

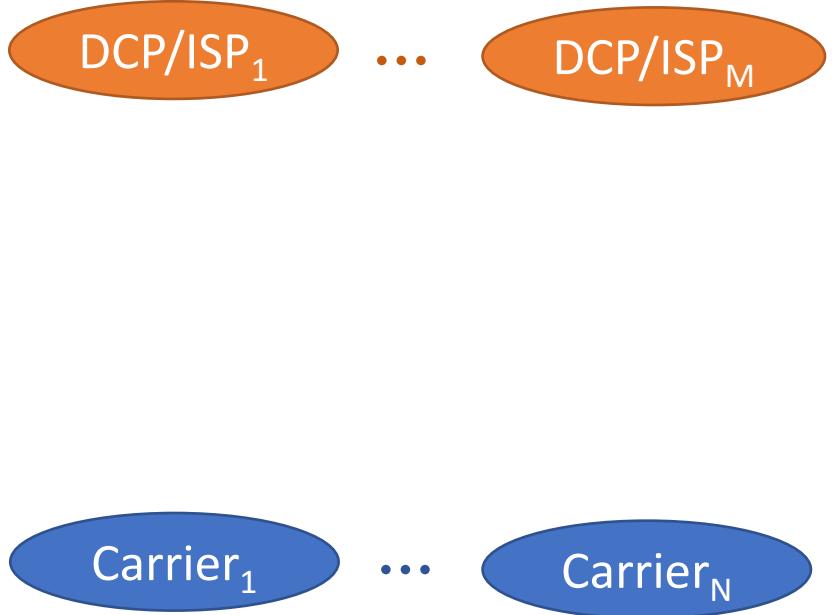
# Task 4: Preemptive Failure Detection and Management

March 3, 2023

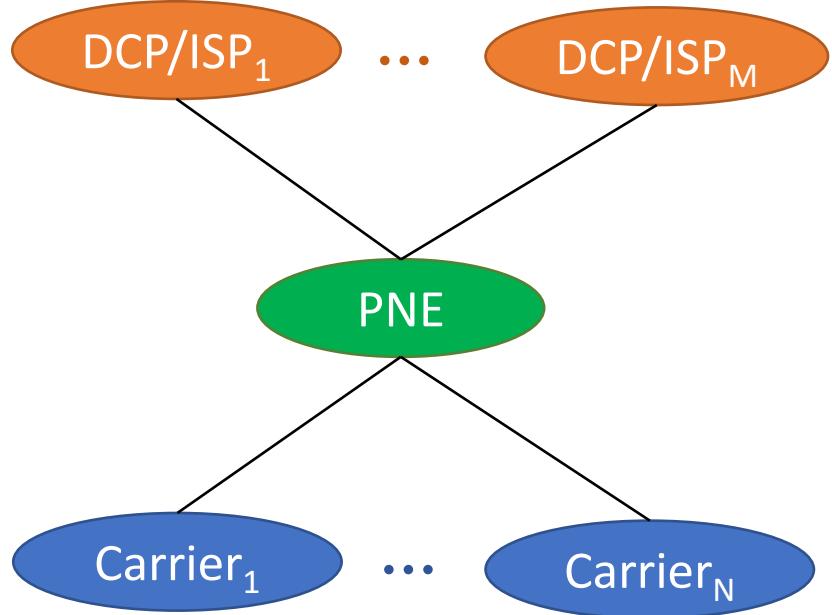
Presented by:  
Forough Shirin Abkenar

# General System Architecture

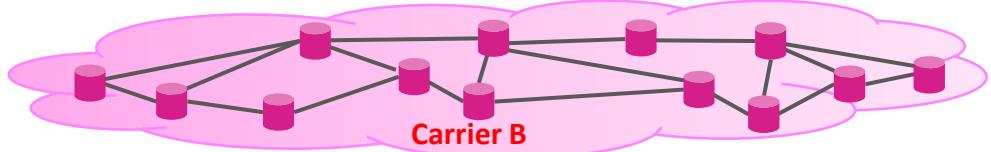
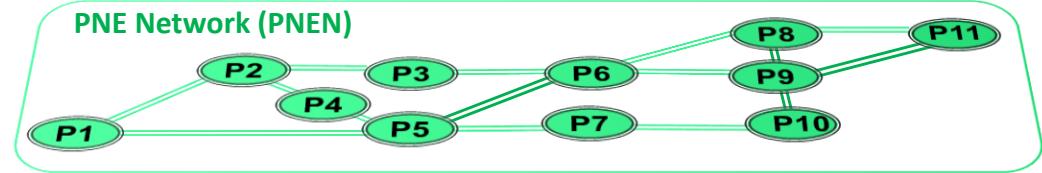
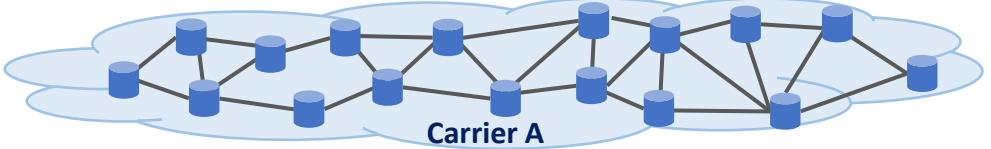
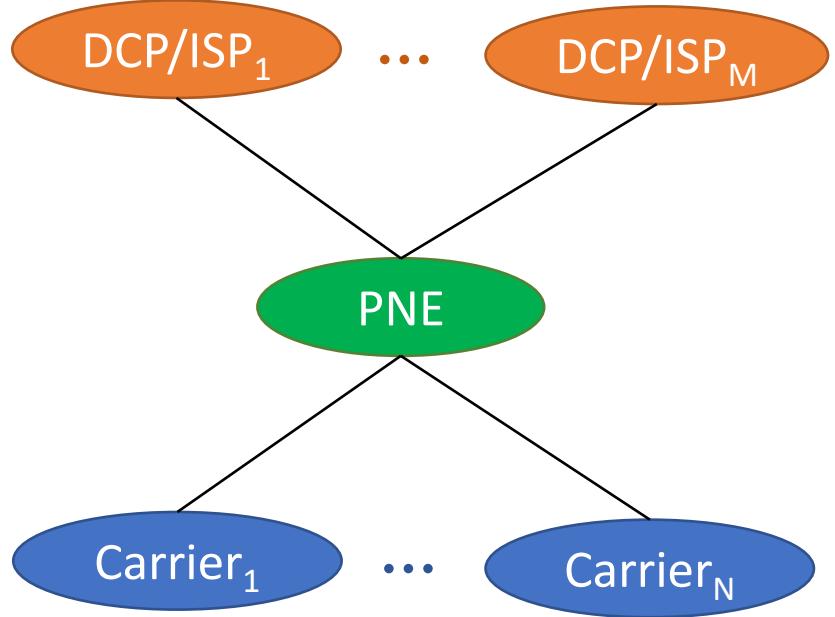
# General System Architecture



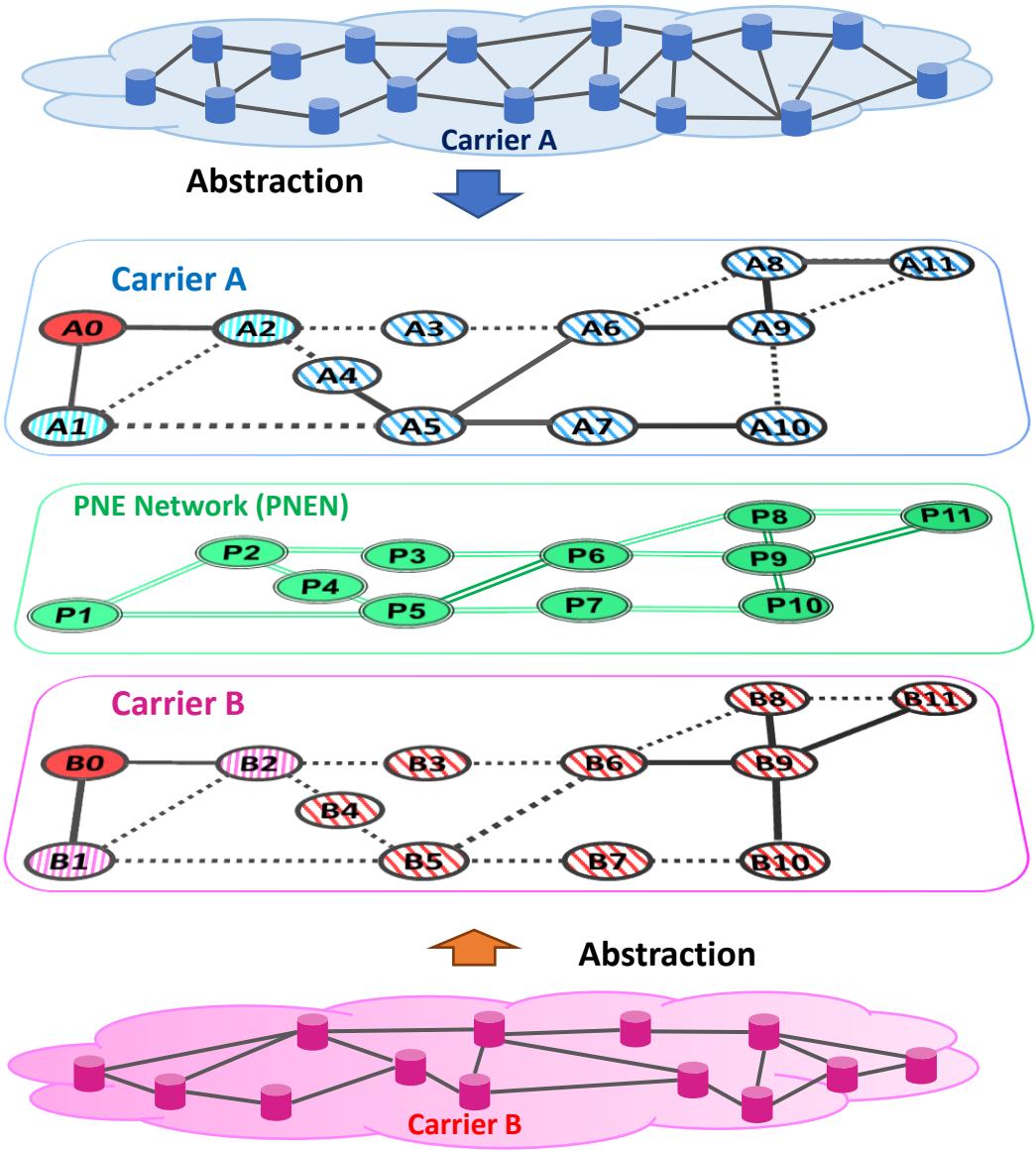
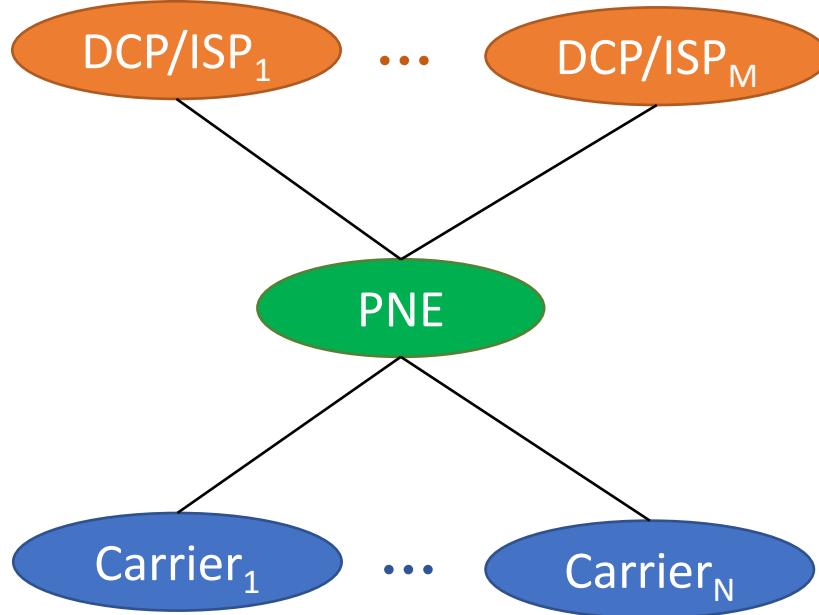
# General System Architecture



