Network Action (MNA) header contains two parts:

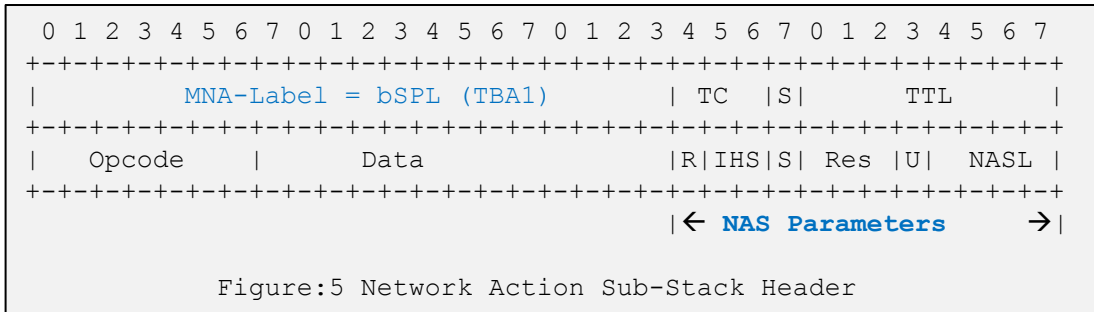
## 1. Network Action Sub-Stack Header

- a. Label to indicate the presence of Network Action Sub-Stack (NASI)
- b. NAS encoding parameters indicating the structure of NAS
  - Includes Scope, Ordering, Length, etc. parameters of NAS

## 2. Network Action LSE Formats

- a. Network Action is encoded in **TLV** format
  - **T**ype – Network Action Opcode
  - **L**ength – Network Action Length (NAL)
  - **V**alue – Ancillary Data (optional)

# MPLS NETWORK ACTION SUB-STACK HEADER

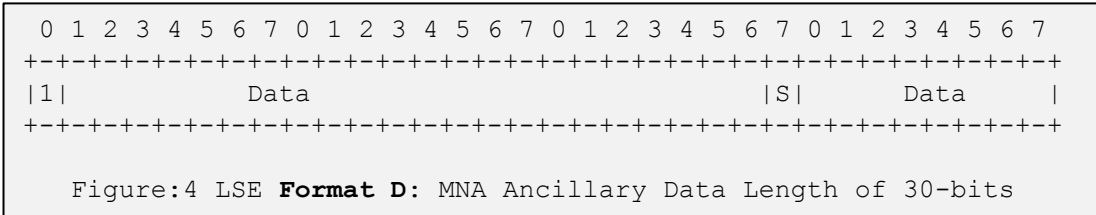
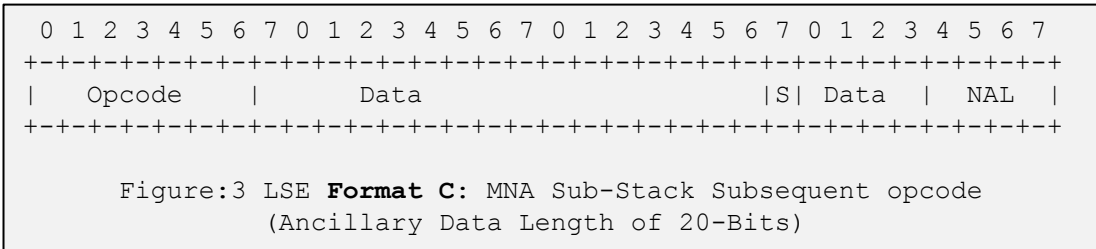
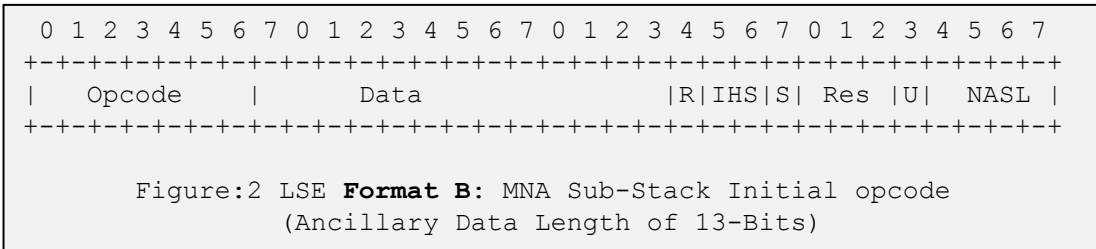
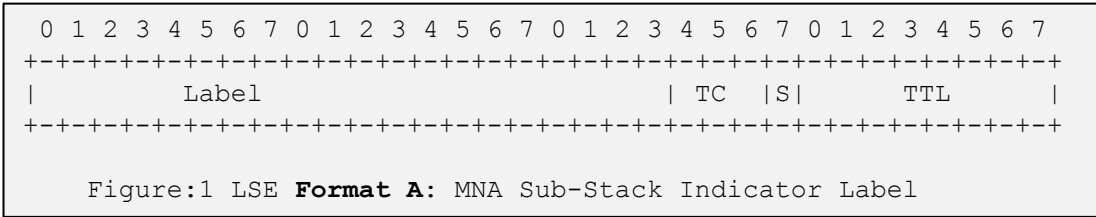


Network Action Sub-Stack Header Contains **MNA Label** and **NAS Encoding Parameters**.

**MNA-Label:** A new bSPL value (value TBA1) is assigned to indicate the presence of the MPLS Network Action Sub-Stack (NAS).

