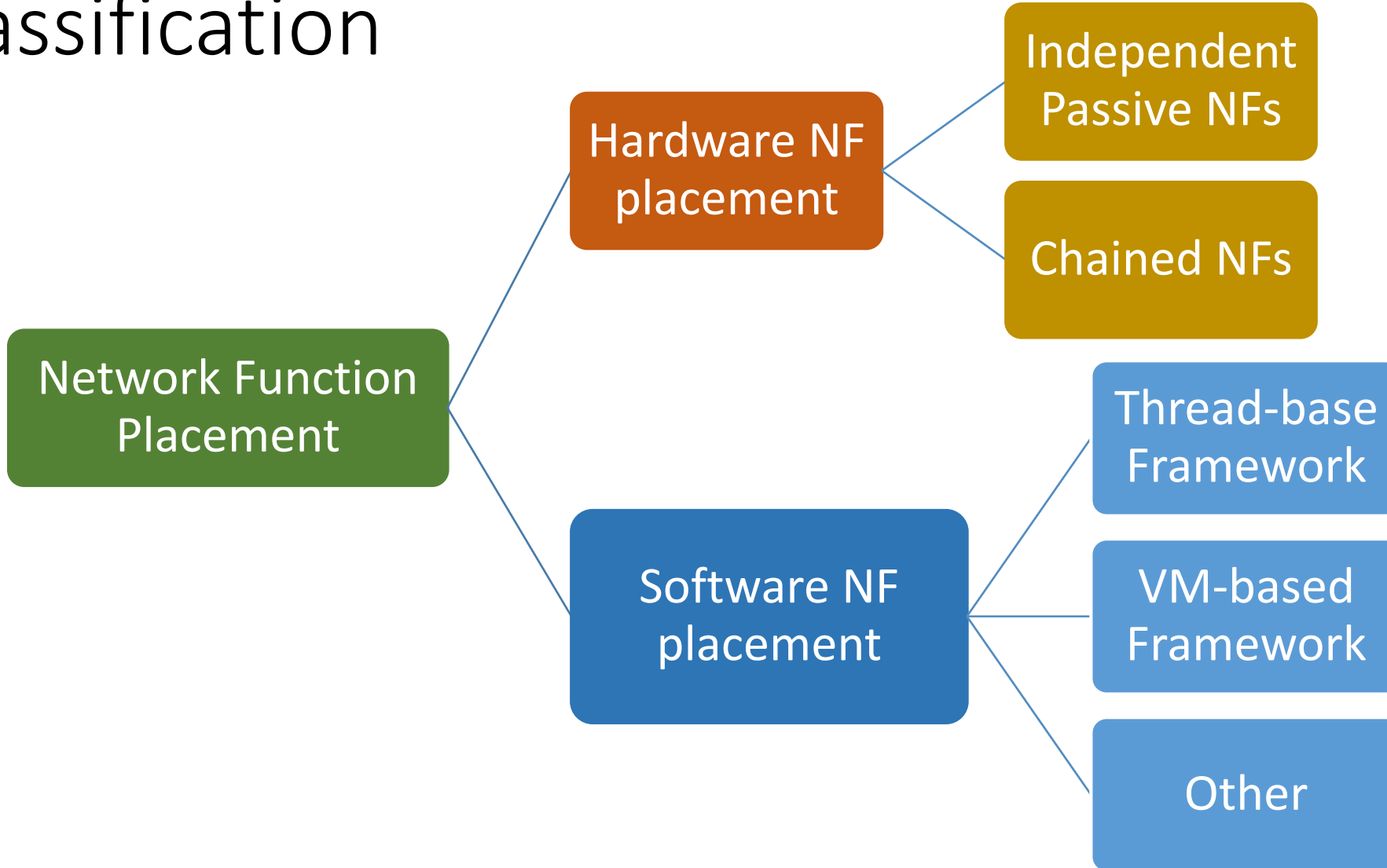# A Survey of Network Function Placement

Xin Li and Chen Qian

Department of Computer Science, University of Kentucky

Classification

Hardware NF Placement

- Independent Passive NFs

- ■ passive monitor

- ■ trade-off between COVERAGE and COST

- Chain NFs

- ■ Service Chain : require Correctness, Efficientcy
