4G, 5G Workloads and Capacity Implications

Intel Labs- Telecom System Research

Legal Information

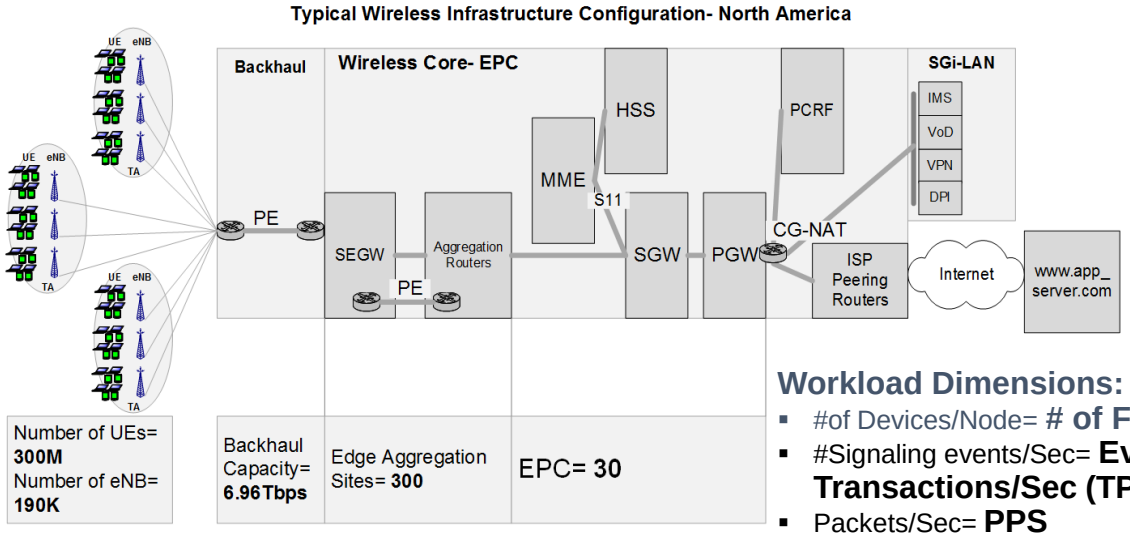
- This presentation contains the general insights and opinions of Intel Corporation (“Intel”). The information in this presentation is provided for information only and is not to be relied upon for any other purpose than educational. Use at your own risk! Intel makes no representations or warranties regarding the accuracy or completeness of the information in this presentation. Intel accepts no duty to update this presentation based on more current information. Intel is not liable for any damages, direct or indirect, consequential or otherwise, that may arise, directly or indirectly, from the use or misuse of the information in this presentation.
- Intel technologies’ features and benefits depend on system configuration and may require enabled hardware, software or service activation. Learn more at intel.com, or from the OEM or retailer.
- No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.
- Intel, the Intel logo and Xeon are trademarks of Intel Corporation in the United States and other countries.
- *Other names and brands may be claimed as the property of others.
-

Agenda

- Workload, Performance & Baselines
- Traditional Telecom vs. Data Center Cloud Infrastructure
- Research in progress
- References