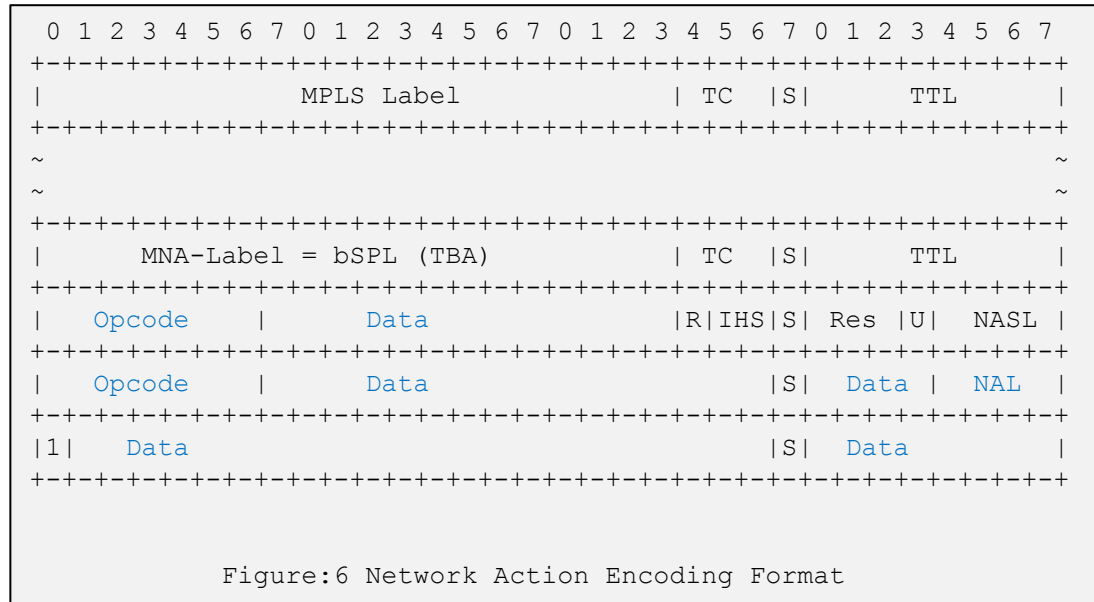
**NAS Parameters:** The TTL and TC fields in the second LSE are used to encode NAS encoding parameters. These parameters are common for all NAIs encoded in this NAS. The NAS encoding parameter contains Scope, Unknown Action Flag and Sub-Stack Length.

# MPLS NETWORK ACTION LSE FORMATS



- Opcode (7 Bits):** Seven bits value indicates a specific Network Action
- Data (Variable):** Ancillary Data carried for the respective Opcode
- R (1 Bit):** Reserved
- IHS (2 Bits):** Two-Bit value indicates the scope of the NAS (I2E (0) or HBH (1) or Select (2))
- Res (3 Bits):** Reserved
- U (1 Bit):** Unknown Opcode handling Bit
- NASL (4 Bits):** Four bits value indicates the Network Action Sub-Stack Length in number of LSEs following
- NAL (4 Bits):** Four bits value indicates a Network Action Length specific to an opcode in number of LSEs following

# NETWORK ACTION SUB-STACK - MULTIPLE NA EXAMPLE



Network Actions are encoded in the **TLV** Format.

**Opcode (Type)** : 7-bit value indicates the NAI Opcode value. This In-Stack NAI-Opcode will use an IANA registry to allocate the opcodes

**NAL (Length)** (Network Action Length): 4-bit value to indicate additional LSEs used to encode Ancillary Data

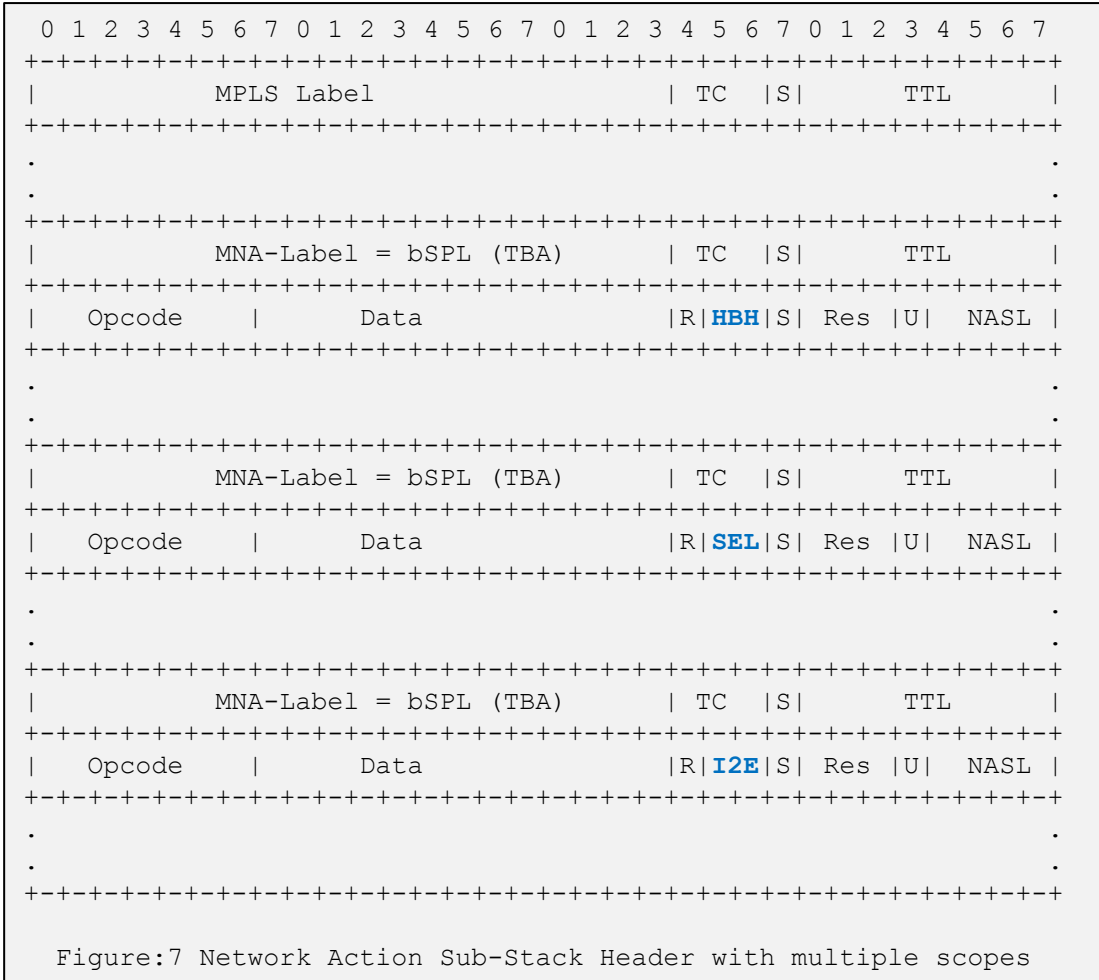
**Data (Value)**: Ancillary Data carried to process Network Action corresponding to the NAI-Opcode