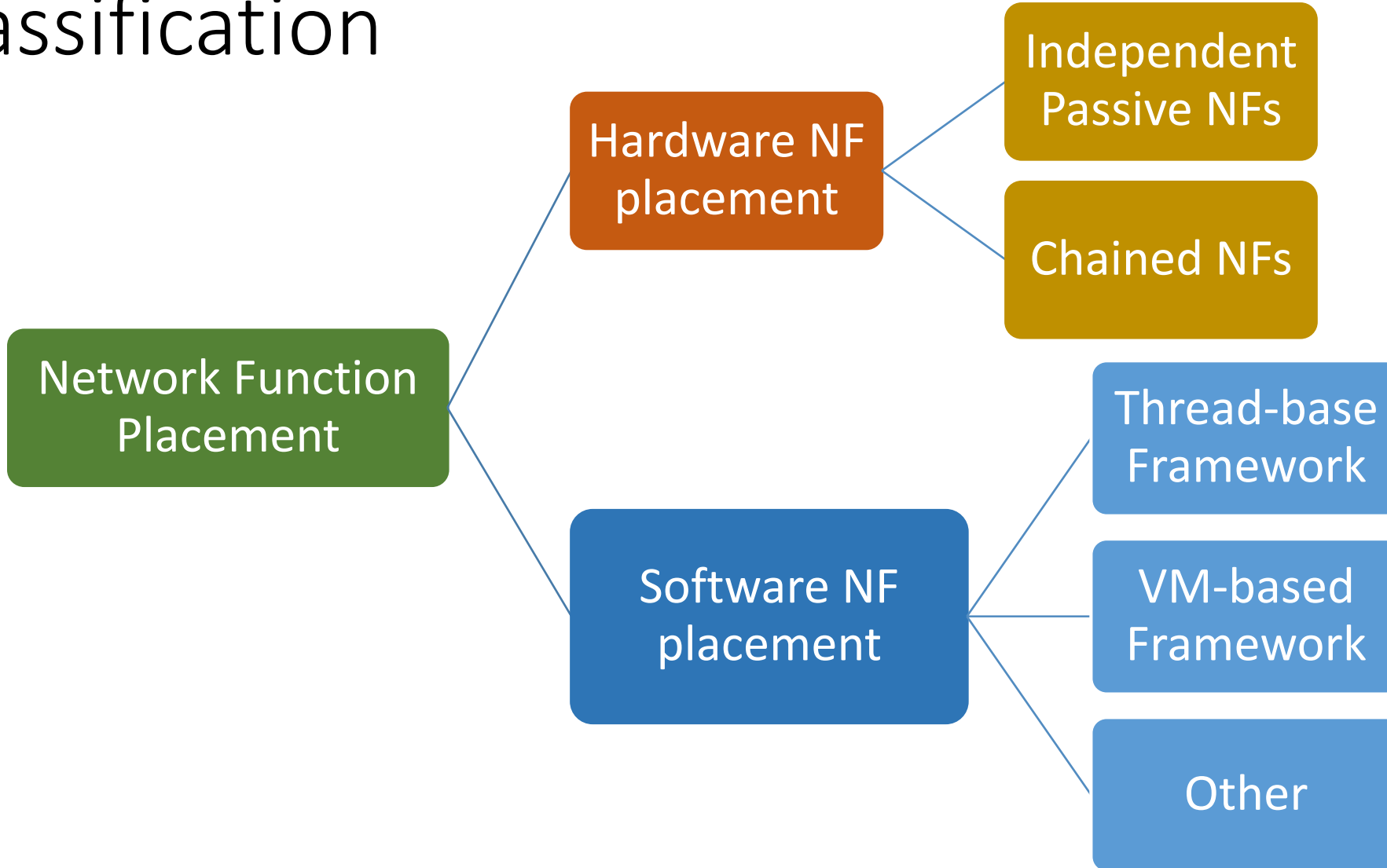 (eg. firewall - IDS - proxy)

- ■ min LATENCY

Hardware NF Placement

NF type	Location	Traffic steering	Placement objective
Independent NFs	in-line	optional	max cov./min cost
Chained NFs	off-line	compulsory	min latency

TABLE I
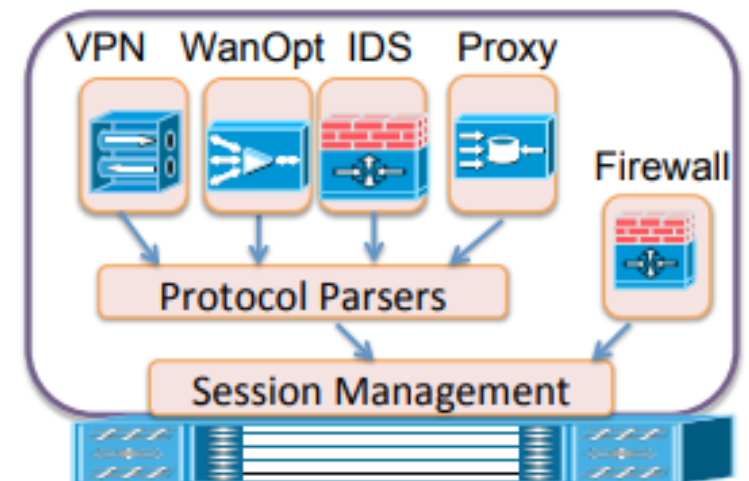COMPARISON BETWEEN INDEPENDENT PASSIVE NFs & CHAINED NFs.

