The Total Cost of Ownership of Stackable Switches

Executive Summary

One of the most important switch innovations of recent years has been the inclusion of specialized stacking ports to connect multiple switches more efficiently in larger configurations. Stackable switches and directors are now available from Brocade, CISCO, Juniper, QLogic and other vendors, enabling the creation of multi-switch Networks with little user disruption and cost. This report will compare the total cost of ownership for SANs using 24-port stackable Fibre Channel switches compared with traditional 24-port non-stacking switches.

The stackable switches compared in this analysis feature twenty 8Gb user ports for connecting servers to storage, plus four switch-to-switch stacking ports which can run at 10Gb or 20Gb. The advantage of stacking is that you can increase the number of available user ports by up to 25% as you grow a Fibre Channel network with the same number of switches.

The Total Cost of Ownership (TCO) analysis case study shown below concludes that for an FC fabric with a 34-user-port initial configuration growing by 20 ports per year, the cost/useable user port per year is $752 for non-stackable switches, and $433/year for stackable switches. Wikibon calculated the number of "useable user port years" (34 ports in year 1, 54 in year 2, 74 in year 3, 94 in year 4 for a sum of 256 user port years) and divided this number into the total cost of ownership to calculate a cost/useable user port per year.)

Wikibon concludes that the TCO for non-stackable switches is 74% more expensive than for stackable switches. The savings in the first year of the case study cost is $2,440, the Net Present Value (NPV) is $70,739 and the breakeven is immediate. The only environment when the stackable switches might not be justified is in very low growth scenarios where the number of switches would never be greater than two.

Wikibon strongly recommends that senior IT management and network managers include stackable switches on RFPs.

Switch Topology Fundamentals: Traditional Non-Stackable Switches

When the number of ports required is greater than a single switch can accommodate, a second switch can be used to grow the network. The traditional way of growing the switch network was to deploy the user ports themselves as interconnects between switches. For example with two switches, you connect two user ports on the first switch with two user ports on the second switch via two fiber optic cables.