**LSE Format B** Network Action encoding contains a fixed Ancillary Data length of 13 bits.

**LSE Format C** Network Action encoding contains a variable Ancillary Data length (Max:  $15 \times 30 + 20 = 470$  bits). This depends on the NAL value that is encoded. Opcode LSE itself carries  $(16+6=)$  20-bits of Ancillary Data.



# NETWORK ACTION SUB-STACK - MULTIPLE SCOPE EXAMPLE



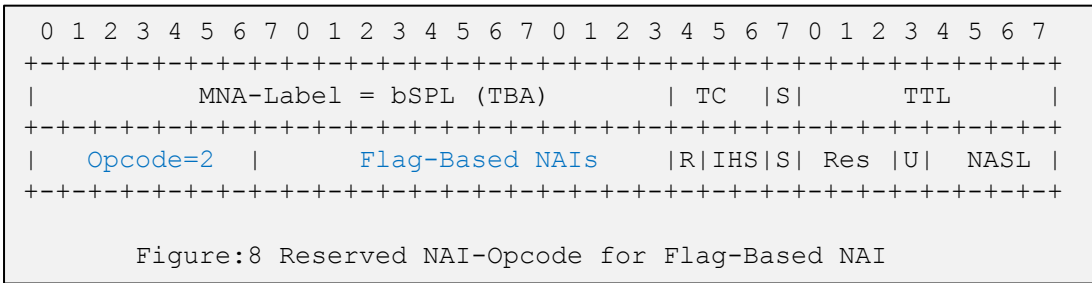
NAS has 2-bit scope for:

- **I2E Scope (Ingress-To-Egress, value 00b):** This NAS is processed only on the Egress Node.
- **HBH Scope (Hop-By-Hop, value 01b):** This NAS is processed on all the nodes on the path of the packet.
- **SEL Scope (select scope, value 10b):** This NAS is processed only on the select nodes.

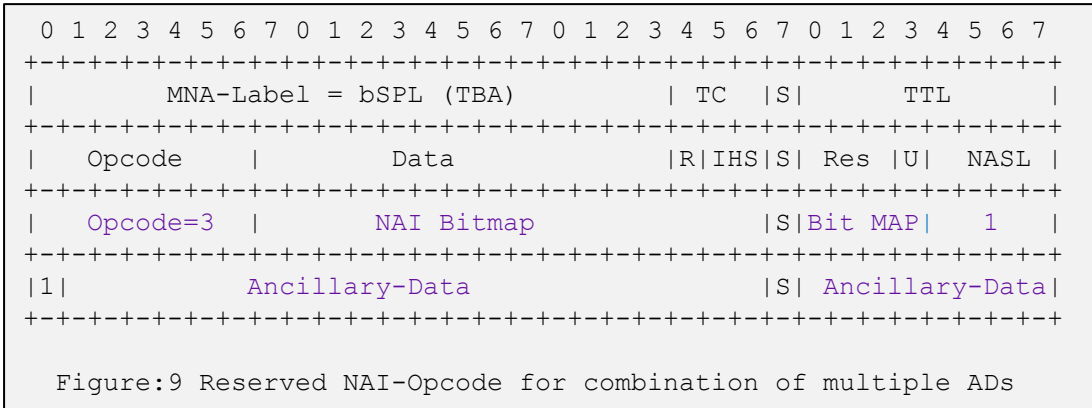
Separate NAS based on the scope makes it easier for the midpoint nodes to only process HBH/Select scoped NAS.

The MPLS stack may carry up to three different scoped NAS.

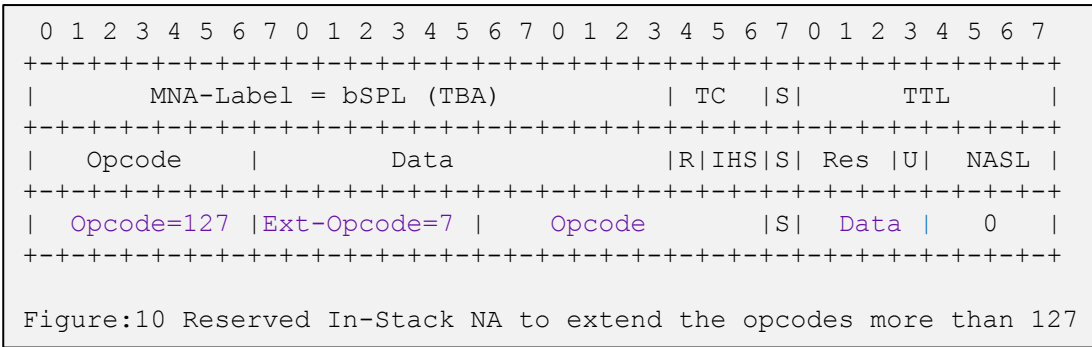
# RESERVED IN-STACK NETWORK ACTION OPCODES



**Reserved NAI-Opcode Value:2 (Flag-Based NAIs)** – Opcode reserved to carry Flag-Based NAIs. This Opcode does not require any Ancillary Data to process the Network Action. The Flag Bits offset value are read from Left to Right.