# General System Architecture

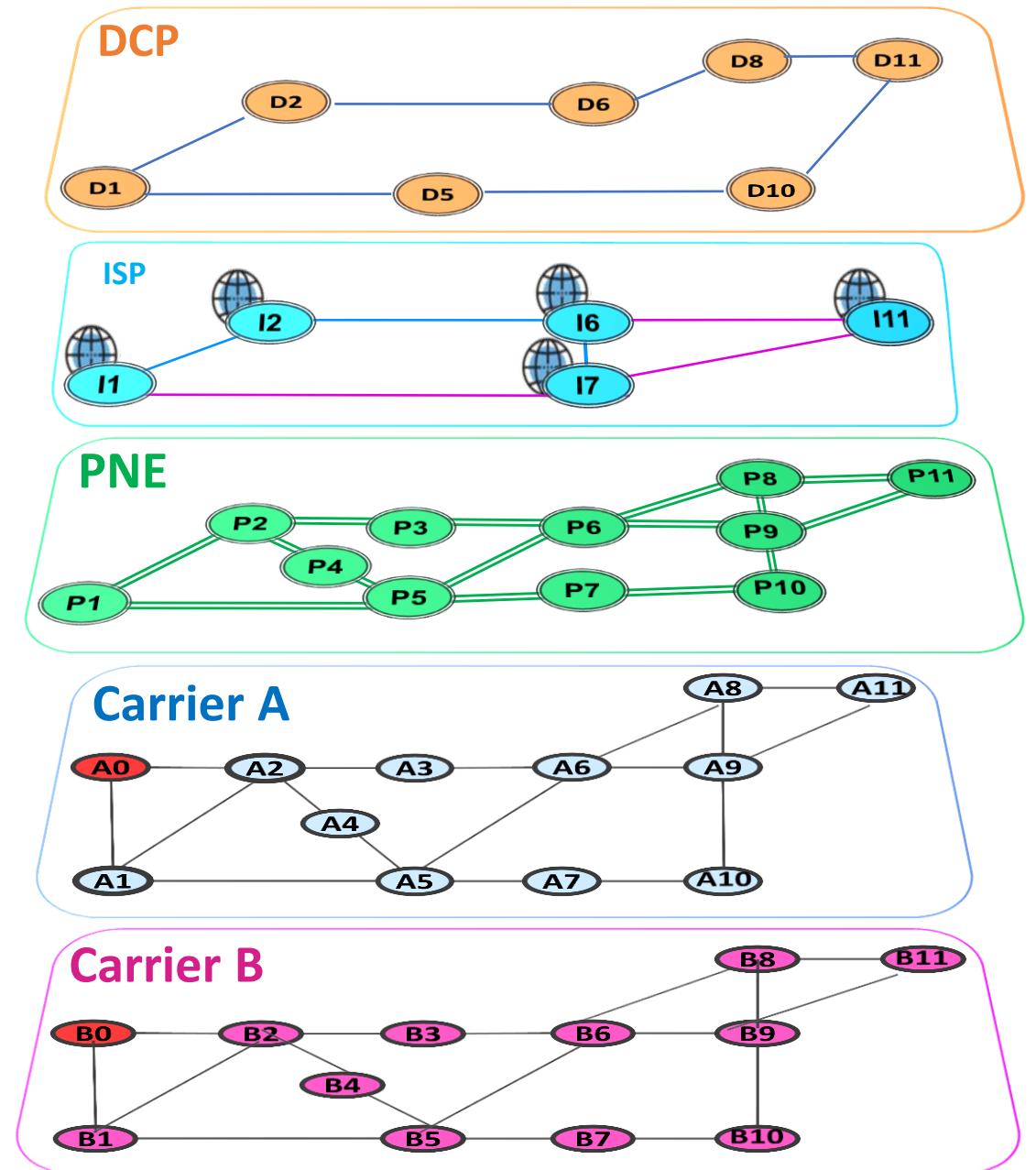
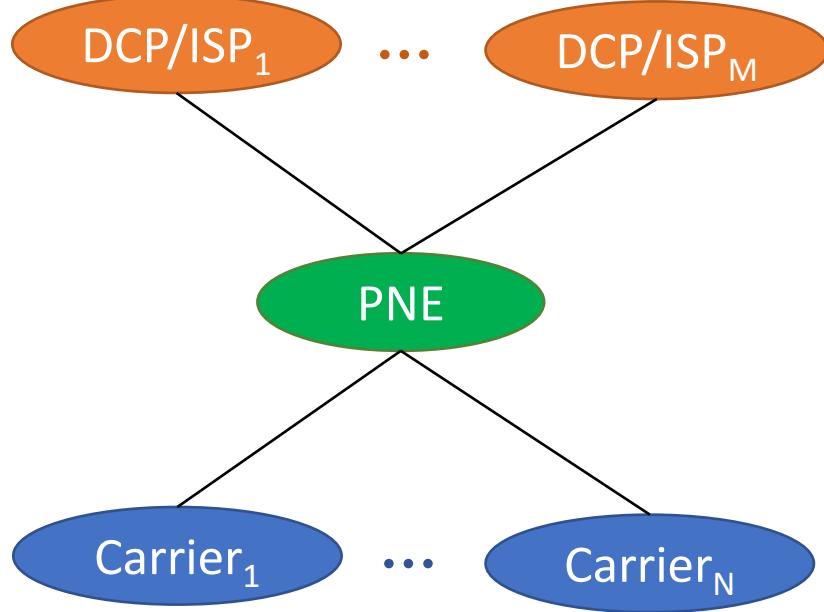


# General System Architecture



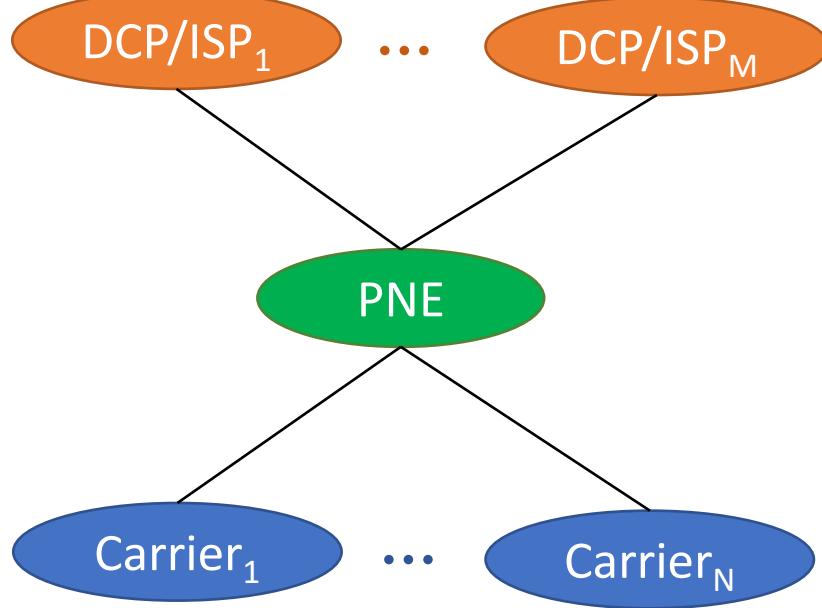
Acknowledgement: US-Japan JUNO2 and JUNO3 projects: NSF Grant no. 1818972 and 2210384

# General System Architecture

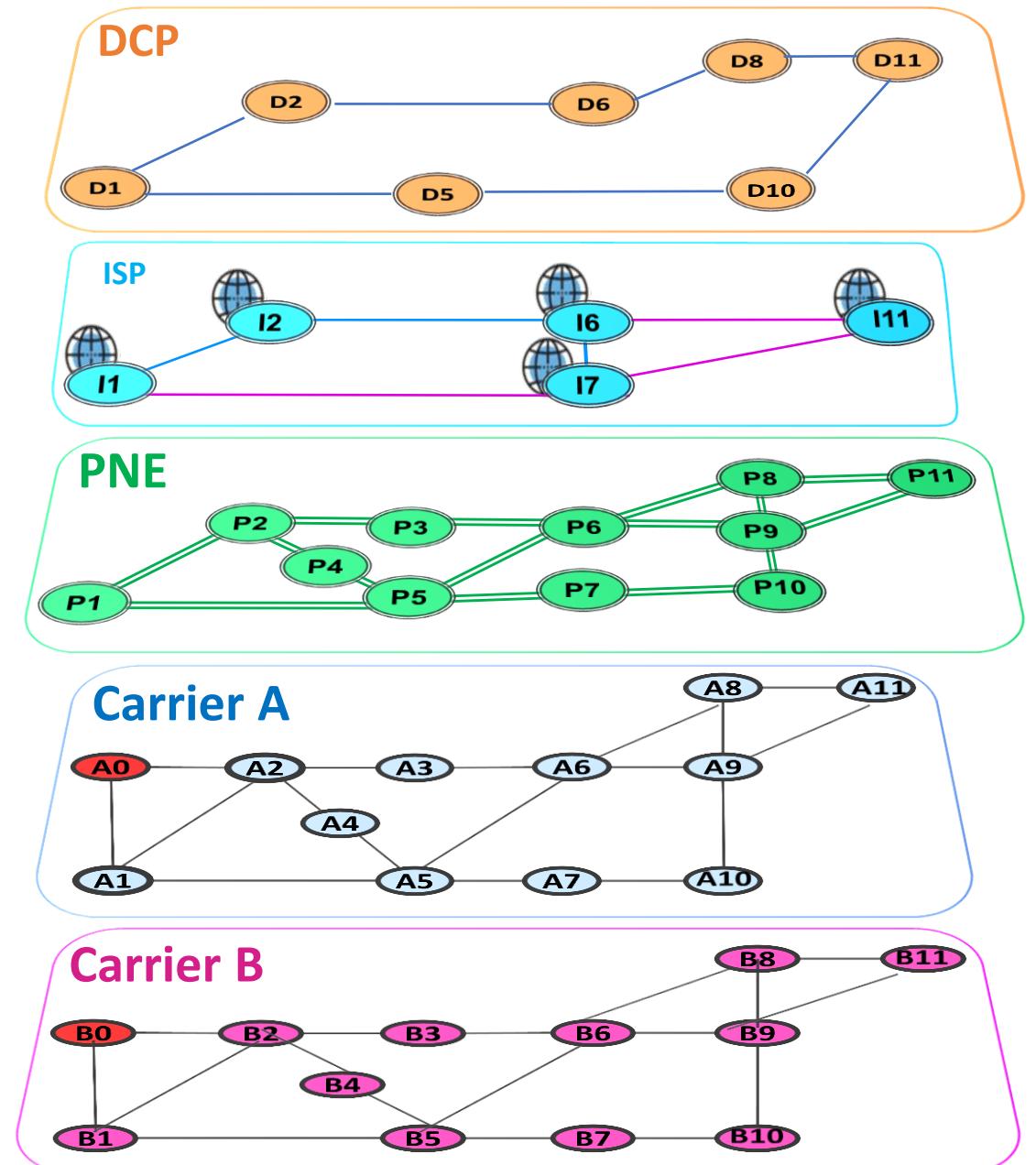


Acknowledgement: US-Japan JUNO2 and JUNO3 projects: NSF Grant no. 1818972 and 2210384