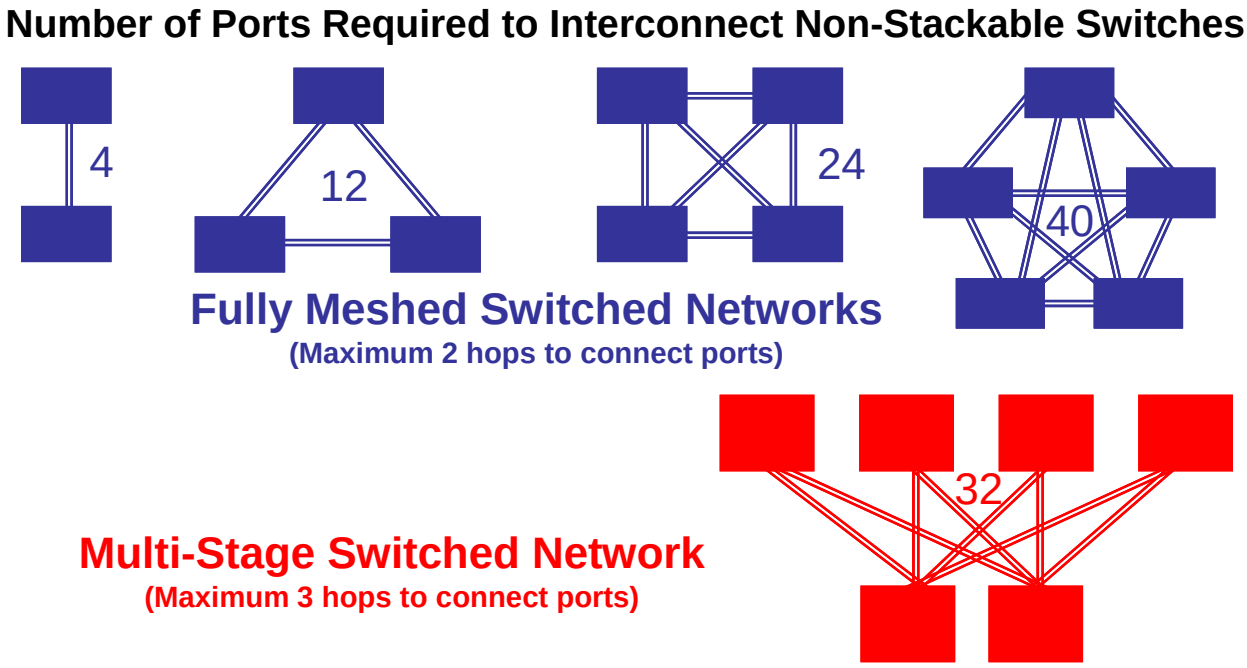

Figure 1 - Switch Topologies (two ports per switch are used to connect each switch pair)

Figure 1 shows how switches can be configured together as the number of switches increases. With 24-port non-stackable switches, up to 5 switches can be arranged together in a fully meshed network, as shown in the blue configurations in Figure 1. In a fully meshed network, any edge port can reach any other edge port in a maximum of two hops. Performance is consistent, the network maintains maximum flexibility in connecting servers and storage arrays, maximizes throughput, and minimizes latency. The numbers in Figure 1 refer to the number of interconnection ports required to connect the switches. The formula is 2n(n-1), where n is the number of switches. Connecting 5 switches takes 40 ports. To connect 6 switches in this topology would take 60 ports – adding the sixth switch would therefore only provide 4 additional user ports. It is not practical or economical to have a fully meshed network above five 24-port switches if user ports are being used for switch interconnects.

Above 5 switches, a multi-stage switching topology is required, as shown in the red configuration in Figure 1. The advantage of this is that fewer ports are required to connect the switches. Only 32 are required for connecting six switches, as opposed to 60 for a fully meshed topology. However, multi-stage topologies do not guarantee just 2 switch hops between any two end points – about half of the time, 3 hops will be needed. It is much harder to balance the traffic in a multi-stage topology, performance and resilience is significantly lower, latency is higher and network administrative costs are higher. You go to multi-stage when you have to, not because you want to.

Figure 2 shows the relationship between the total number of ports, the number of interconnect ports and the net number of available user ports, as the number of traditional 24-port switches increases from two to eight switches. To install 80 user ports, 120 ports have to be purchased. To install 128 user ports, a total of 192 ports are required – and a lower-performing multi-stage topology must be used.