**Reserved NAI-Opcode Value:3 (Combination of Multiple NAIs)** – Opcode reserved to carry combination of Multiple NAIs that May require AD. In this case the, 3<sup>rd</sup> LSEs AD carries set of NAI Bit Maps and the next LSEs carries 30-bit of AD corresponding to NAI Bit Map encoded.



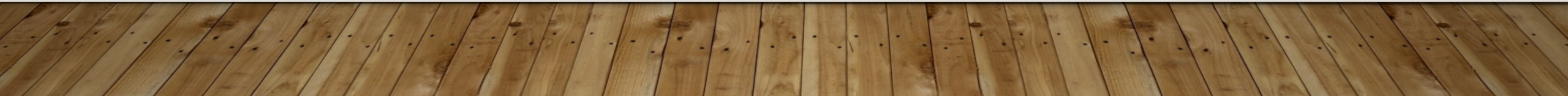
**Reserved NAI-Opcode Value:127 (Opcode Extension)** – Opcode reserved to extend the NAI-Opcode value beyond value 127.

# NEXT STEPS

- Welcome your review comments and feedbacks
- Address pending review comments
  - Opcode = 3 (NAI Flags with AD)
    - Authors discussed and are ok to remove
    - Waiting for Chairs Go-ahead to update the draft
- Early IANA Allocation of Code-points (bSPL)

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**THANK YOU!**



# POST-STACK MPLS NETWORK ACTION SOLUTION (DRAFT-JAGS-MPLS-PS-MNA-HDR-00)

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# ABBREVIATIONS

<b>Abbreviations</b>	<b>Meaning</b>
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IHS	Ingress-To-Egress, Hop-By-Hop, Select Scope
ISD	In-Stack Data
LSE	32-Bit Label stack Entry
MNA	MPLS Network Action
PS-NA	Post-Stack Network Action
NAI	Network Action Indicator
NAL	Length of Network Action in number of LSEs
NASL	Length of Network Action Sub-Stack in number of LSEs
NAS	Network Action Sub-Stack
NASI	Network Action Sub-Stack Indicator
P	Post-Stack Network Action Presence
PSD	Post-Stack Data
U	Unknown Opcode Handling

# AGENDA

- Scope
- High Level Solution
  - Post-Stack Network Action Indicator
  - Post-Stack Network Action Top Header
  - Post-Stack Network Action Header
- Reserved In-Stack Network Action Opcodes
- Post-Stack Network Action Encoding Examples
- Next Steps

# SCOPE

- Solution for Post-Stack MNA Encoding
- Address MNA Requirements [draft-ietf-mpls-mna-requirements]
- Align with MNA Framework [draft-ietf-mpls-mna-fwk]
- Based on the In-Stack MNA Solution defined in [draft-ietf-mpls-mna-hdr]



# HIGH-LEVEL SOLUTION

MPLS Network Action (MNA) header contains two parts:

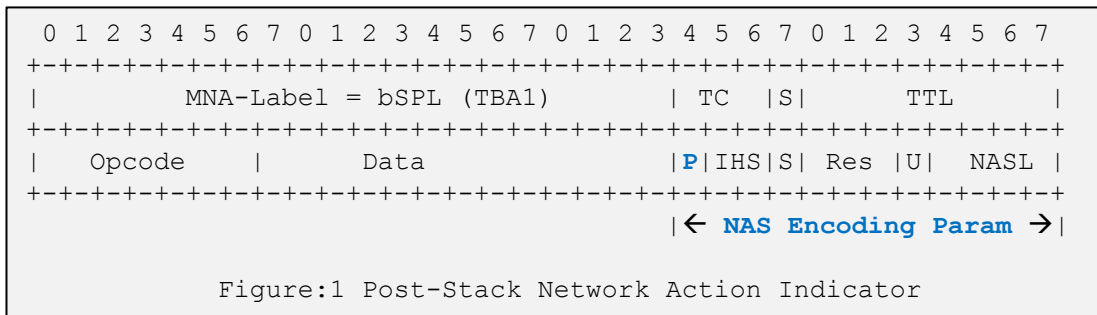
## 1. **Post-Stack Network Action Indicator**

- a. “P” Bit in the NAS parameters indicates the presence of Post-Stack Data
- b. The scope field in the NAS parameters indicates the corresponding Post-Stack Data Scope
- c. The U field in the NAS parameters indicated the Unknown Post-Stack Opcode handling

## 2. **Post-Stack Network Action Encoding**

- a. Post-Stack Network Action Top Header
- b. Post-Stack Network Action Encoding

# POST-STACK NETWORK ACTION INDICATOR



Network Action Sub-Stack Header Contains **MNA Label** and **NAS Encoding Parameters**.

**MNA-Label:** A new bSPL value (value TBA1) is assigned to indicate the presence of the MPLS Network Action Sub-Stack (NAS).