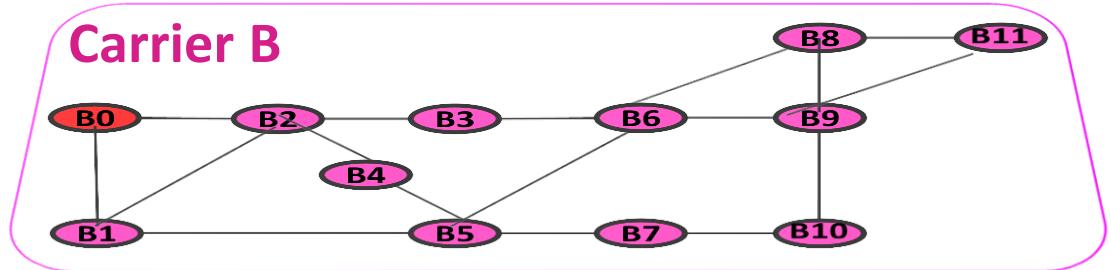
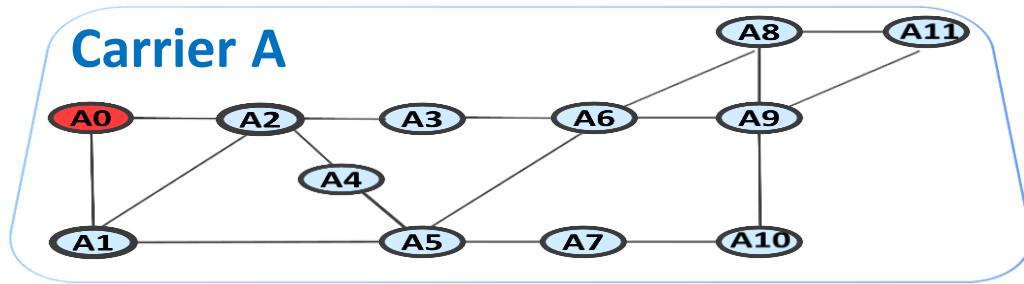
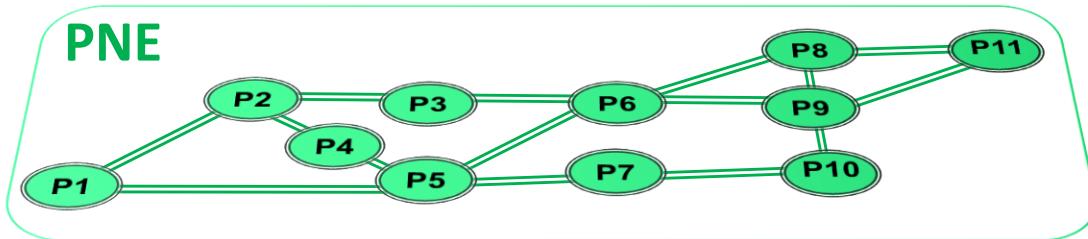
# General System Architecture



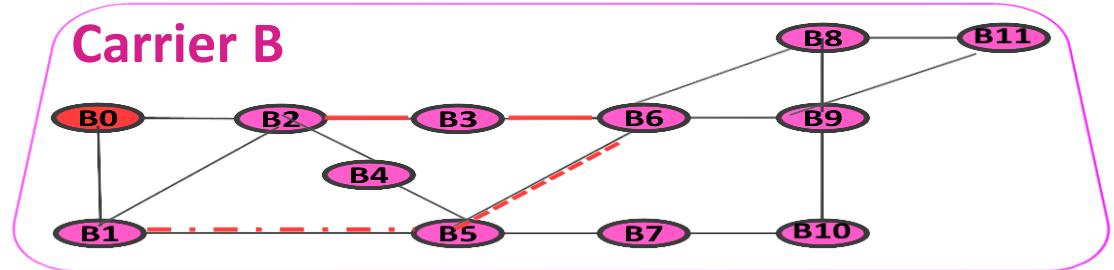
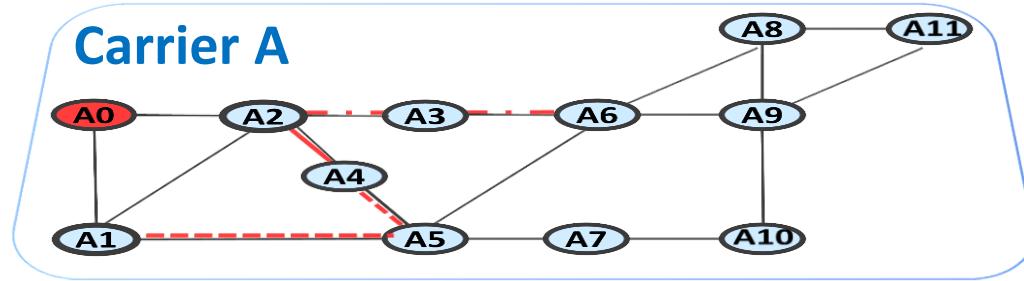
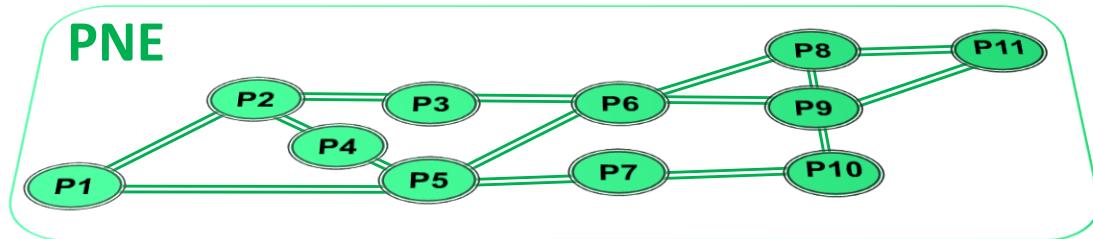
**Reliable cooperation across multiple entities requires robust physical-layer-aware failure management**



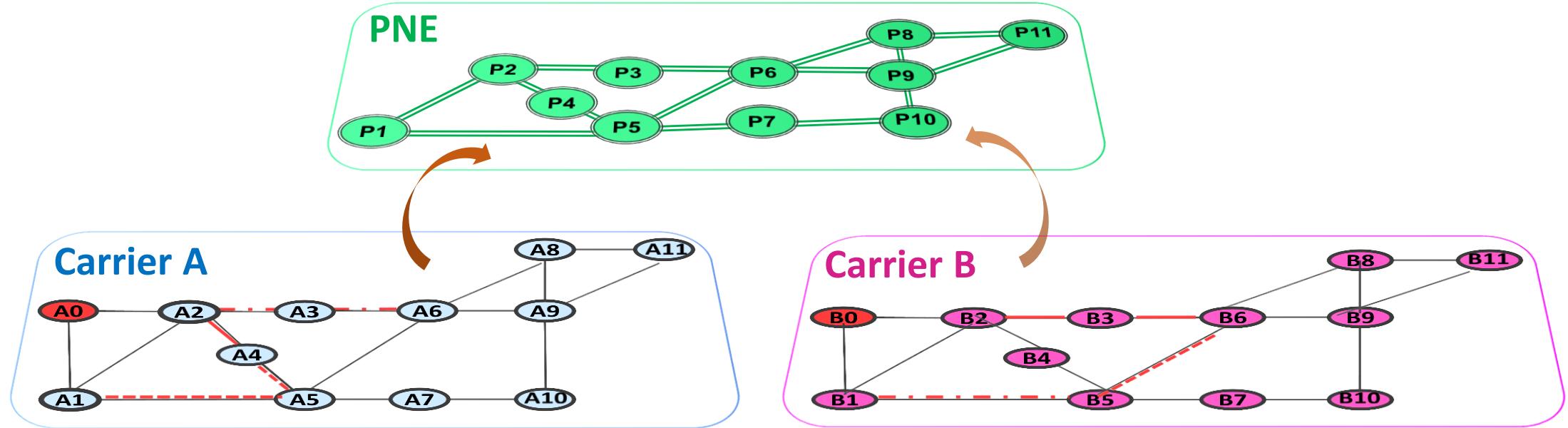
# Preemptive Failure Detection and Management



# Preemptive Failure Detection and Management

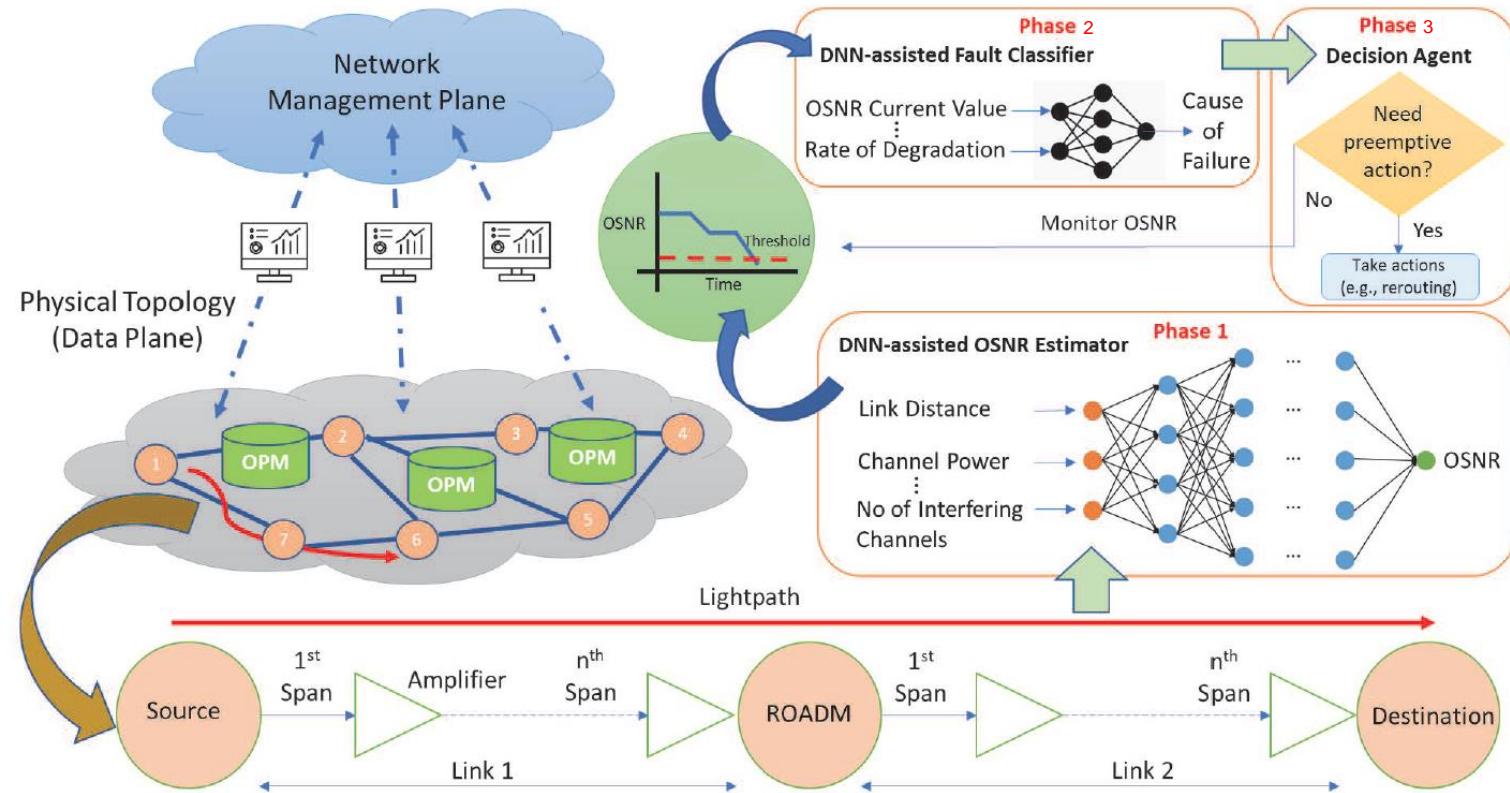


# Preemptive Failure Detection and Management



*Degradation/disconnection at the physical layer needs  
preemptive detection and management*