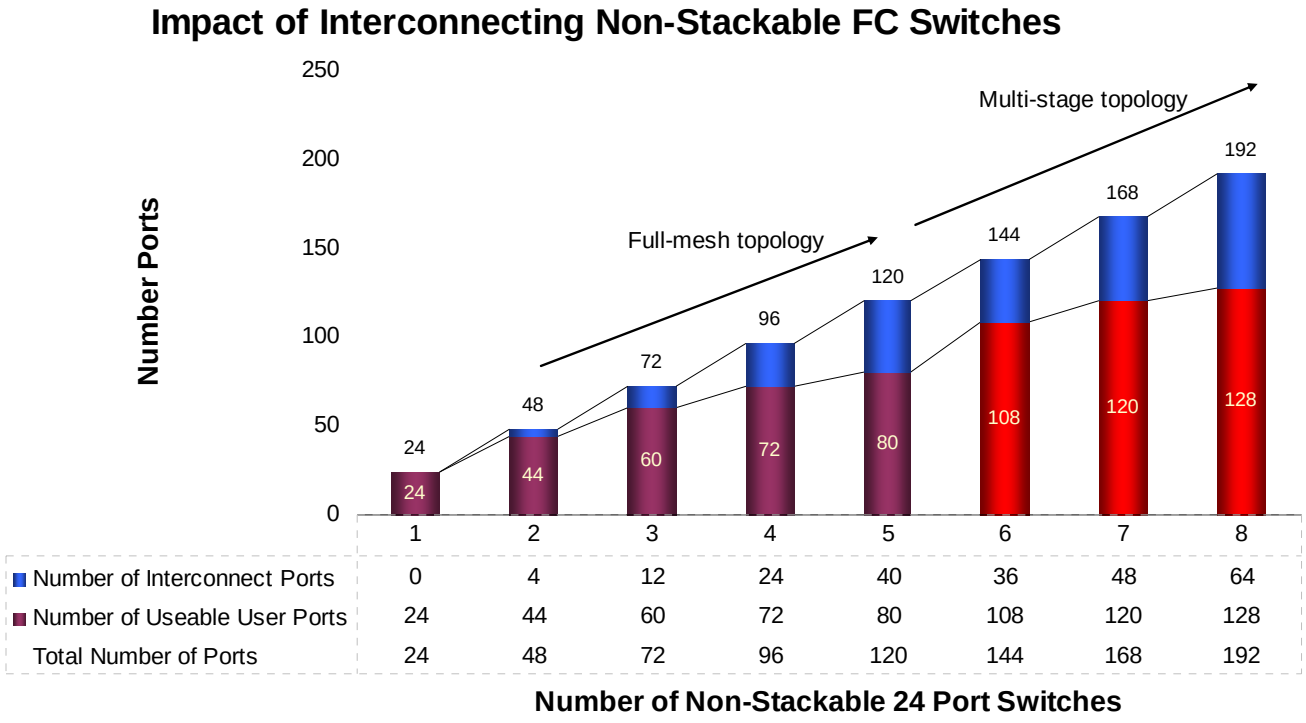

Figure 2 - Impact of Connecting Non-Stackable 24-Port FC Switches on Available User Port Count

The Impact of Stackable Switches

The 24-port stackable switch compared in this analysis features 20 8Gb user ports, and 4 10Gb or 20Gb stacking ports. Running at 10Gb mode, each stacking port provides the bandwidth equivalent of three 4Gb FC ports, and with an upgrade to 20Gb, each stacking port is equivalent to three 8Gb FC ports. Stacking creates more bandwidth between switches as the topologies are built out. The only disadvantage is that on the smallest scale-out configuration (2 switches) the stackable switch scenario offers 10% fewer user ports.

At five switches in a full-mesh topology, the stackable switches deliver 25% more usable ports (100 vs. 80). A stacking port has the equivalent of 3 times the bandwidth of an FC port, delivers 50% more inter-switch throughput than 2 FC ports.