**NAS Parameters:** The TTL and TC fields in the second LSE are used to encode NAS encoding parameters. These parameters are common for all NAIs encoded in this NAS. The NAS encoding parameter contains:

**P (1 Bit):** Indicates the presence of the Post-Stack MNA

**IHS (2 Bit):** Indicates the combined scope of the In-Stack and the Post-Stack Network Actions

**U (1 Bit):** Indicates the combined Unknown Action Handling of the In-Stack and the Post-Stack Network Actions

# POST-STACK NETWORK ACTION TOP HEADER

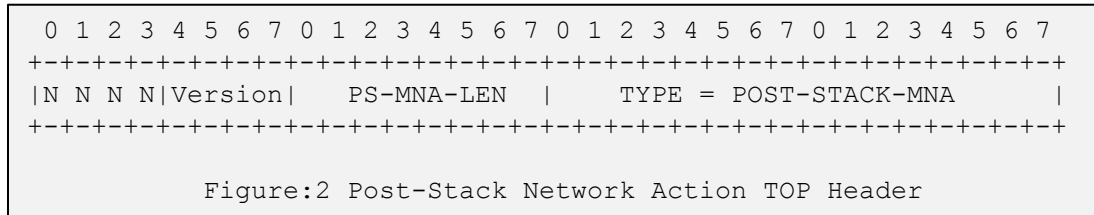
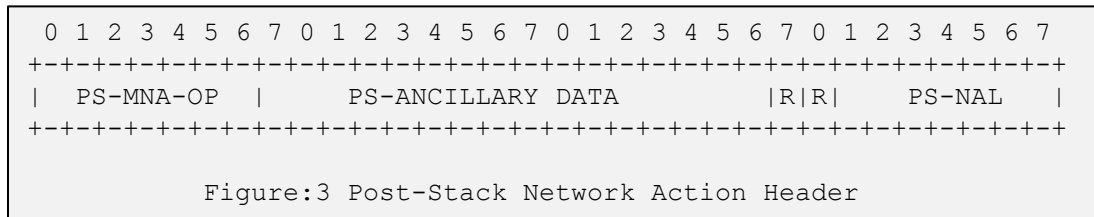


Figure:2 Post-Stack Network Action TOP Header

## Network Actions Top Header encoding Format:

- **NNNN (4 bits):** This first nibble at the start of the Post-Stack Network Action.
- **Version (4 bits):** Post-Stack MNA version
- **PS-MNA-LEN (8 bits):** Post-Stack MNA Total Length in words
- **TYPE (16 bits):** Type is set to POST-STACK-MNA. In case of Generic Associated Channel, this is a channel-type

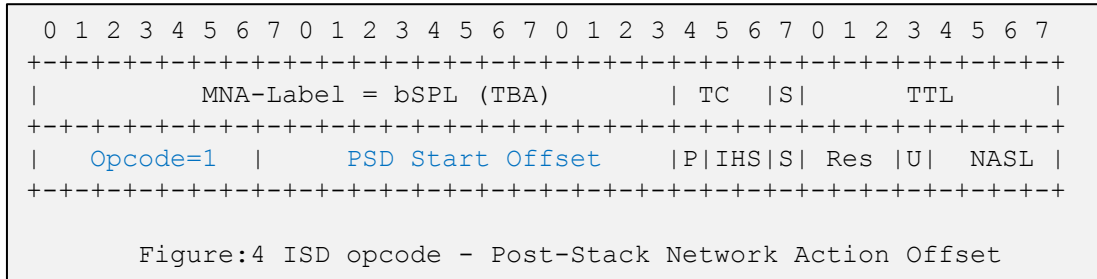
# POST-STACK NETWORK ACTION HEADER



## Network Actions Header encoding Format.

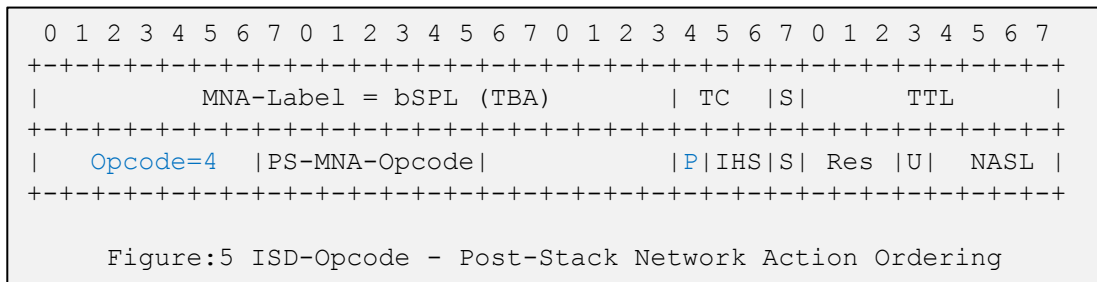
- **PS-MNA-OP (7 bits)** : Post-Stack Network Action Opcode. Opcode “0” is reserved and other opcodes will be assigned by IANA.
- **PS-ANCILLARY DATA (16 bits)**: Post-Stack Ancillary data associated by the Network Action opcode. Rest of the data is encoded after this header.
- **R (2 bits)**: Reserved Bits.
- **PS-NAL (7 bits)**: Post-Stack Network Length for the respective Network Action. This value is in the order of words excluding current word.

# RESERVED NETWORK ACTION IS-STACK OPCODES



**Reserved NAI-Opcode Value:1 (Post-Stack Network Action Offset) [Optional]** – In the case where the PSD is not encoded right after the MPLS BoS, this opcode indicates the offset from the MPLS BoS in units of words where the PSD is encoded. If this opcode is not encoded in the ISD, then the PSD encoding will start right after the MPLS BoS. This gives flexibility to encode the PSD anywhere after the MPLS BoS.