Classification

Software NF Placement
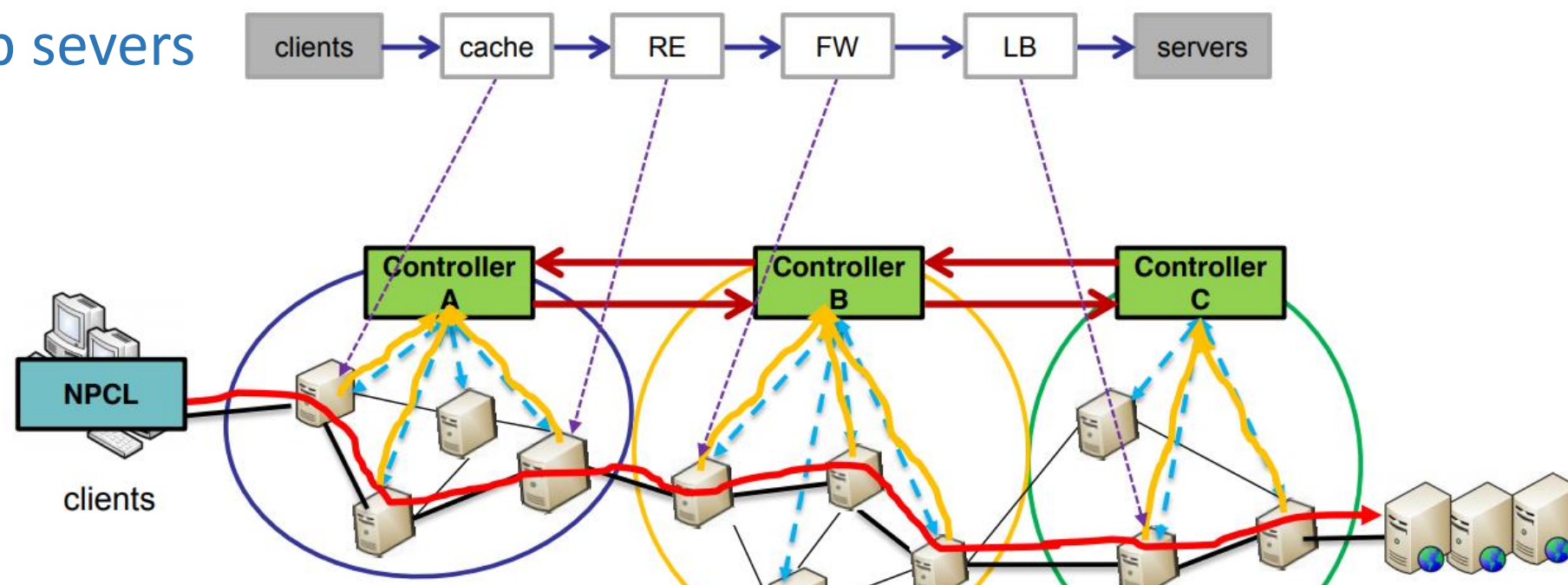## Monolithic Consolidating - CoMb

- multiple application on hardware platform
- location independent

Software NF Placement

Cross-border On-path Placement - MIDAS

- Location dependent
- Steps
  - 1) compute utilization balancing across NFPs and location dependency
  - 2) select CoMb severs