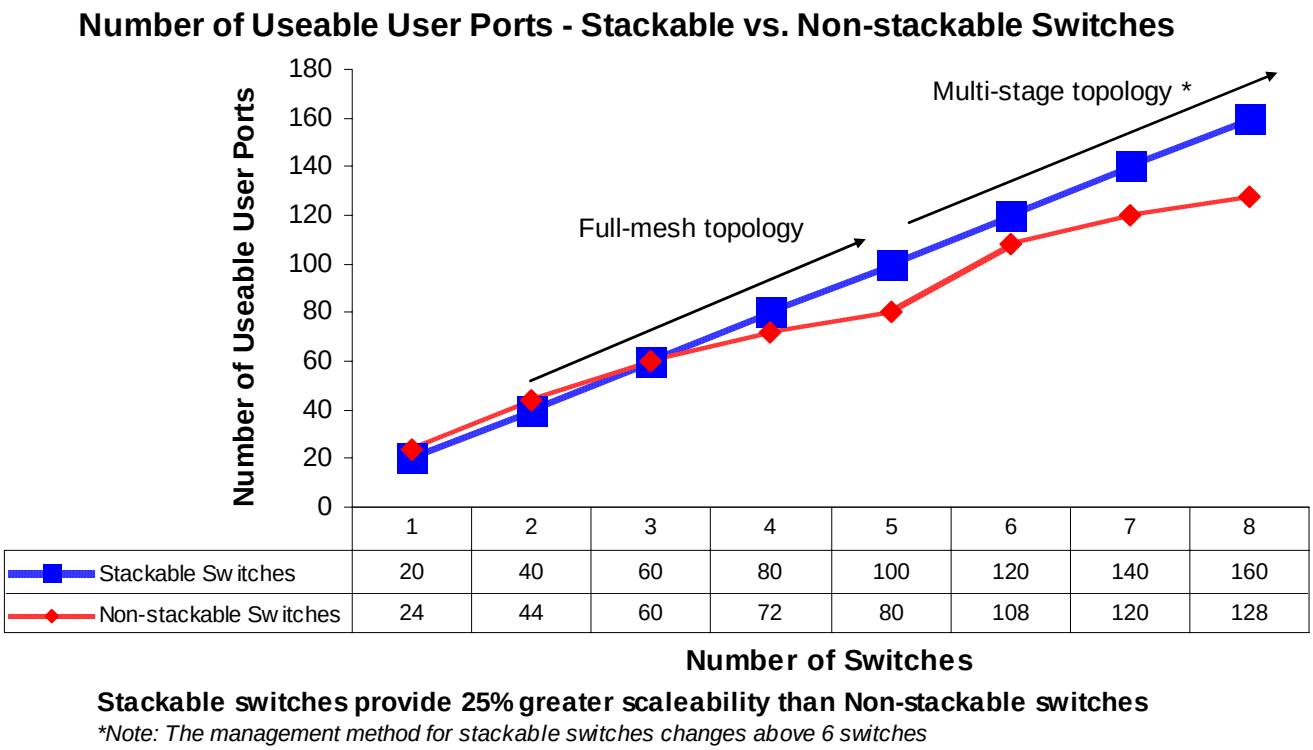

Figure 3 - Comparison of Number of User Ports for Stackable and Non-stackable Switches

Case Study of Total Cost of Ownership

The case study scenario is a requirement to deliver an initial 34 user ports, and to grow this by 20 ports each year. The overall timescale is 4 years. The assumptions are given in table 1 below.

Assumptions	Stackable Port Switch	Non-Stackable Port Switch
Initial Number of User Ports	34	34
Additional User Ports/Year	20	20
Cost of FC Port	$500	$500
Cost of Stackable Port (10 - 20Gb upgrade)	$0	n/a
Cost of FC Optical Interconnect Cable	n/a	$50
Cost of 10Gb/20Gb Integrated Cable/Connector for Stackable Ports	$360	n/a
Software License/switch (Management, Traditional Trunking)	n/a	$5,000
Software License/site (Management, Stackable Trunking)	$1,000	n/a
Number of Switches when Management Software required	3	3
Cost of Reorganizing Fully-meshed Switch Topology to Multi-stage (1 person weeks)	n/a	$5,000
Fully Loaded Network Administrator Cost/Year	$120,000	$120,000
Effective Hours/Week for Network Administrator	35	35

Table 1 - Case Study Assumptions

Table 2 shows a detailed TCO for non-stackable switches. The number of usable ports required is 34 in the first year, growing to 94 in year 4. The total number of usable ports is 256. In year 4, the topology switches from full-mesh to multi-stage to meet the growth requirements. The cost of completely reorganizing the existing switches and changing the topology is estimated at $2,500 (1 person weeks from a network administrator). This is a disruptive installation, and would require careful planning. The total cost over four years is $192,534, and the cost per usable port per year is $752.

Traditional Non-Stackable Switch Approach (24 8Gb FC Port Switches)	Year 1	Year 2	Year 3	Multi-stage Year 4	Total
Server & Storage Ports to be Switched	34	54	74	94	**256**
Number of switches required	2	3	5	6	
FC Ports Required	38	66	114	130	
FC Port Costs ($500/Port)	$ 19,000	$ 14,000	$ 24,000	$ 8,000	**$ 65,000**
Interconnect FC Cable Costs ($50/Cable)	$ 200	$ 400	$ 1,400	$ -	**$ 2,000**
Software License (Management & Trunking, $5,000/Switch)		$ 15,000	$ 10,000	$ 5,000	**$ 30,000**
Implementation Costs (12% Capital Costs fully meshed topology)	$ 2,280	$ 3,480	$ 4,080	$ 1,560	**$ 11,400**
Implementation Costs (Reorganization of Network Topology)				$ 2,500	**$ 2,500**
Maintenance Costs/Year	$ 3,420	$ 8,640	$ 14,760	$ 17,100	**$ 43,920**
Network Administration (0.5 hour/switch/week fully-meshed, 1 hour multi-stage)	$ 3,429	$ 5,143	$ 8,571	$ 20,571	**$ 37,714**
Total 4-year Switch Costs	**$ 28,329**	**$ 46,663**	**$ 62,811**	**$ 54,731**	**$ 192,534**
Cost of useable user port/year = $192,534/256 =					**$ 752**