# General Overview of The Proposed Framework in Single Entity



Preemptive failure detection and management (PFDM) framework

# From Local to Federated

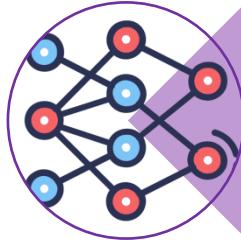


# From Local to Federated



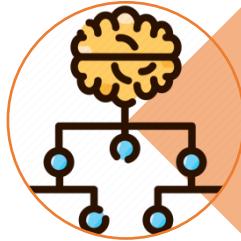
**Federated Survivability Framework in Multi-Domain Optical Networks**

# Phases of The Proposed Framework



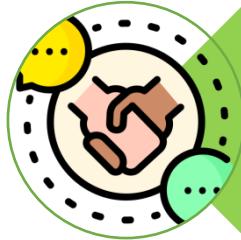
## Phase I

- Abstraction and OSNR Estimation



## Phase II

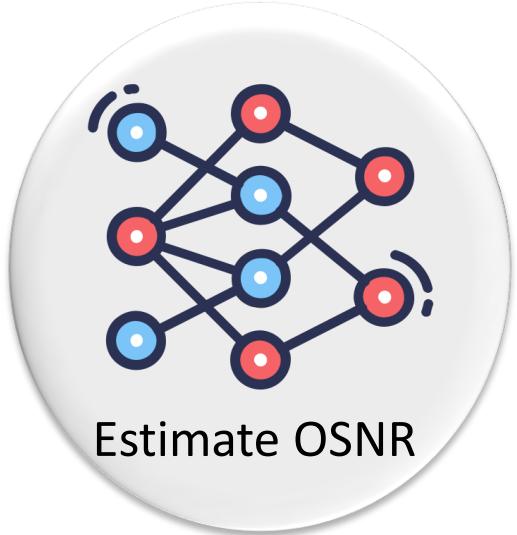
- Failure Classification and Cost Evaluation



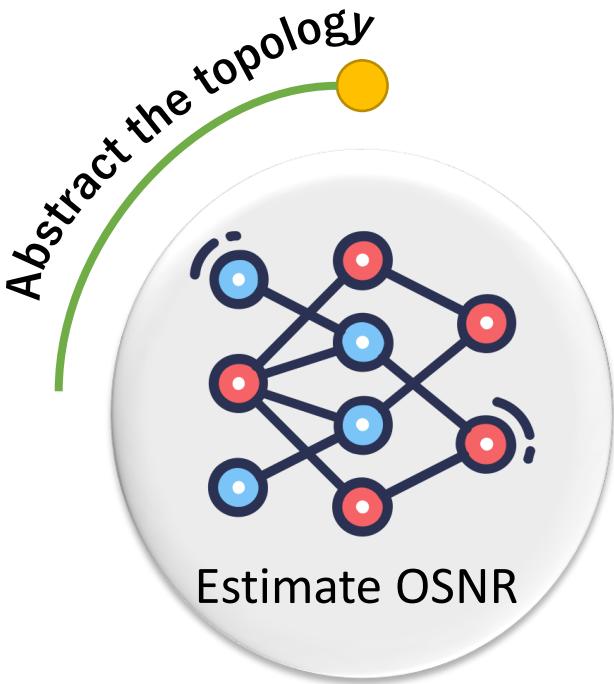
## Phase III

- Negotiation and Post-Failure Action

# Flow of The Proposed Framework

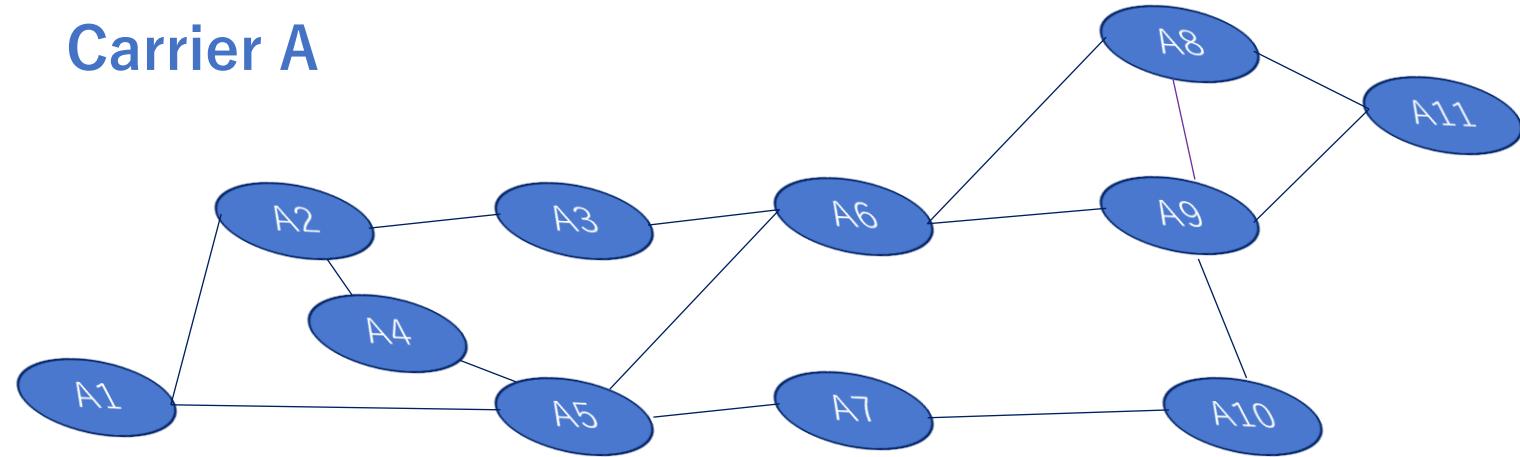


# Flow of The Proposed Framework

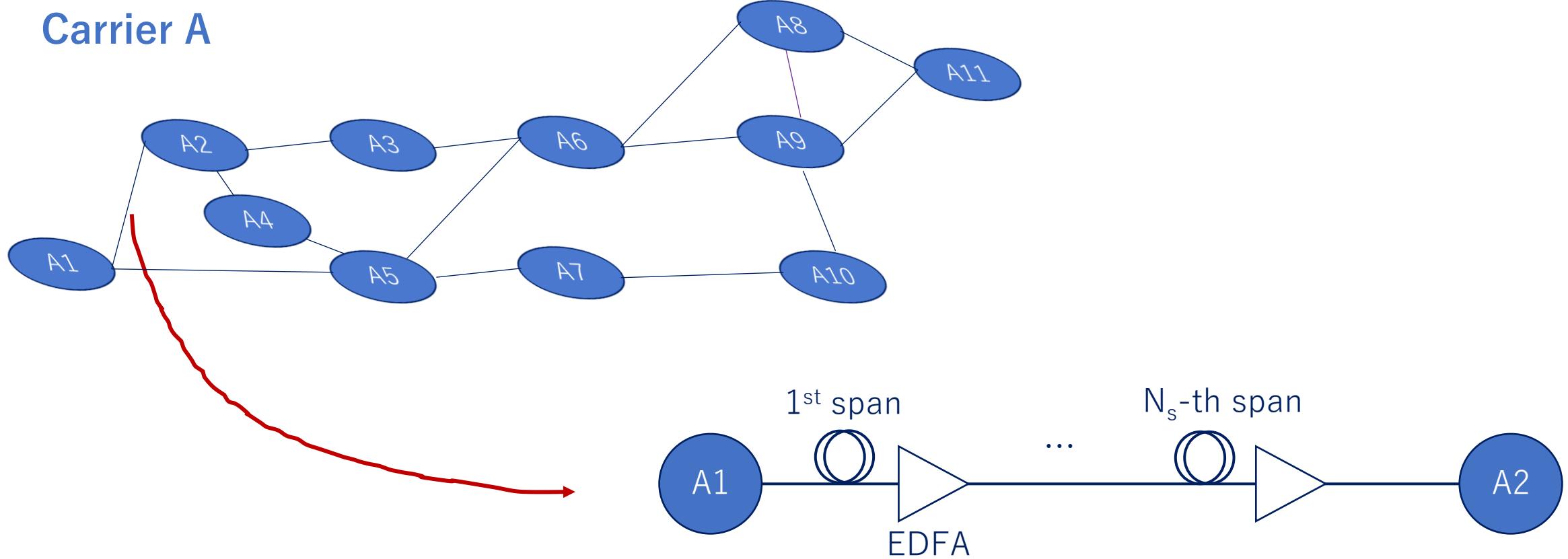


# Phase I: Abstraction and OSNR Estimation

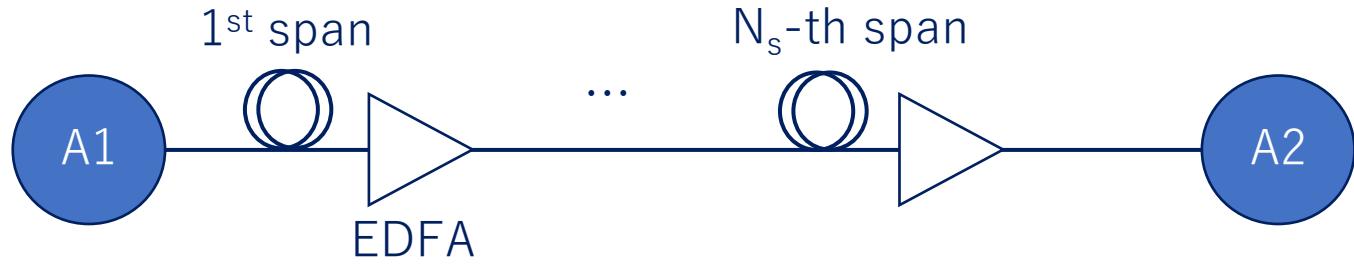
Carrier A



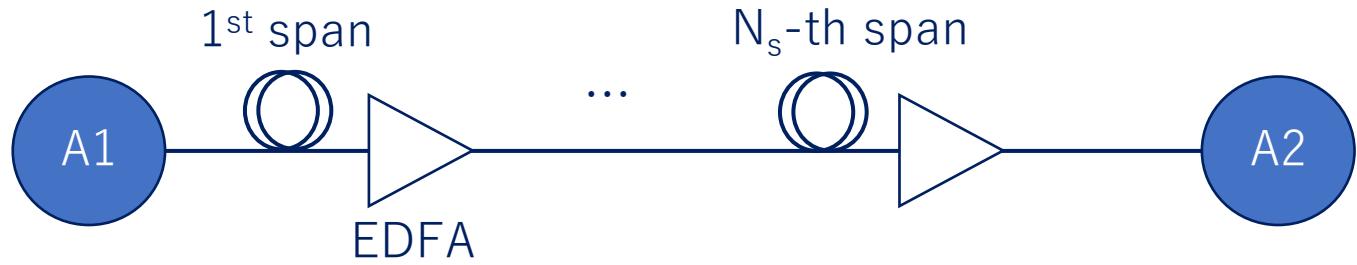
# Phase I: Abstraction and OSNR Estimation