Path Loosely Controlled Placement – E2

- minimize inter-server traffic

- Steps

  - 1) redraw the service chain into pGraph
  - 2) determine the number of instances of each NF
  - 3) convert pGraph to iGraph
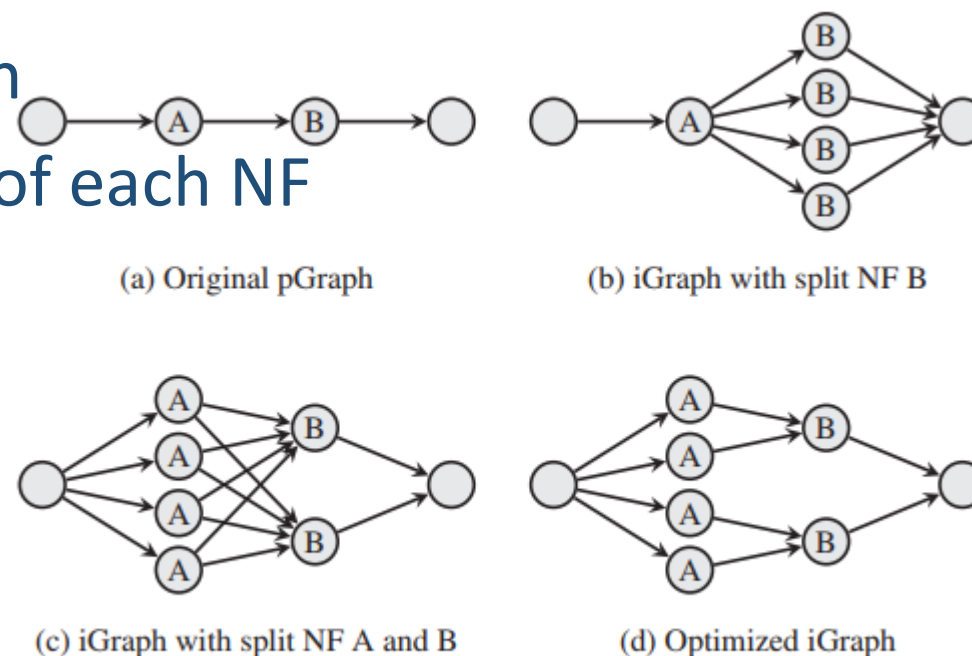 - 4) actual instance placement

(a) Original pGraph

(b) iGraph with split NF B

(c) iGraph with split NF A and B

(d) Optimized iGraph

Figure 4: Transformations of a pGraph (a) into an iGraph (b, c, d).
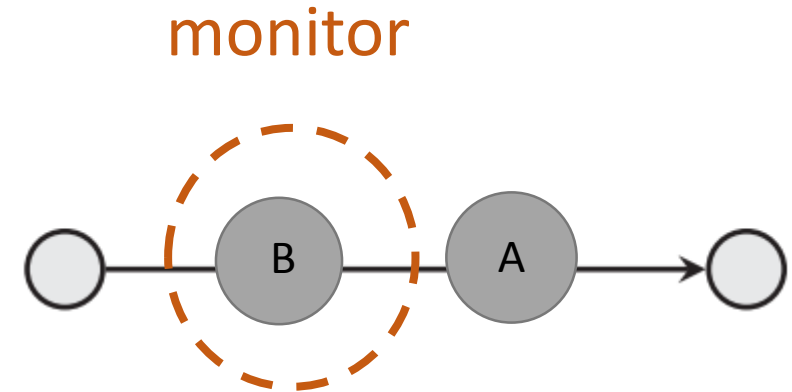
Path Tightly Controlled Placement – VNP-OP

- Control the Routing Path by SDN

- minimize the cost

  ■ VNF deployment cost

  ■ Energy cost

  ■ Traffic forwarding cost

  ■ Penalty for SLO violation

- Reduce to Trans-shipment problem, NP-hard

Software NF Placement
Unordered Placement-PACE

- Service Chain can be UNORDERED and partially unordered
- more flexible
- Satisfy more requests

Other

Element-based Framework-Slick

- implement NFs as a chain of lightweight functions(element)

- steps

- 1) Consolidate element if necessary

- 2) place element

- element's inflation factor

- $\log(f_{out}/f_{in})$ f:traffic volumes

- place negative inflation factor near source

Other
Distributed NFs-CSamp

- Create a new NF : monitor NFs
- Avoiding redundant measurements : hash-based packet selection
- distributed redundant elimination have been implement

Other
Host-based Framework - ETTM

- place at endpoints
- provide fault-tolerance and reliability

Software NF Placement(4)

NFV form	NFV framework	Placement strategy	On path?	Mangling NF?	Location dependency?	Order preserve?
Thread-based	CoMb [25]	Monolithic consolidating	✓	✓	x	✓
	MIDAS [1]	Cross-border on-path placement	✓	x	✓	✓
VM-based	E2 [22]	Path-loosely-controlled placement	x	x	x	✓
	Statos [10]	Path-loosely-controlled placement	x	✓	x	✓
	VNP-OP [4]	Path-tightly-controlled placement	x	✓	x	✓
	PACE [18]	Unordered placement	x	x	x	x
Other Forms	Slick [3]	Partial consolidating	✓	x	✓	✓
	CSamp [27]	On-path distributed placement	✓	N/A	✓	N/A
	ETTM [8]	Monolithic consolidating	✓	✓	x	✓

TABLE II
COMPARISON BETWEEN DIFFERENT NFV FRAMEWORKS

Challenges & Future Work

- NFV offers new opportunities for performance optimization.
- Performance of ensure correct forwarding in face of mangling NFs.

Conclusion

- issue both hardware and virtualized NFs

- design and strategy of each NFs placement

- future challenges and opportunities

Q&A