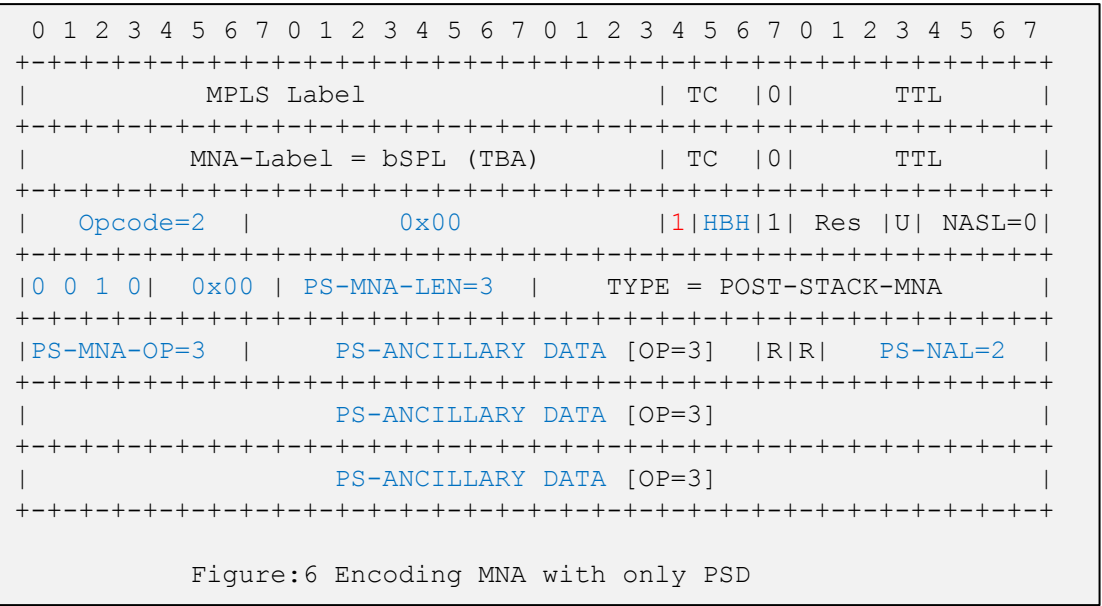
ISD LSE Formats: B



**Reserved NAI-Opcode Value:4 (Post-Stack, In-Stack NA ordering) [Optional]** – In the cases where the ordering of network action is required and where some of the network action resides in Post-Stack Network Action, this opcode can be used to insert Post-Stack Network Actions into the order of execution.