# Phase I: Abstraction and OSNR Estimation

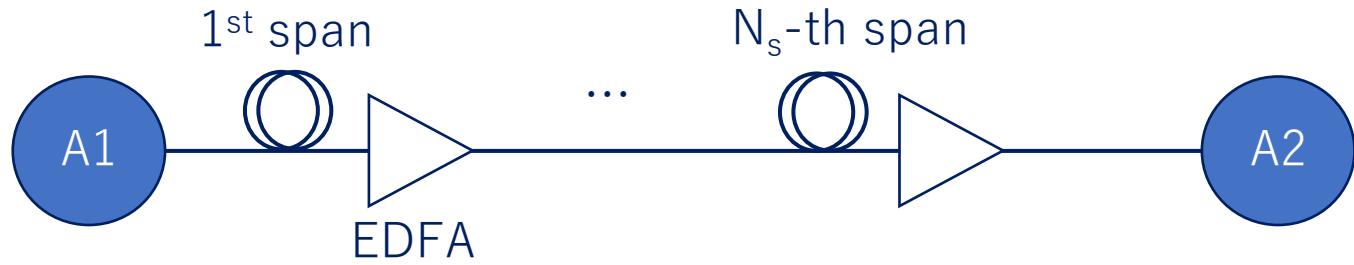


# Phase I: Abstraction and OSNR Estimation



$$OSNR_l^{-1}(f) = \frac{P_{ASE}^l(f) + P_{NLI}^l(f)}{P_{ch}}$$

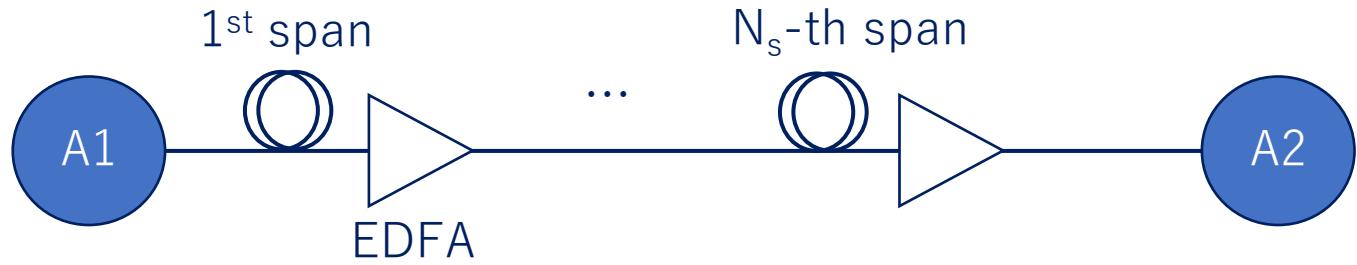
# Phase I: Abstraction and OSNR Estimation



$$OSNR_l^{-1}(f) = \frac{P_{ASE}^l(f) + P_{NLI}^l(f)}{P_{ch}}$$

frequency

# Phase I: Abstraction and OSNR Estimation

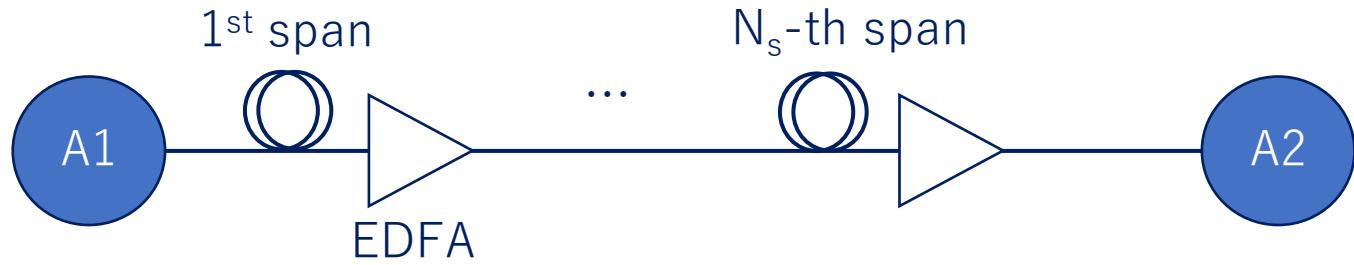


$$OSNR_l^{-1}(f) = \frac{P_{ASE}^l(f) + P_{NLI}^l(f)}{P_{ch}}$$

ASE noise  
frequency

The equation for OSNR estimation is shown. The term  $P_{ASE}^l(f)$  is highlighted with a blue arrow pointing to the label "ASE noise". The term  $P_{NLI}^l(f)$  is highlighted with a blue arrow pointing to the label "frequency".

# Phase I: Abstraction and OSNR Estimation

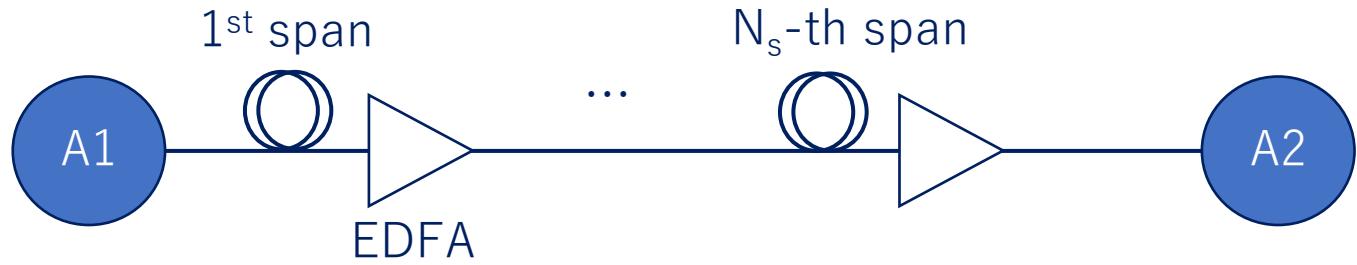


$$OSNR_l^{-1}(f) = \frac{P_{ASE}^l(f) + P_{NLI}^l(f)}{P_{ch}}$$

ASE noise      Cumulative NLI

frequency

# Phase I: Abstraction and OSNR Estimation

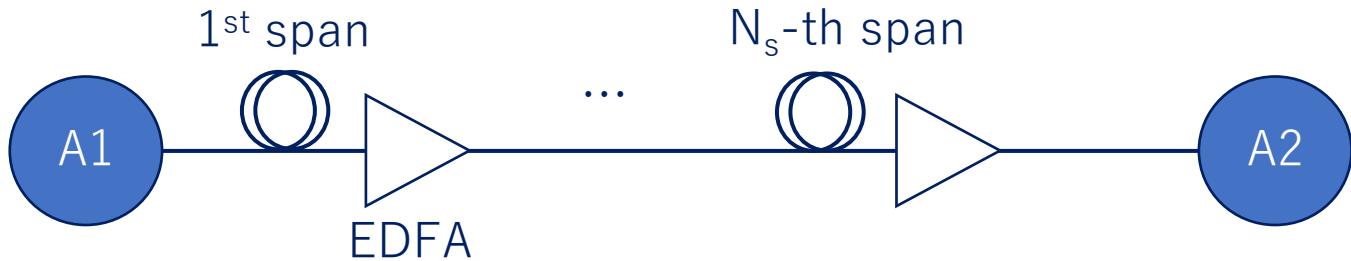


$$OSNR_l^{-1}(f) = \frac{P_{ASE}^l(f) + P_{NLI}^l(f)}{P_{ch}}$$

Diagram illustrating the components of the OSNR calculation:

- ASE noise: Points to the term  $P_{ASE}^l(f)$ .
- Cumulative NLI: Points to the term  $P_{NLI}^l(f)$ .
- frequency: Points to the variable  $f$  in the denominator.
- Channel power: Points to the variable  $P_{ch}$  in the denominator.

# Phase I: Abstraction and OSNR Estimation



$$OSNR_l^{-1}(f) = \frac{P_{ASE}^l(f) + P_{NLI}^l(f)}{P_{ch}}$$

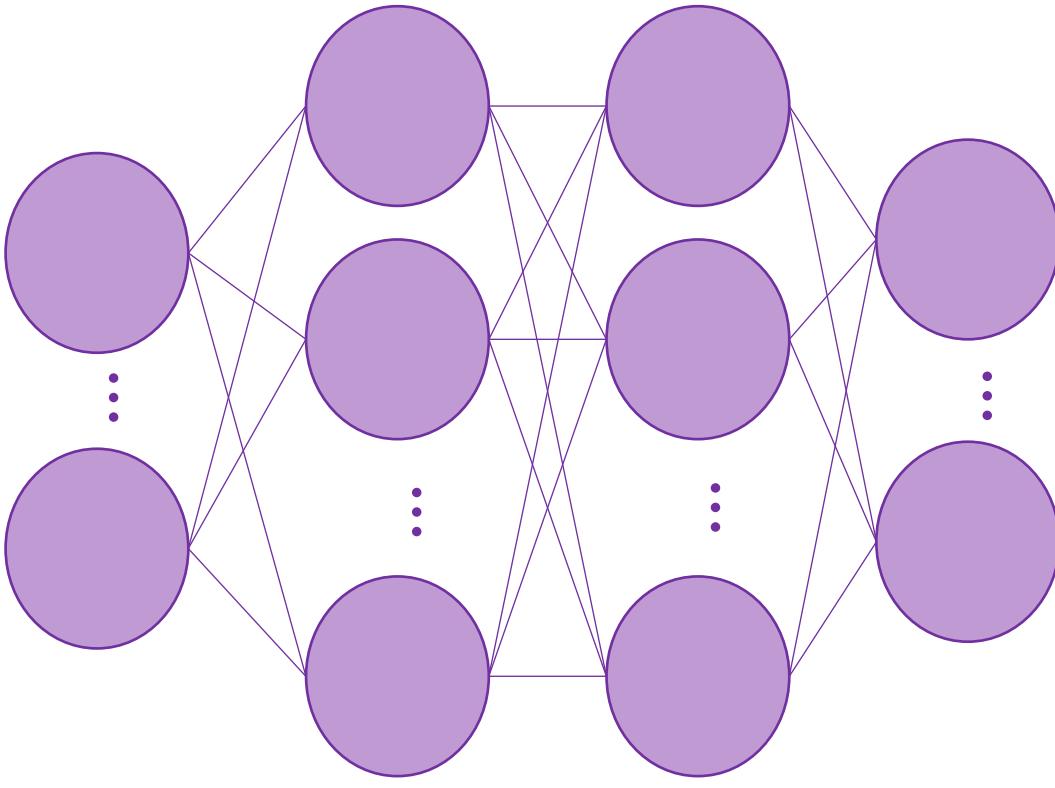
ASE noise      Cumulative NLI

frequency      Channel power

ASE Features	
# of span	
Span length	
Spontaneous emission factor	
In-line EDFA gain	NLI Features
General Features	
Reference Bandwidth	
Channel Power	Planck constant
Modulation Level	
Link Length	
Frequency	

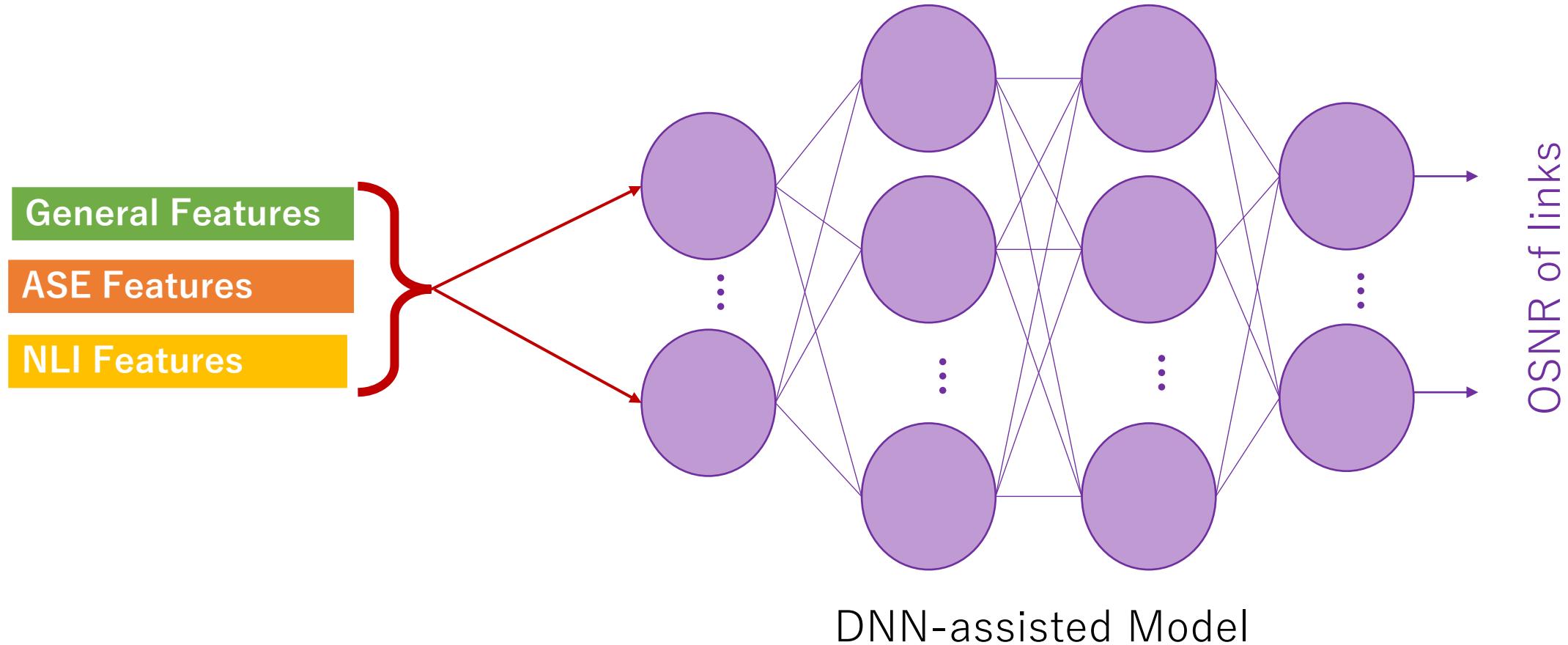
# Phase I: Abstraction and OSNR Estimation

