ITU Workshop on "Cloud Computing"

(Tunis, Tunisia, 18-19 June 2012)

Emerging Architecture for Cloud Computing

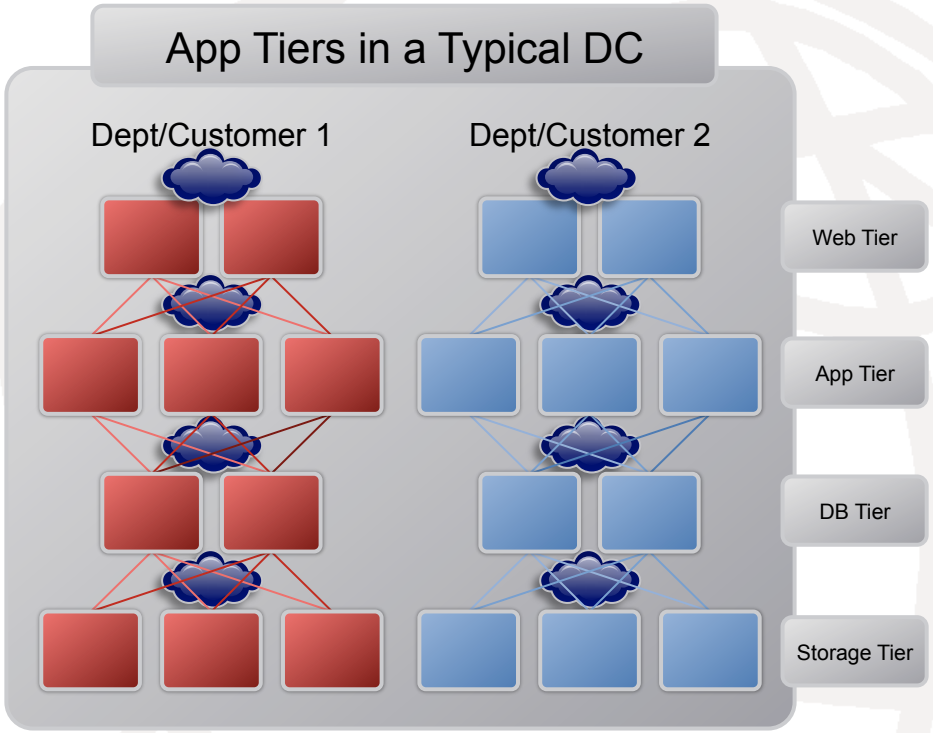
Monique Jeanne Morrow
Distinguished Engineer and CTO
Asia-Pac
mmorrow@cisco.com

