Dimensioning Challenges of xhaul
After Incorporation of 22-03 Meeting Comments

Version 2.0

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In order to illustrate the challenges of deploying the xhaul architecture, a dimensioning exercise was performed for a 10x10 Km metro with 8000 5G small cell ANs, covering 65% of area, and delivering 1Tbps to Apps.

Even with moderate assumptions, the results were difficult to deploy.

-Peak user throughput of only 5Gbps was used instead of 20 Gbps.
-eCPRI was considered instead of native CPRI .
-Aggressive NGMN peak-to-average throughput algorithm was used.
-For first phase of 5G 10% of peak and for next phase 15% of peak can be considered. The multiplexing gain can be considered only once, either for NGFI-1, or NGFI-11 or Backhaul depending upon the position of concentrator, after which the capacity has to be maintained

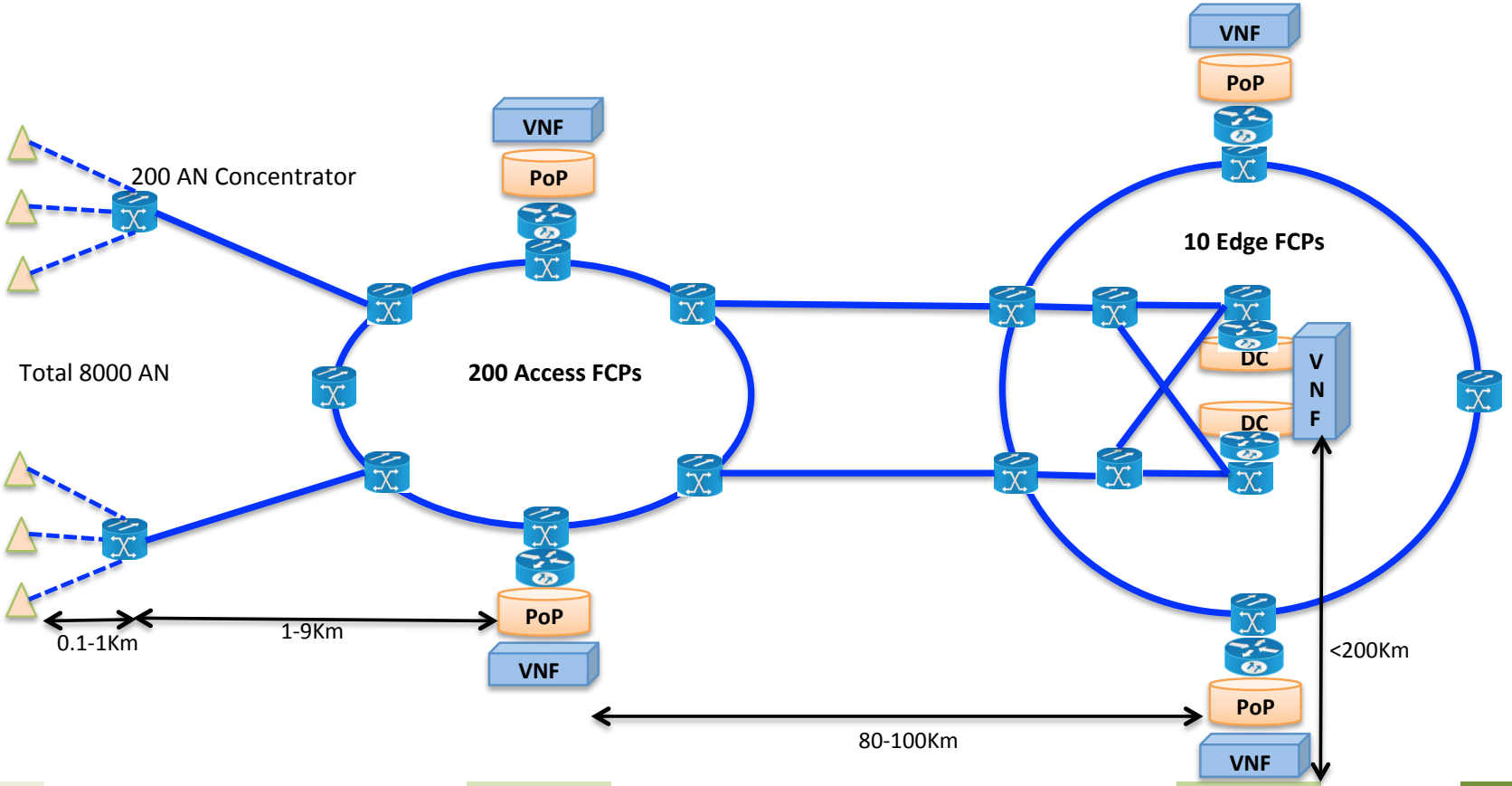
- **FCP**: Fiber Concentration Point, for handling Optical L0/L1/L2

- **PoP**: Point of Presence or NFV Infrastructure where a VNF can be spawned to handle L4/L7. A VNF could be a vBBU on Access Cloud, or a UPF on Edge Cloud.