# Phase I: Abstraction and OSNR Estimation

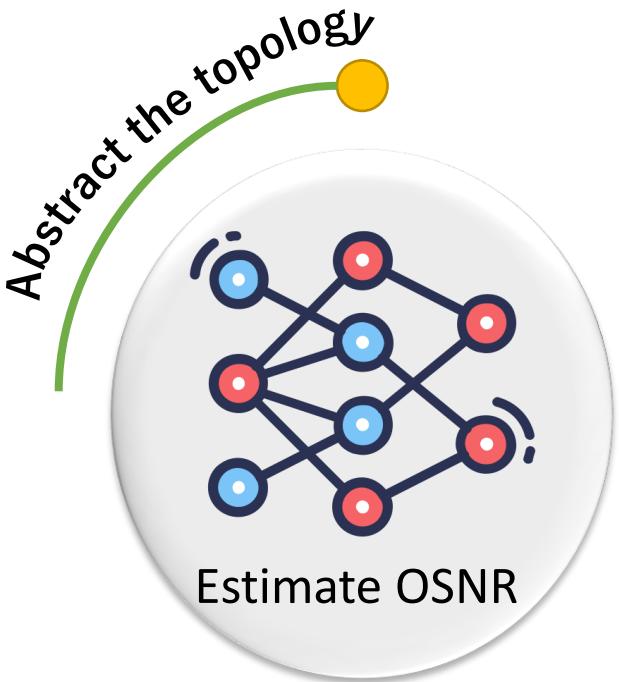


DNN-assisted Model

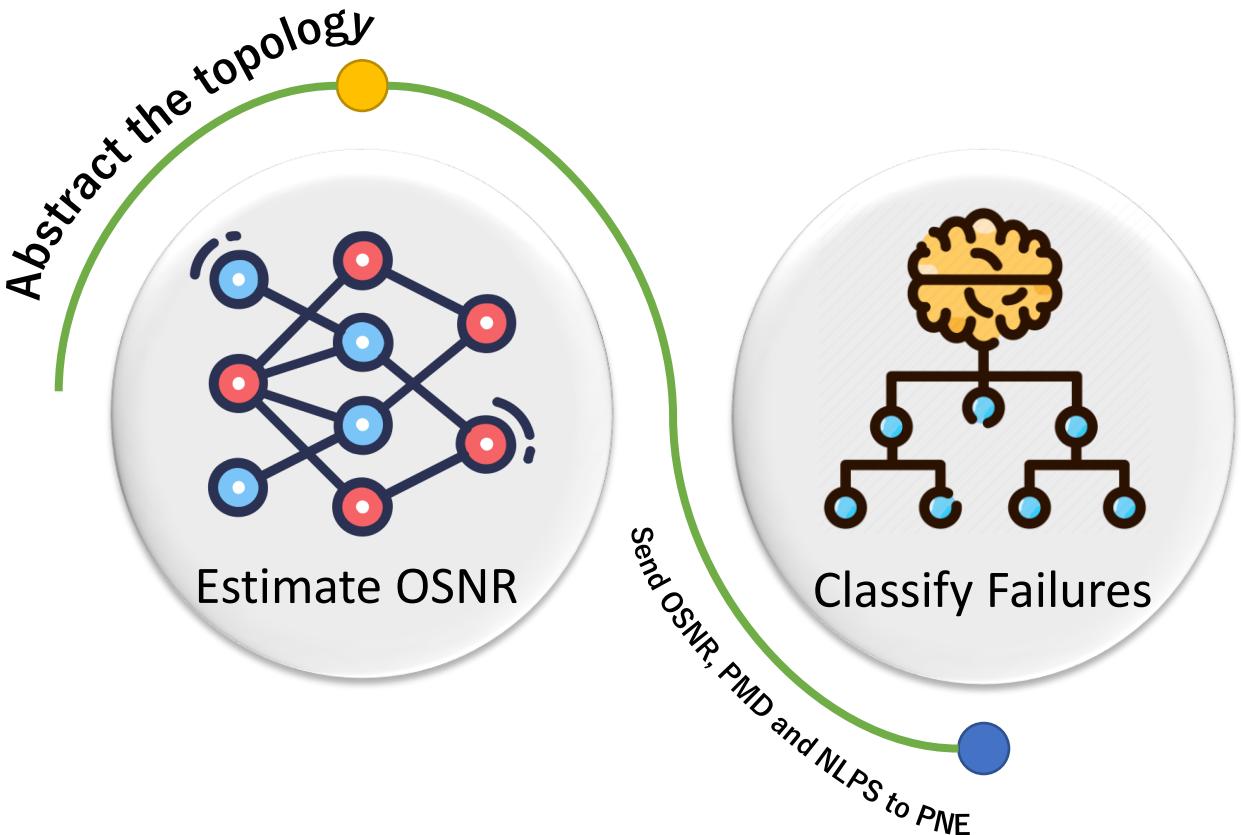
# Phase I: Abstraction and OSNR Estimation