Workload, Performance & Baselines

Infrastructure & Load

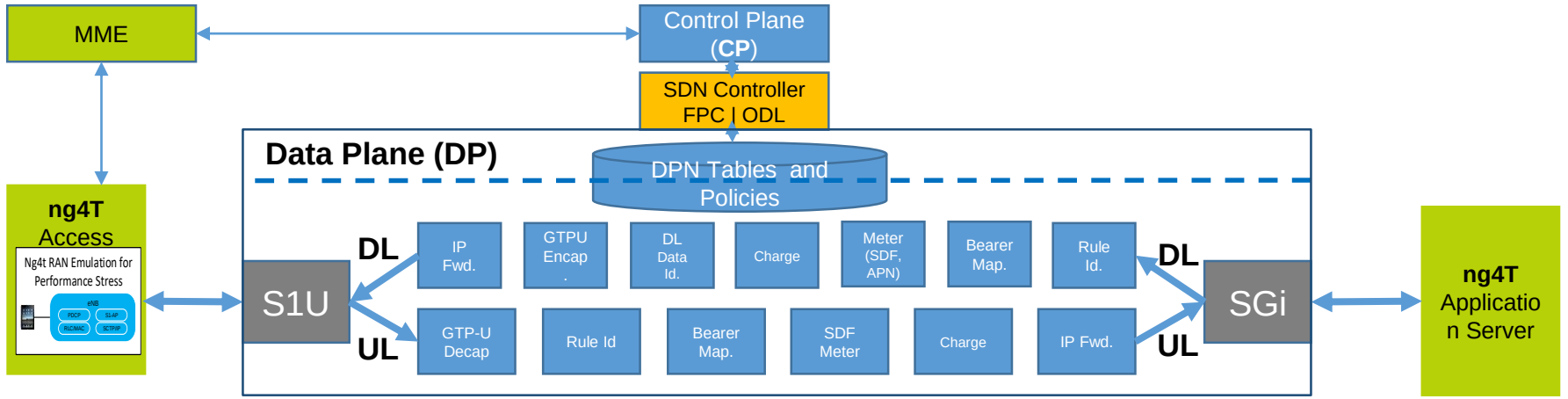


Workload Dimensions:

- #of Devices/Node= **# of Flows**
- #Signaling events/Sec= **Events or Transactions/Sec (TPS)**
- Packets/Sec= **PPS**

Workload Dimensions		MME	S-PGW
Today	# of Flows/Node	3M	10M
	TPS/Node	50K	15K =~70us
	PPS/Node	-	20M =~50ns
Projected ~5G/IoT	# of Flows/Node	x100= 300M	x100= 1Bn
	TPS/Node	x100= 5M	x100= 1.5M= ~0.7us
	PPS/Node	-	x10= 200M= ~5ns

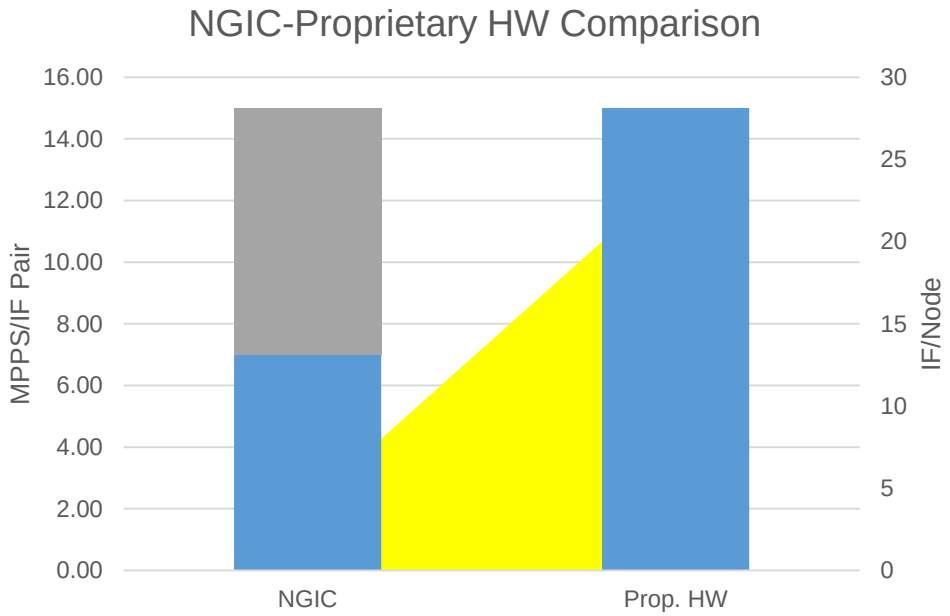
Intel Labs NGIC open source @:
https://gerrit.opencord.org/#/admin/projects/ngic