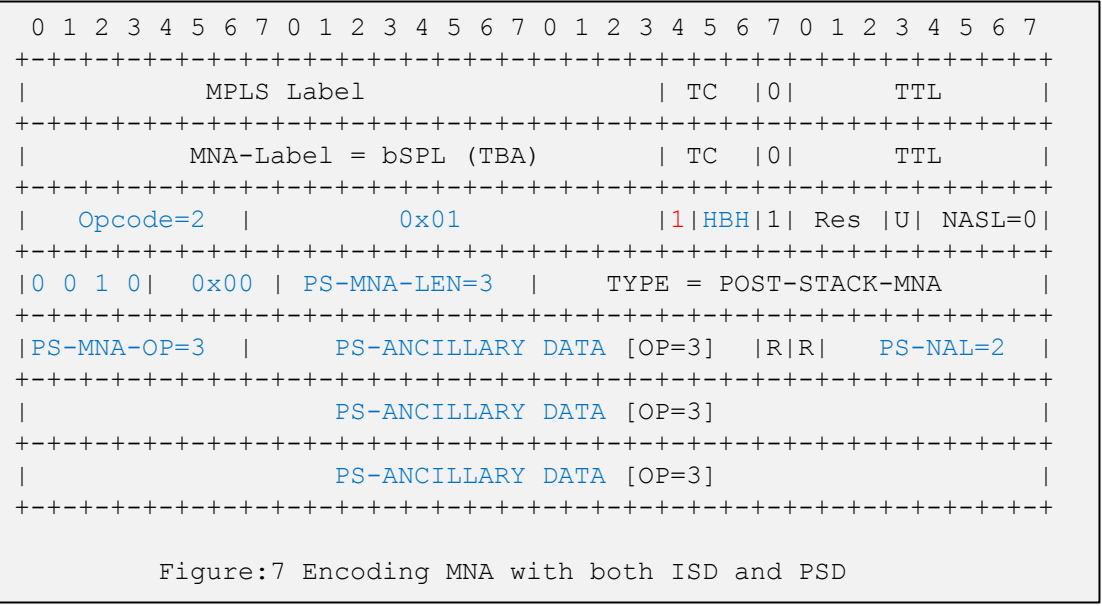
ISD LSD Formats: B, C, D

# POST-STACK ENCODING – ONLY PSD EXAMPLE



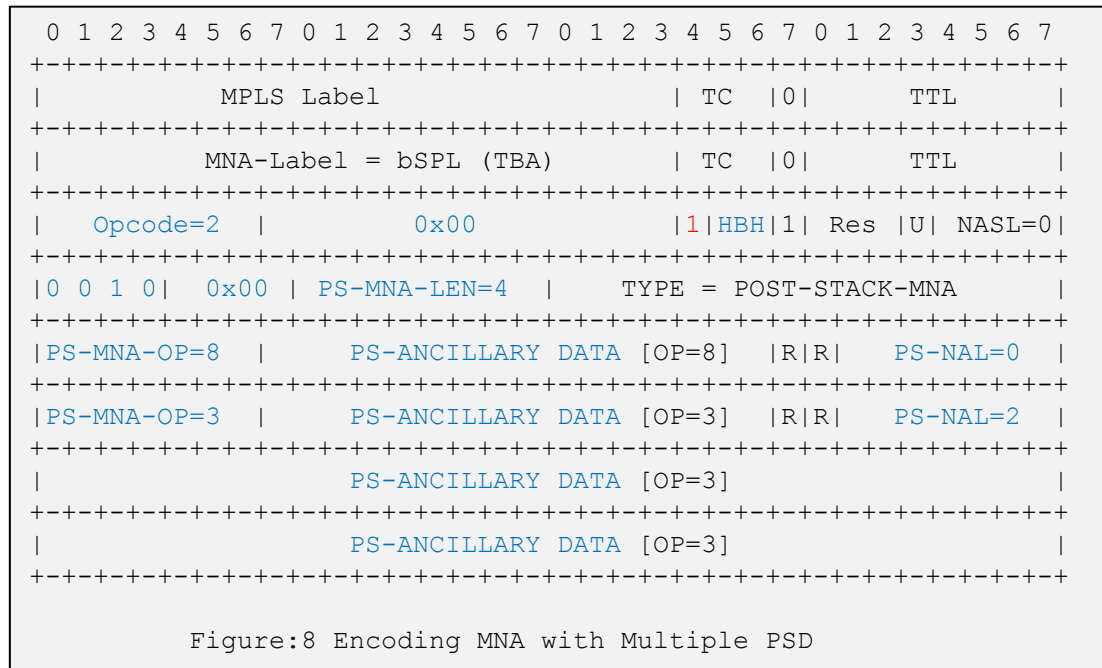
- **ISD Opcode: "2"** – Flags Based ISD opcode without Ancillary Data
  - **ISD Ancillary Data: "0x0"** – No Flags encoded
  - **P Bit: "1"**
- 
- **NNNN Bit: 0 0 1 0** (0x02 allocated Example by IANA) indicates PSD
  - **PS-MNA-LEN:** Total Length of PSD is 3 words
  - **PS-MNA-OP:** The opcode value "3"
  - **PS-NAL:** Total length of Post-Stack Ancillary data that is encoded for the Post-Stack NA opcode "3"

# POST-STACK ENCODING – BOTH ISD AND PSD EXAMPLE



- **ISD Opcode: "2"** – Flags Based ISD opcode without Ancillary Data
  - **ISD Ancillary Data: "0x1"** – ISD Flag 0x01 is set
  - **P Bit: "1"**
- 
- **NNNN Bit: 0 0 1 0 (0x02)** indicates PSD (IANA Allocated Example)
  - **PS-MNA-LEN:** Total Length of PSD is 3 words
  - **PS-MNA-OP:** The opcode value "3"
  - **PS-NAL:** Total length of Post-Stack Ancillary data that is encoded for the Post-Stack NA opcode "3"

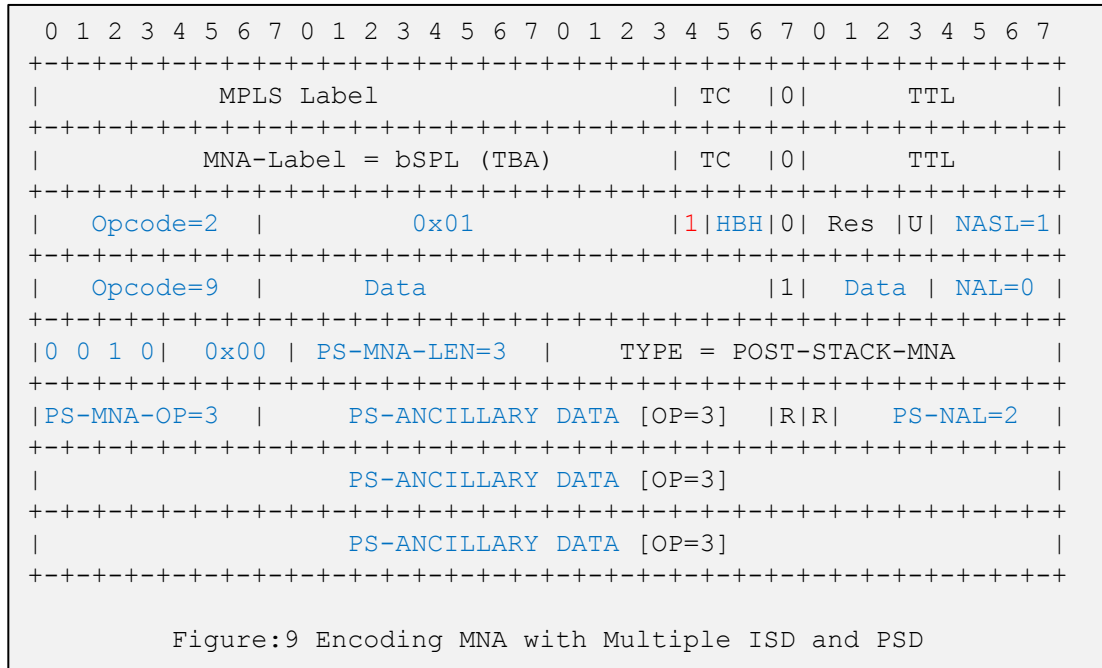
# POST-STACK ENCODING – MULTIPLE PSD EXAMPLE



- **ISD Opcode: "2"** – Flags Based ISD opcode without Ancillary Data
  - **ISD Ancillary Data: "0x0"** – No Flags encoded
  - **P Bit: "1"**
- 
- **NNNN Bit: 0 0 1 0 (0x02)** indicates PSD (IANA Allocated Example)
  - **PS-MNA-LEN:** Total Length of PSD is 4 words
  - **PS-MNA-OP:** The opcode value "8"
  - **PS-NAL:** Total length of Post-Stack Ancillary data that is encoded for the Post-Stack opcode "8"
  - **PS-MNA-OP:** The opcode value "3"
  - **PS-NAL:** Total length of Post-Stack Ancillary data that is encoded for the Post-Stack opcode "3"