# Flow of The Proposed Framework



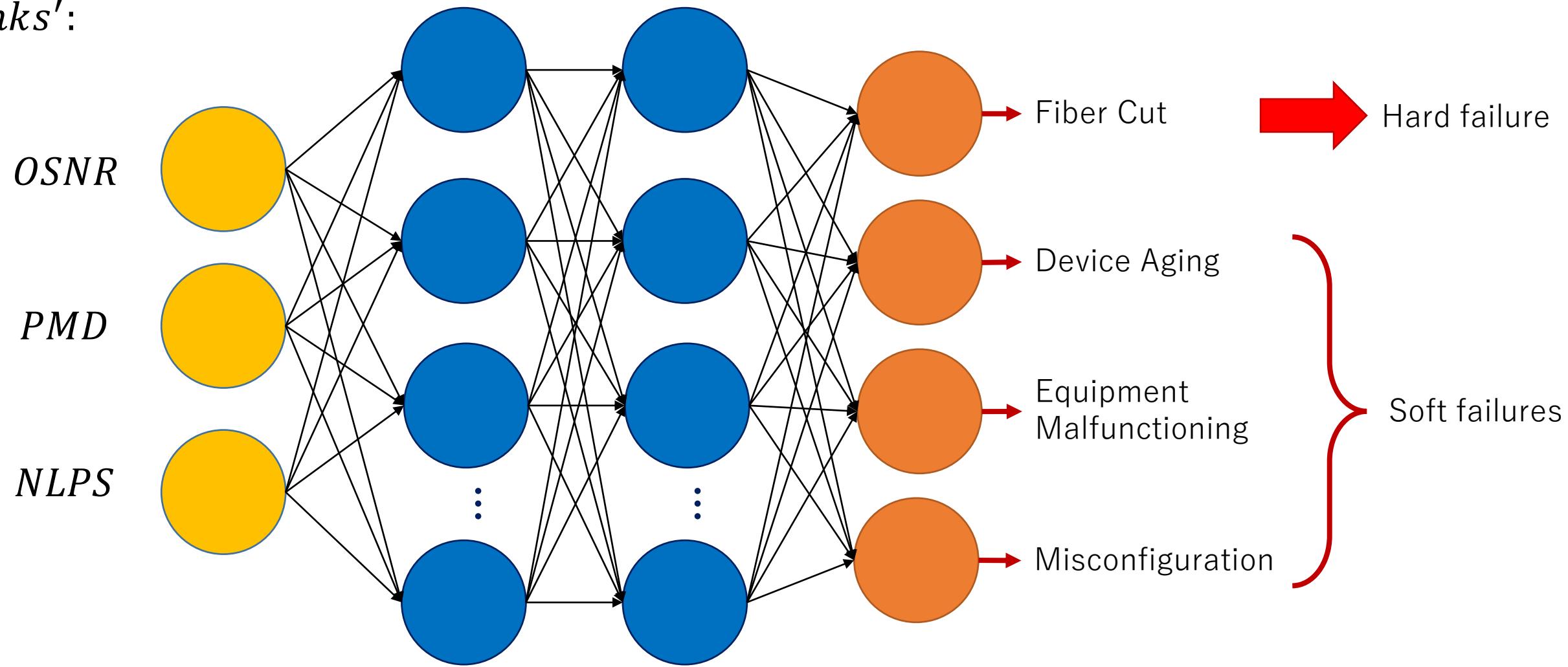
# Flow of The Proposed Framework



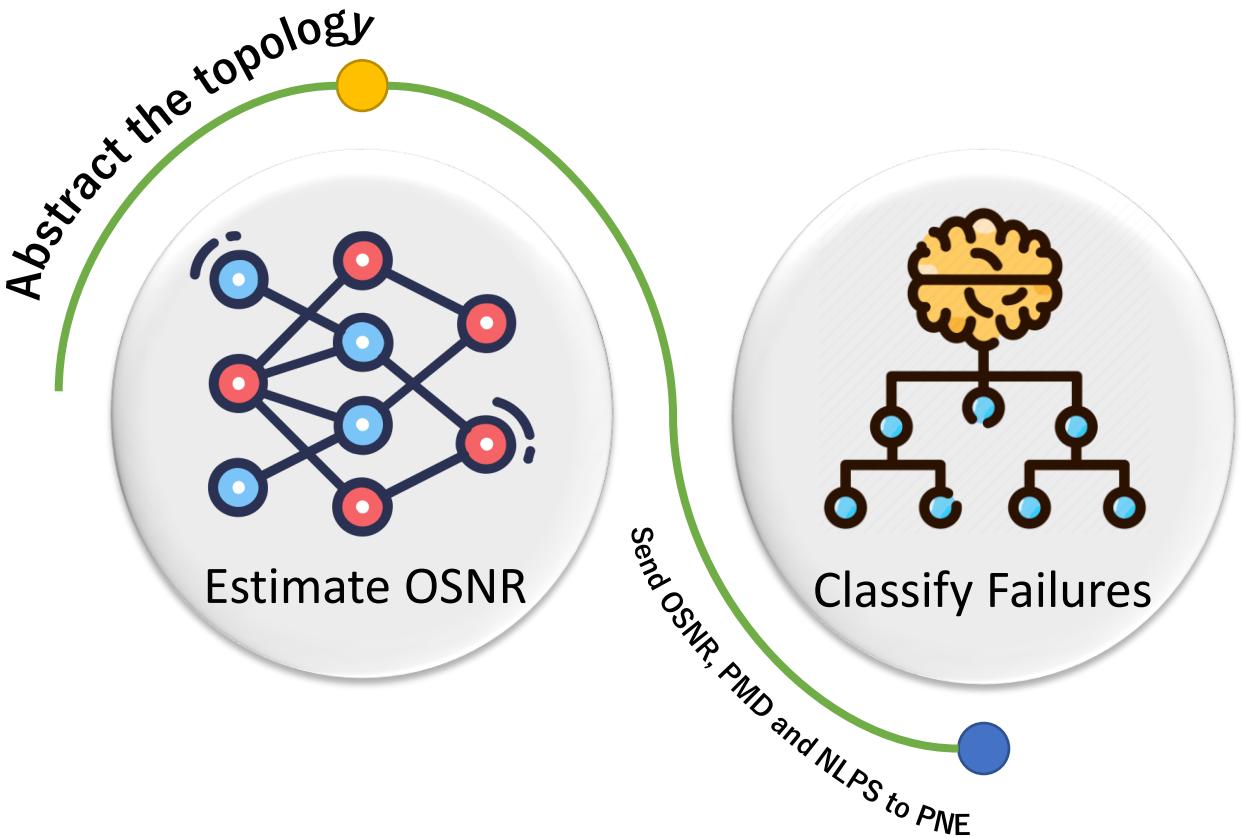
# Phase II: Classification

## Phase II: Classification

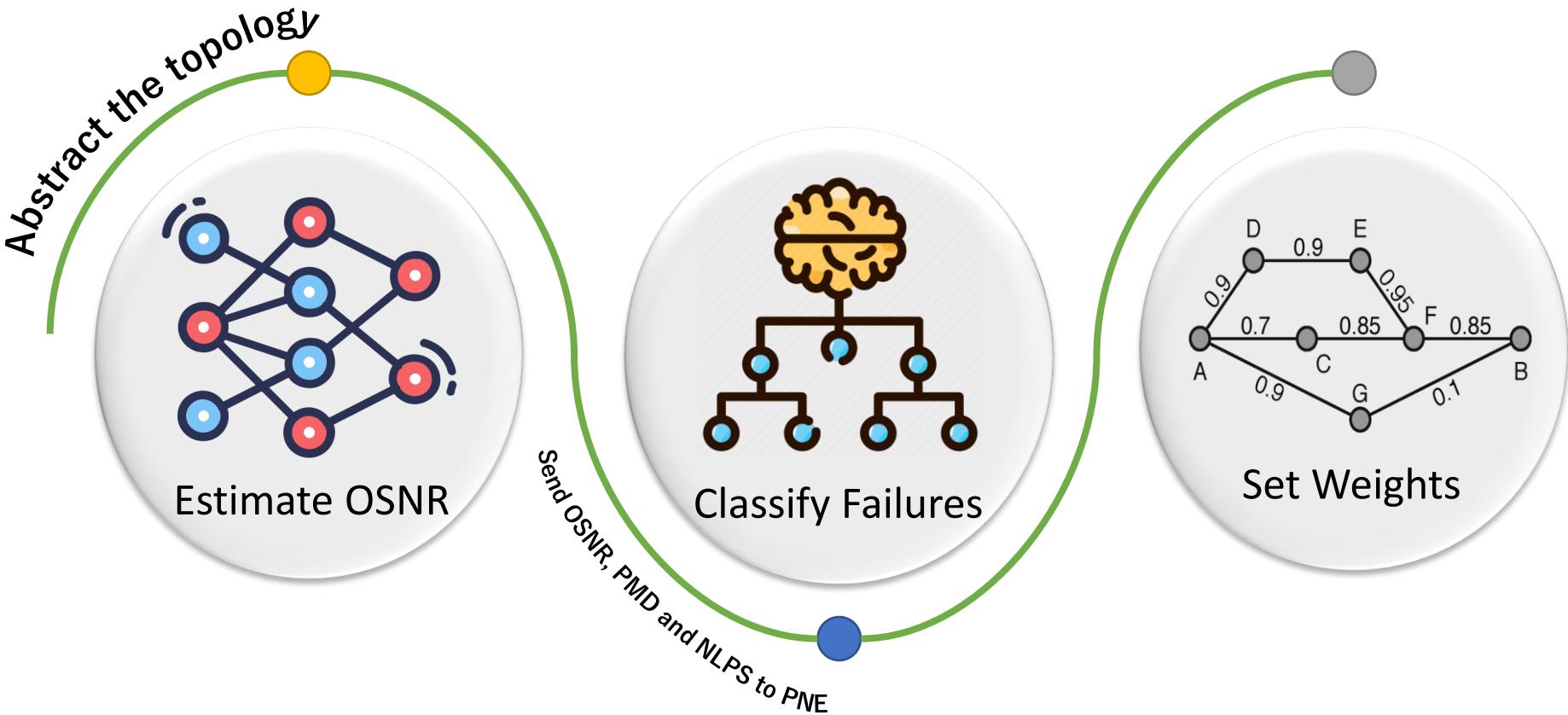
Links':