Note - In year 4 switch topology must change from fully meshed to multi-stage, with lower performance and availability characteristics

Table 2 - Total Cost of Ownership for Traditional Non-stackable Switches

Table 3 gives the TCO for stackable switches. The number of usable port years (256) is the same as in Table 2. The stackable ports are upgraded to 20Gb (3 x 8Gb FC) when the switch count reaches 4 to ensure sufficient inter-switch bandwidth. The ability of stackable switches to grow linearly is reflected in the more consistent incremental costs of growing the configuration. The overall total cost of ownership for the switches is $110,940 over four years, and the cost per useable port per year is $433. Compared to stackable switches, the cost of traditional non-stackable switches is 74% higher.

Stackable Switch Approach (20 FC 8Gb Port + 4 10/20Gb Port Switches)	Year 1	Year 2	Year 3	Year 4	Total
Server & Storage Ports to be Switched	34	54	74	94	**256**
Number of switches required	2	3	4	5	
FC Ports Required with Stacking Switch Approach	34	54	74	94	
FC Port Costs ($500/Port)	$ 17,000	$ 10,000	$ 10,000	$ 10,000	**$ 47,000**
Stackable Ports (14 x 10Gb, $0/port)	$ -	$ -	$ -	$ -	**$ -**
Stackable Ports (upgrade 10Gb to 20Gb, $200/port)			$ 4,800	$ 1,200	**$ 6,000**
10Gb/20Gb Integrated Cable/Connector Costs ($360/Cable)	$ 360	$ 720	$ 1,080	$ 1,440	**$ 3,600**
Software License (Management, Stackable Trunking) $1,000/Site		$ 1,000	$ -	$ -	**$ 1,000**
Implementation Costs (12% Capital Costs)	$ 2,040	$ 1,320	$ 1,200	$ 1,200	**$ 5,760**
Maintenance Costs/Year	$ 3,060	$ 5,040	$ 6,840	$ 8,640	**$ 23,580**
Network Administration (0.5 hour/switch/week fully-meshed, 1 hour multi-stage)	$ 3,429	$ 5,143	$ 6,857	$ 8,571	**$ 24,000**
Total 4-year Switch Costs	**$ 25,889**	**$ 23,223**	**$ 30,777**	**$ 31,051**	**$ 110,940**
Cost of useable user port/year = $110,940/256 =					**$ 433**

Table 3 - Total Cost of Ownership for Stackable Switches

The financial metrics for the case study are given in Table 4. There is no first year investment (the first year savings are $2,440). The Net Present Value (NPV) is $70,739, and the breakeven is immediate.

Financial Metrics	
First Year Investment	**$ (2,440)**
NPV (5%)	**$70,739**
Breakeven (Months)	**-**
Annual ROI	**n/a**
IRR	**n/a**

Table 4 - Case Study Financial Metrics

Conclusions and Recommendations

Wikibon believes that stackable switches are a significant improvement over non-stackable switches. The initial cost difference for a small configuration is minimal. For a larger configuration stackable switches will usually entail significantly lower costs. Stackable switches offer higher (25%) usable user port counts, easier configuration growth and better inter-switch bandwidth and manageability.

Action Item: Stackable switches are more efficient and cost effective way of scaling out FC switches. Senior IT management and Network Managers should include stackable switches in their RFPs, and ensure that realistic growth projections are included in the cost analysis.