- **DC:** Data Centre with a full blown Telco Cloud handling user plane and control plane virtual functions of EPC/NGC, PCC, and Applications

Dimensioning with 3-Tier and Without CUPS				
	Tbps			
Peak AN traffic	0.005			
I/O	0.005			
AN	0.01	Number of AN	Per AN traffic	Per AN h/w
O/P	0.01	8000	5 Gbps peak	AAU
AN per Access FCP	40			
		NGFI-I without being split would mean the capacity had to be maintained for peak of each AN located 100m next to each other, but connected to DU upto 10Km far		
Per NGFI-I link	0.4			
I/O per Access FCP	0.4	Multiplexing gain at Access FCP		
I/O Per Access PoP	0.16	No. of Access FCPs	No. of Access PoPs	Servers per PoP
O/P Per Access PoP	0.08	200	50	55
Access PoPs per Edge FCP	5	CU+DU+NGC		
		Based on the conservative algorithm of the NGMN, smoothening the peaks and average, and reducing the NGFI-II transport load by 10 folds		
Per NGFI-II link	0.4			
I/O per Edge FCP	0.4			
I/O per Edge PoP	0.8	No. of Edge FCPs	No. of Edge PoPs	Servers per PoP
O/P per Edge PoP	0.4	10	5	270
Edge PoPs per Core FCP	2.5	CU+NGC		
Per Backhaul link	1			
I/O per Core FCP	1			
I/O per Core DC	1			
O/P per Core DC	0.5	No. of Core FCPs	No. of Core DC	Servers per DC
Total Core DC	2	2	2	350
Total to Apps ->	1	NGC		

Dimensioning with 4-Tier Transport and CUPS				
	Tbps			
Peak AN traffic	0.005			
I/O	0.005			
AN	0.01	Number of AN	Per AN traffic	Per AN h/w
O/P	0.01	8000	5 Gbps peak	AAU
AN per Muxponder	40			
		The AN Concentrator smoothens the peaks and average, and reduces both the NGFI-I transport load and Access Cloud server requirements by 10 folds		
Per NGFI-I link	0.04			
I/O per Access FCP	0.04			
I/O Per Access PoP	0.16	No. of Access FCPs	No. of Access PoPs	Servers per PoP
O/P Per Access PoP	0.08	200	50	30
Access PoPs per Edge FCP	5	DU+CU+UPF		
		Statistical multiplexing gain moved to NGFI-I		
Per NGFI-II link	0.4			
I/O per Edge FCP	0.4			
I/O per Edge PoP	0.8	No. of Edge FCPs	No. of Edge PoPs	Servers per PoP
O/P per Edge PoP	0.4	10	5	160
Edge PoPs per Core FCP	2.5	CU+UPF		
Per Backhaul link	1			
I/O per Core FCP	1			
I/O per Core DC	1			
O/P per Core DC	0.5	No. of Core FCPs	No. of Core DC	Servers per DC
Total Core DC	2	2	2	350
Total to Apps ->	1	NGC (AMF+SMF+UPF+PCC)		



AN	AN Concentrator		50 Access Cloud PoPs		5 Edge Cloud PoPs		2 Core Cloud DCs
RU			DU		CU		AMF+SMF+UPF
	NGFI-I'	NGFI-I		NGFI-II		Backhaul	
RU			DU		CU+UPF+MEC		AMF+SMF
	100 µs			1 ms		10 ms	
RU			DU+CU+UPF+MEC				AMF+SMF
	01.-1Km	1-9Km		80-100 Km		< 200 Km	
RU			DU		CU		EPC

AN	AN Concentrator		50 Access Cloud PoPs		5 Edge Cloud PoPs		2 Core Cloud DCs
RU			DU		CU		AMF+SMF+UPF
	NGFI-I'	NGFI-I		NGFI-II		Backhaul	
RU			DU		CU+UPF+MEC		AMF+SMF
	100 µs			1 ms		10 ms	
RU			DU+CU+UPF+MEC				AMF+SMF
	01.-1Km	1-9Km		80-100 Km		< 200 Km	
RU			DU		CU		EPC

Without any concern about latency or transport capacity the UPF stays in Core with high capacity to support massive IoT apps server load

Without much concern about latency, UPF need not move to load Access Cloud, but to save backhaul capacity it must move to Edge Cloud with UHD cached

UPF moves closer for under 1ms latency requirement, and app such as V2X can also be spwan at Access Cloud

Without much concern about latency, CU can stay at Edge Cloud instead of loading Access Cloud, and without CUPS, the EPC remains in Core Cloud