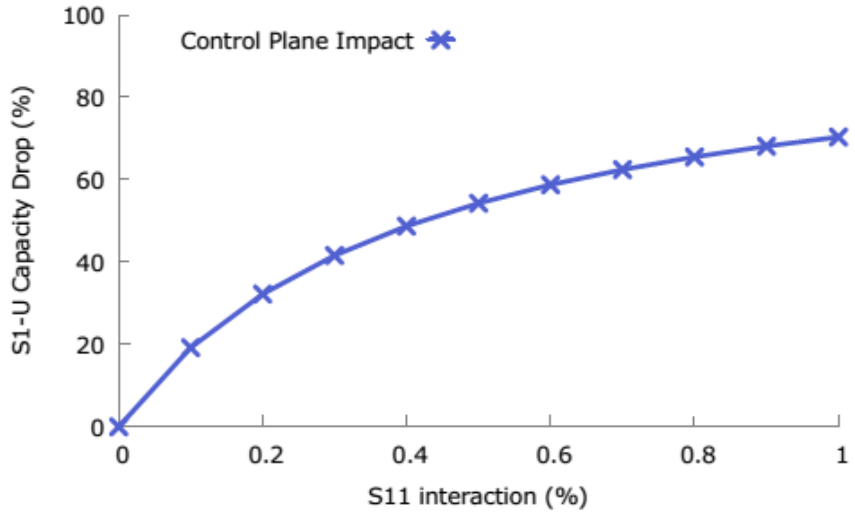


NGIC capacity/Node:
#of Flows: 500K
1x 10GbE Data Paths: ~8MPPS
1x ~Signaling Path: 1000TPS

- **Innovative Architecture decoupling events form packet processing**
- **Operationally deployable single instance**
- **Enables micro-service architectures**

Traditional Telecom vs. Data Center Cloud Infrastructure





User plane capacity reduction w/ control plane load

Standard High Volume (SHV) Servers vs. Proprietary Hardware:

- Interface/Node density is very low in SHV. Typ. 2-4 (max)/Node
- Sustainable MPPS/Interface Pair of SHV is ~1/2 compared to proprietary HW

Key Challenge: Low IF/Node density in SHV

Cellular Telecom packet flow specificities:

- Many (p) updates / (1x) flow vs. 1x update / (q) many flows; p, q > 1000
- # of flows per VNF instance cap ~0.5M

Key Challenge: Load distribution across nx VNF is great, but does aggregate infrastructure capacity ~= nx capacity/VNF?

Research in progress

Problem re-statement:
Growing number of workloads require independent scaling of compute resources for VNFs within & across Nodes→ massive workload movements across cores, servers, VMs, containers, racks and data centers.

Required			Baseline Scale out needed	
Workload Dimensions		S-PGW	NGIC Capacity	#NGIC Instances
Today	# of Flows/Node	10M	0.5M	**20**= Max of[10M/0.5M, 15K/1K, 20M/8M]
	TPS/Node	15K =~70us	1K	
	PPS/Node	20M =~50ns	8M	
Projected ~5G/IoT	# of Flows/Node	x100= 1Bn	0.5M	**2000**= Max of[1Bn/0.5M, 1.5M/1K, 200M/8M]
	TPS/Node	x100= 1.5M= ~0.7us	1K	
	PPS/Node	x10= 200M= ~5ns	8M	

Research Questions:

- What are the optimal Virtual Infrastructure Manager (VIM) and SDN technologies for nx NGIC instances to deliver nx capacity?
- What are the fabric technologies (HW & SW) connecting nx distributed instances?
- With ‘n’ → ∞ does capacity get bounded?
- What is the relation of inter instance VM – VM east – west traffic to increasing ‘n’

Questions/Discussion

References

Research References

- “Understanding the bottlenecks in virtualizing cellular core network functions”

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7114735&punumber%3D7113431%26filter%3DAND(p_IS_Number%3A7114713)

- High-performance evolved packet core signaling and bearer processing on general-purpose processors; Hirschman, B. ; Mehta, P. ; Ramia, K.B. ; Rajan, A.S. ; Dylag, E. ; Singh, A. ; Mcdonald, M

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7113219