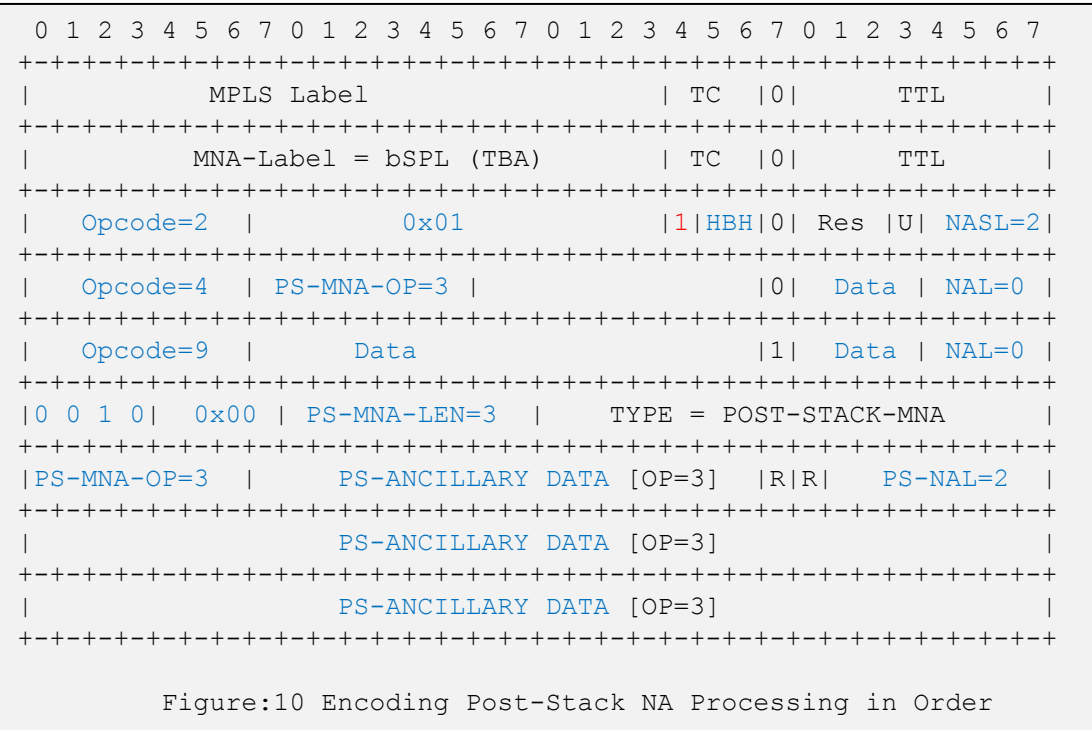


# POST-STACK ENCODING – MULTIPLE ISD AND PSD EXAMPLE



- **ISD Opcode: “2”** – Flags Based ISD opcode without Ancillary Data
  - **ISD Ancillary Data: “0x1”** – ISD Flag 0x01 is set
  - **P Bit: “1”**
- 
- **ISD Opcode: “9”** – App reserved opcode “9” with AD
  - **ISD Ancillary Data: Data** – Data encoded for opcode “9”
- 
- **NNNN Bit: 0 0 1 0 (0x02)** indicates PSD (IANA Allocated Example)
  - **PS-MNA-LEN:** Total Length of PSD is 3 words
  - **PS-MNA-OP:** The opcode value “3”
  - **PS-NAL:** Total length of Post-Stack Ancillary data that is encoded for the Post-Stack opcode “3”

# POST-STACK ENCODING – NETWORK ACTION PROCESSING IN ORDER



- **ISD Opcode: “2”** – Flags Based ISD opcode without Ancillary Data
  - **ISD Ancillary Data: “0x1”** – ISD Flag 0x01 is set
  - **P Bit: “1”**
- 
- **ISD Opcode: “4”** – Indicates the need for ISD/PSD processing in order
  - **ISD Ancillary Data: Data** – Encodes PS MNA opcode 3, that needs to be executed before processing ISD opcode “9”
- 
- **ISD Opcode: “9”** – App reserved opcode “9” with AD
  - **ISD Ancillary Data: Data** – Data encoded for opcode “9”
- 
- **NNNN Bit: 0 0 1 0 (0x02)** indicates PSD (IANA Allocated Example)
  - **PS-MNA-LEN:** Total Length of PSD is 3 words
  - **PS-MNA-OP:** The opcode value “3”
  - **PS-NAL:** Total length of Post-Stack Ancillary data that is encoded for the Post-Stack opcode “3”

# ADVANTAGES

- The solution defined is backwards compatible
  - It can co-exist with the GACH and CW information after the BOS
- The solution defined naturally extends the In-Stack MNA solution
  - Using the similar encoding of TLV with Opcode, Length and Variable length Data
  - A node can "skip processing or drop the packet" for the unknown opcodes using the same U flag

## NEXT STEPS

- Welcome your review comments and feedbacks
- Address review comments (from Greg, Loa, et al.)
  - Value to use as the first Nibble NNNN after BOS
  - Options IANA assigned or “0 0 0 0” or GACH (0 0 0 1)
- Requesting working group adoption

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THANK YOU!