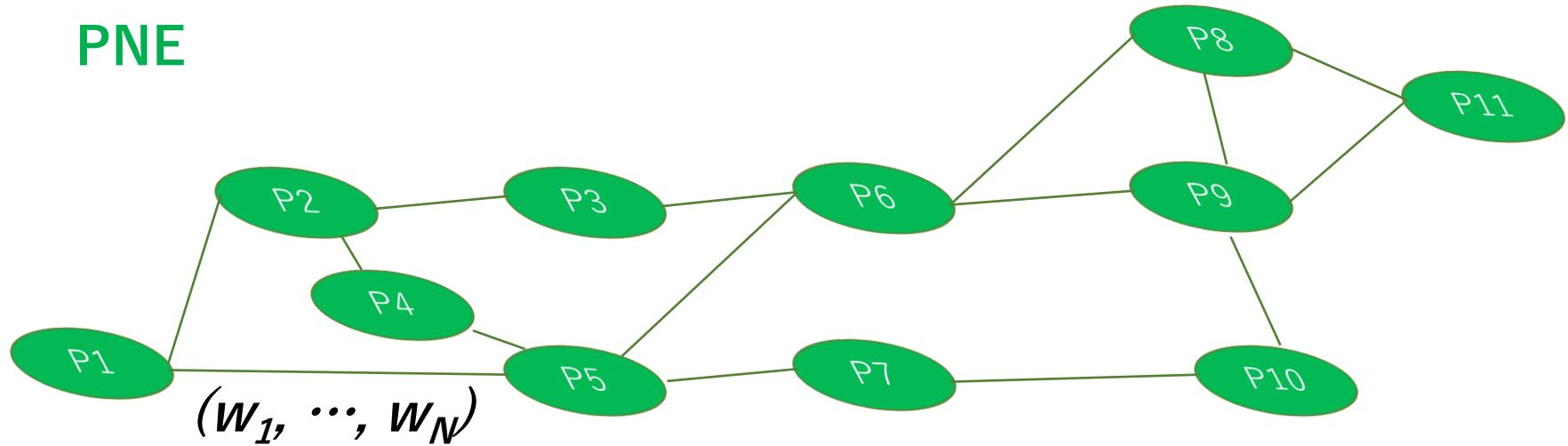
# Flow of The Proposed Framework



# Flow of The Proposed Framework

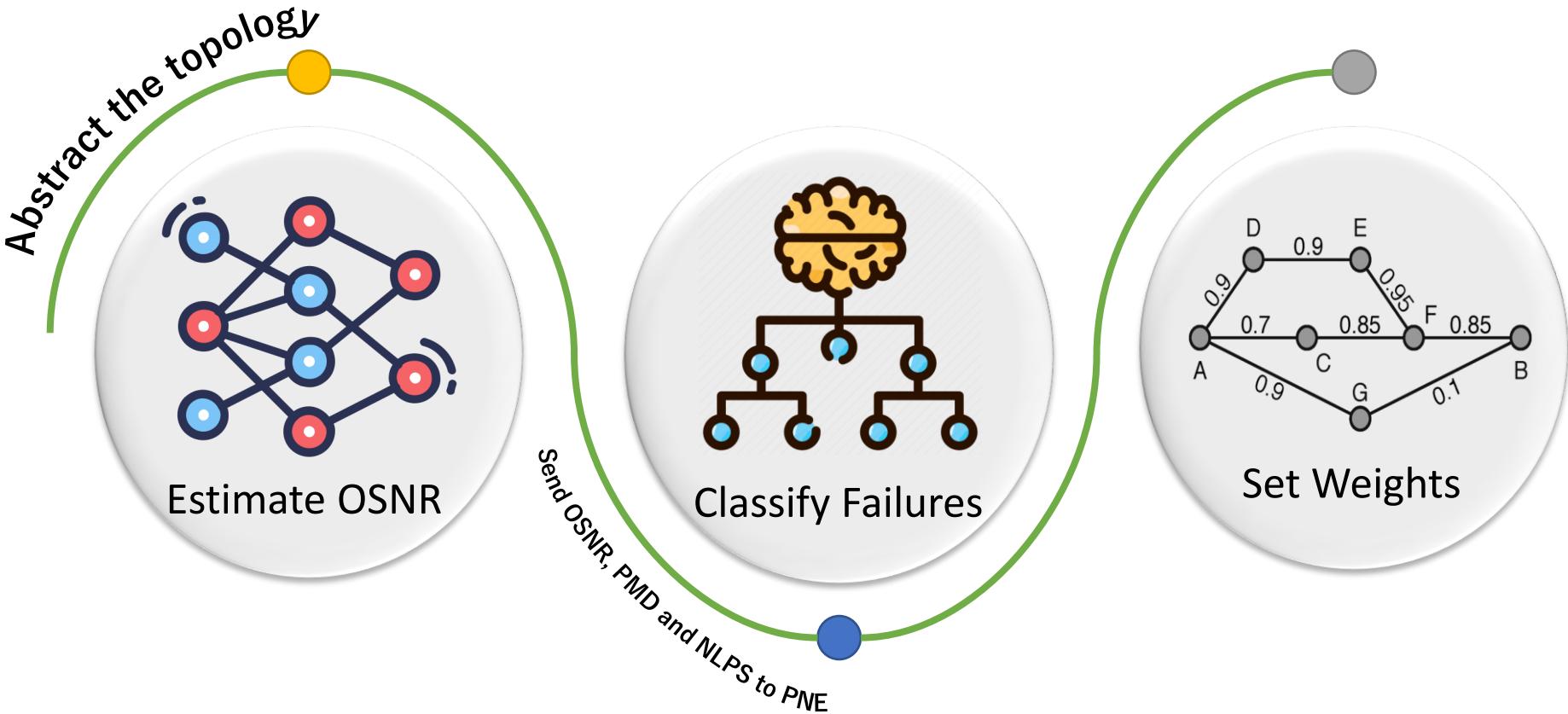


# Setting Weights

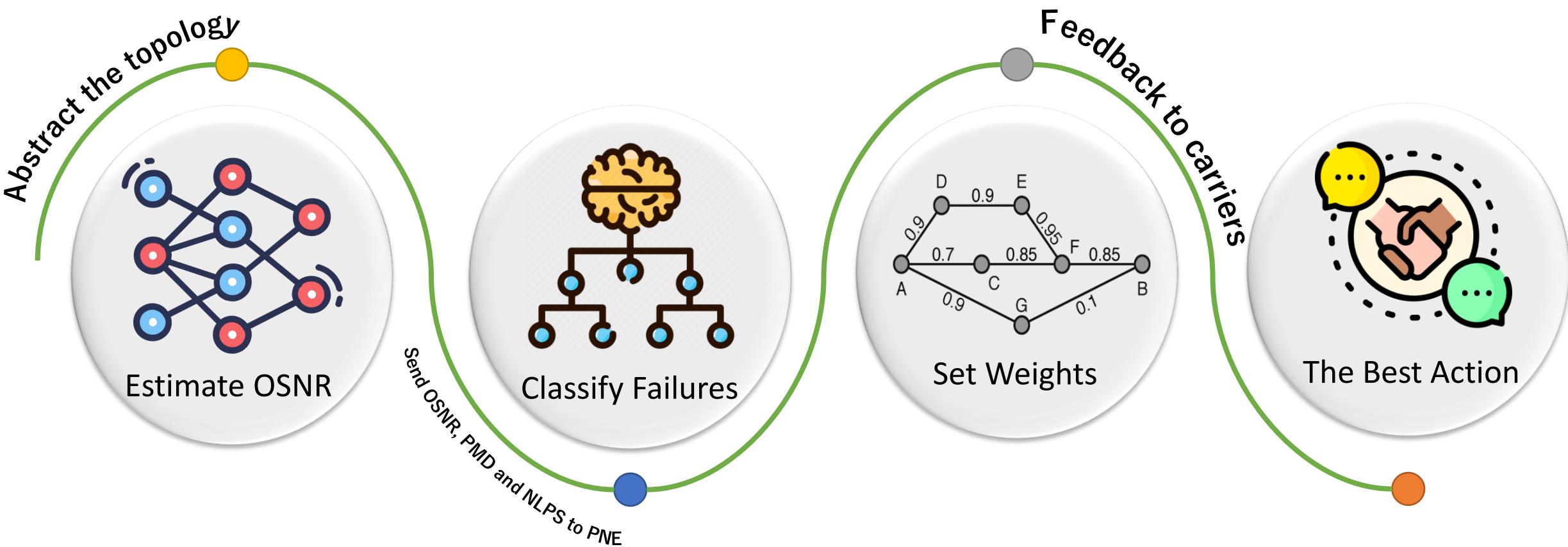


Link	Weight	Link	Weight	Link	Weight	Link	Weight
(P1-P2)	$(w_1, \dots, w_N)$	(P3-P6)	$(w_1, \dots, w_N)$	(P6-P8)	$(w_1, \dots, w_N)$	(P8-P11)	$(w_1, \dots, w_N)$
(P1-P5)	$(w_1, \dots, w_N)$	(P4-P5)	$(w_1, \dots, w_N)$	(P6-P9)	$(w_1, \dots, w_N)$	(P9-P10)	$(w_1, \dots, w_N)$
(P2-P3)	$(w_1, \dots, w_N)$	(P5-P6)	$(w_1, \dots, w_N)$	(P7-P10)	$(w_1, \dots, w_N)$	(P9-P11)	$(w_1, \dots, w_N)$
(P2-P4)	$(w_1, \dots, w_N)$	(P5-P7)	$(w_1, \dots, w_N)$	(P8-P9)	$(w_1, \dots, w_N)$		

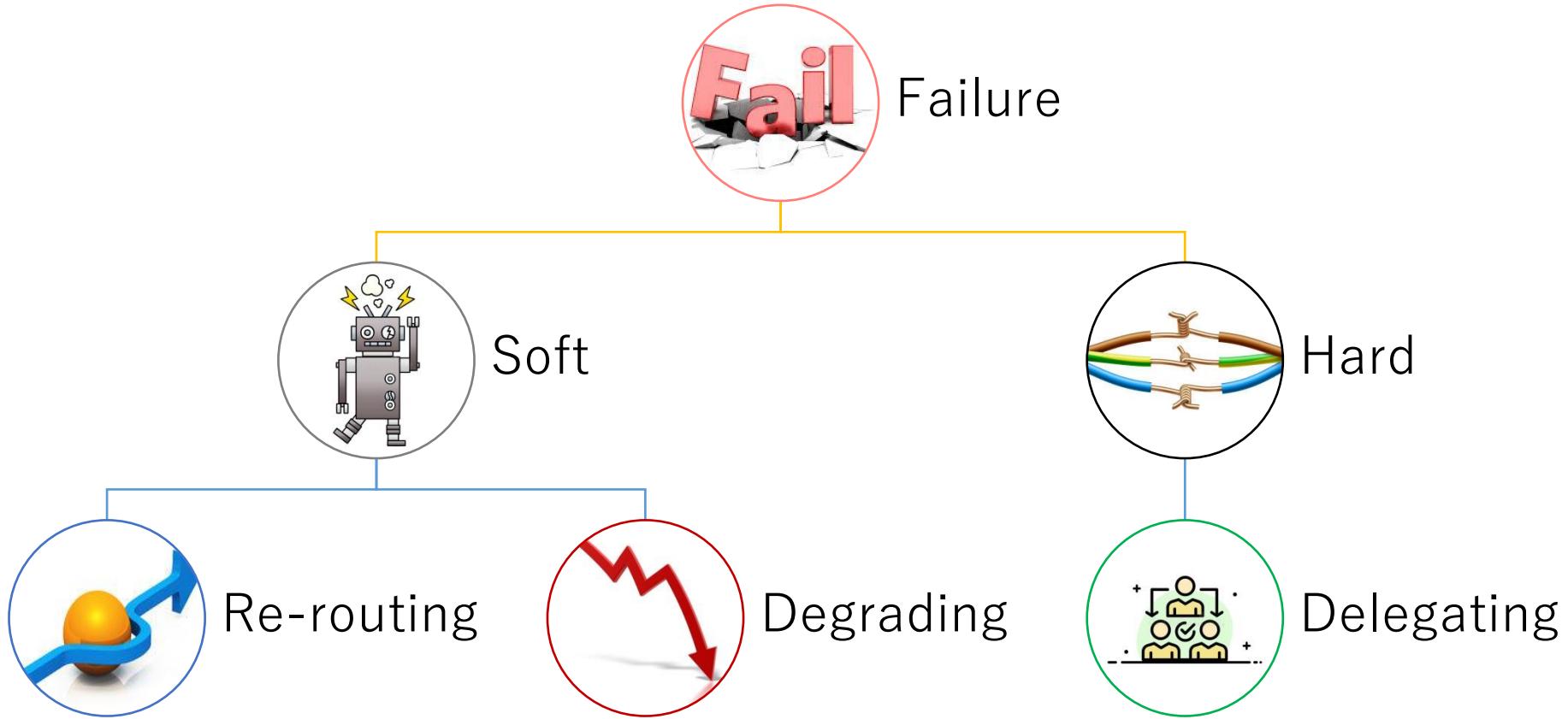
# Flow of The Proposed Framework



# Flow of The Proposed Framework

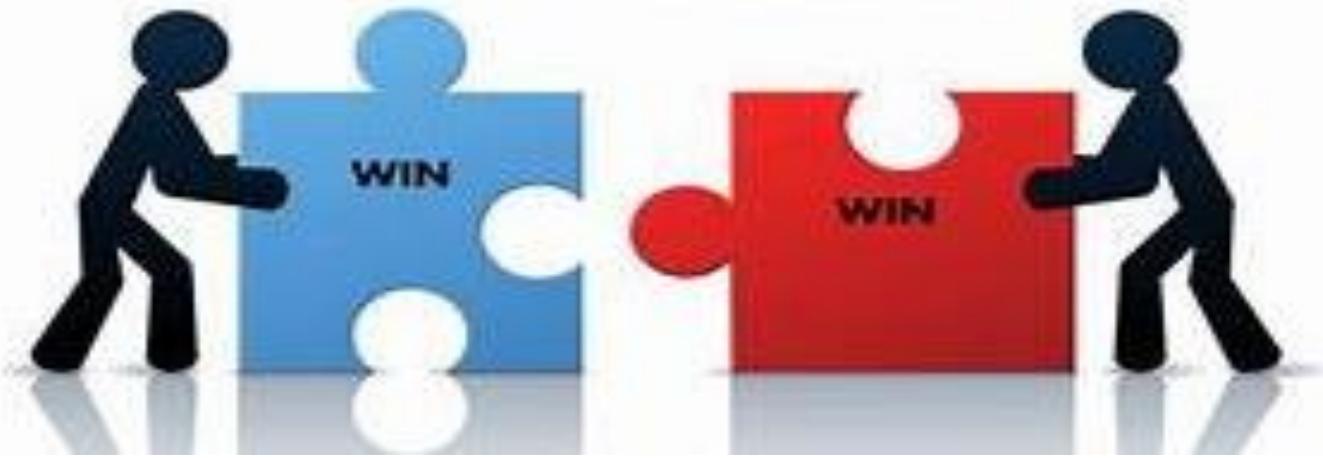


## Phase III: Providing Carriers with Suggestions



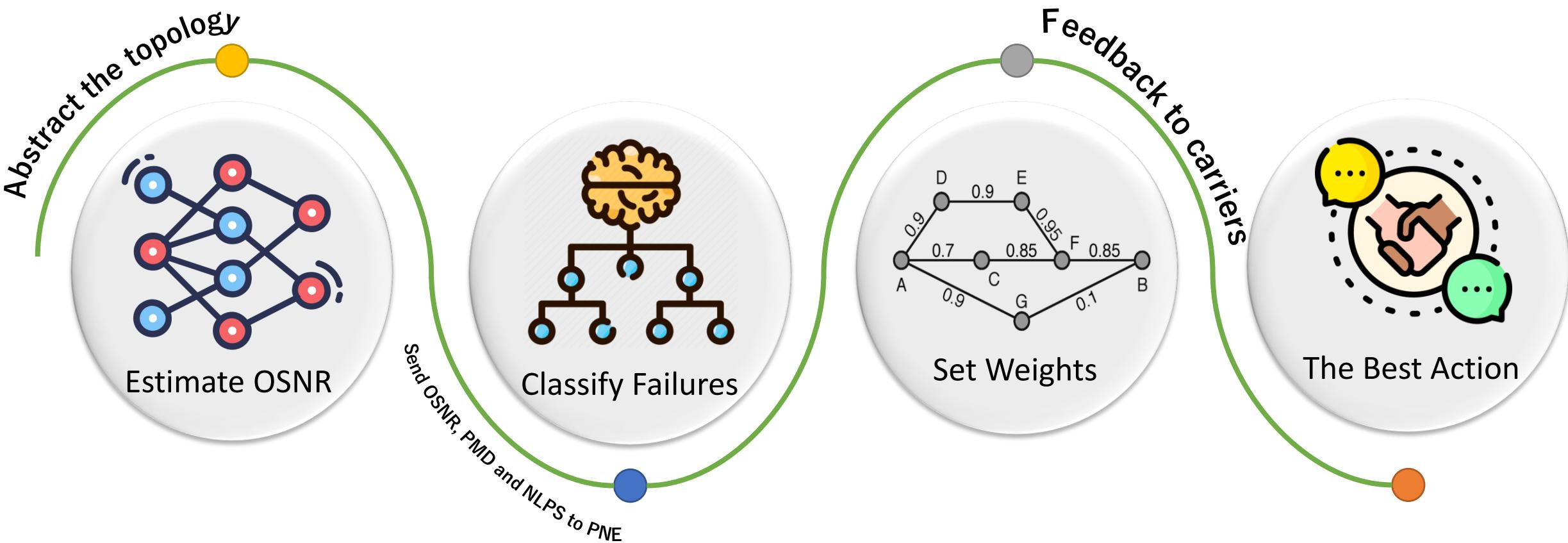
# Phase III: Negotiation

## NEGOTIATION



PNE	Carrier	DCP	ISP
<ul style="list-style-type: none"><li>• Enhance network survivability</li><li>• Prolong network lifetime</li><li>• Optimal resource management</li></ul>	<ul style="list-style-type: none"><li>• Reduce burden (resource crunch)</li><li>• Reduce recovery cost</li></ul>	<ul style="list-style-type: none"><li>• Lower cost</li><li>• Higher quality</li></ul>	<ul style="list-style-type: none"><li>• Lower cost</li><li>• Higher quality</li></ul>

# Flow of The Proposed Framework



# Flow of The Proposed Framework