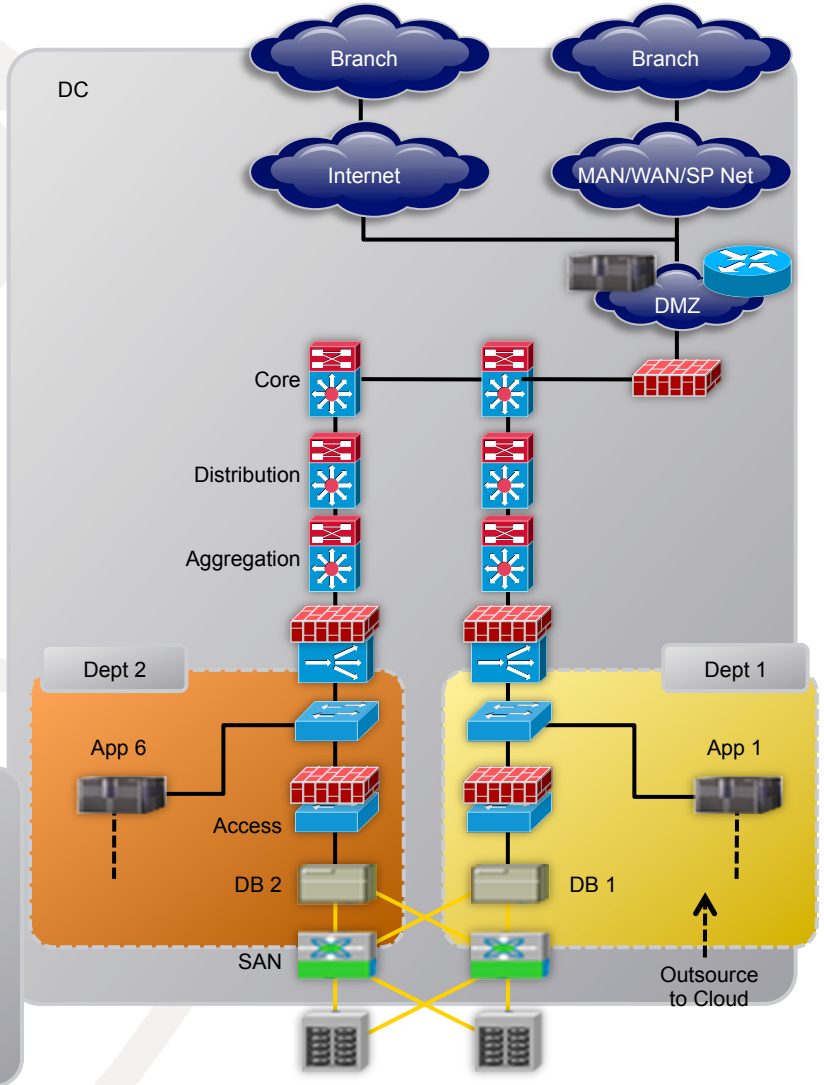
My Co-Authors

Masum Z. Hasan,Sree Gudreddi, Edgar Magana and Lewis Tucker

Cisco CTO Office

Remember: Network Factored Cloud?

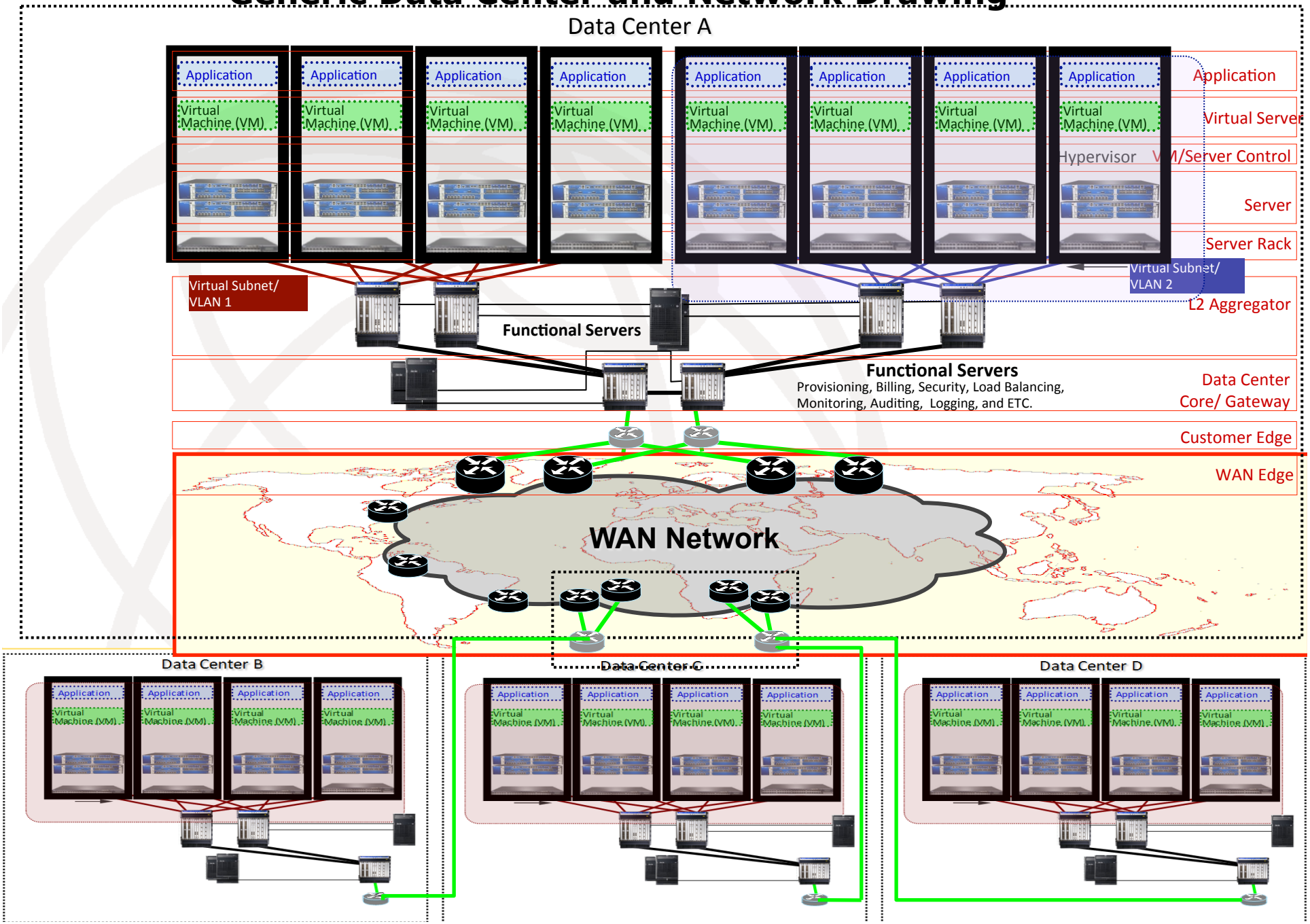




Tiered Network:

- Storage
- SAN/NAS
- Access: App tiers reside here
- Aggregation, distribution, core (part of app tiers may reside here)
- DMZ
- Campus core/MAN/WAN edges

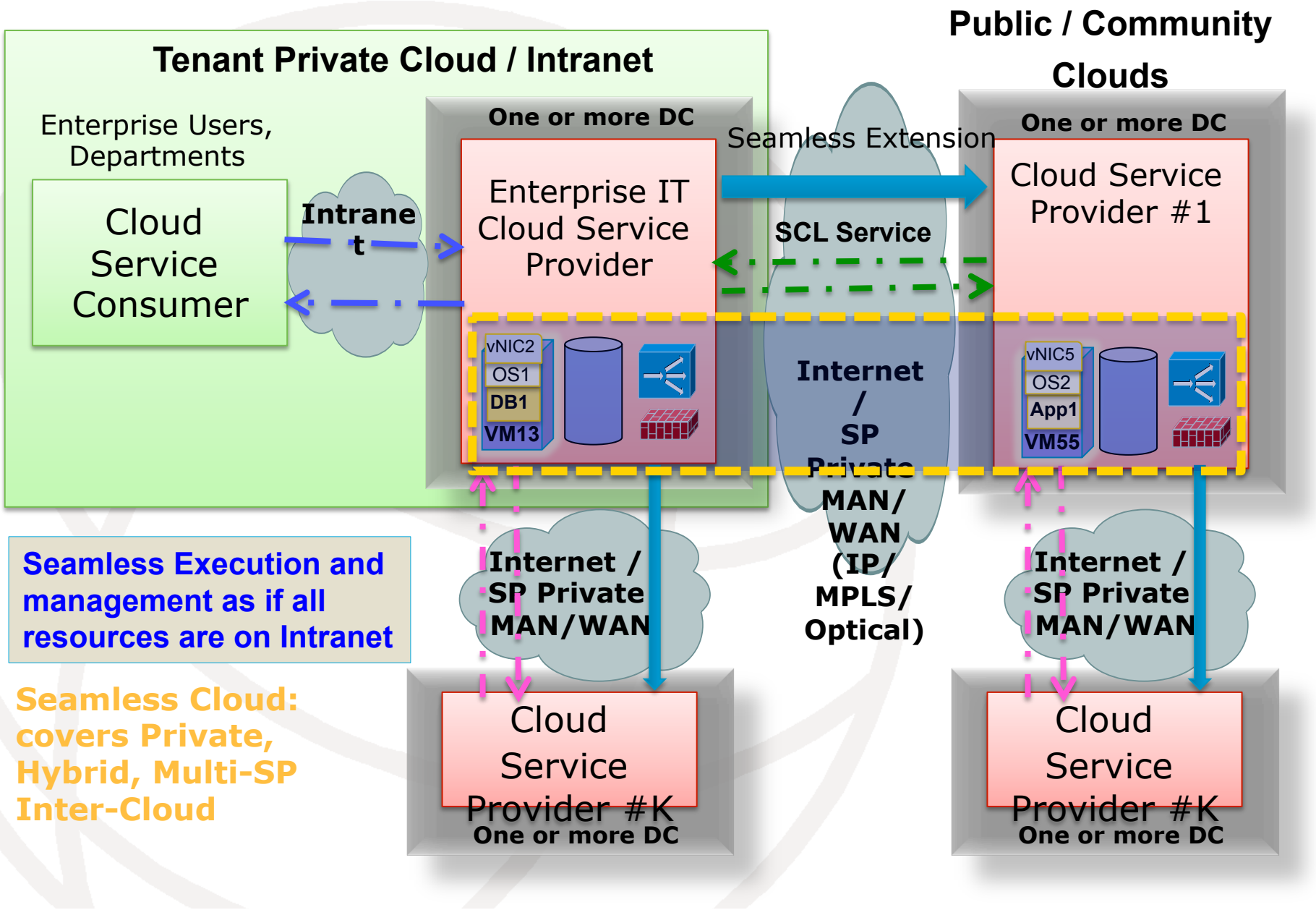
Generic Data Center and Network Drawing



Workloads categorisation (and generalisations)

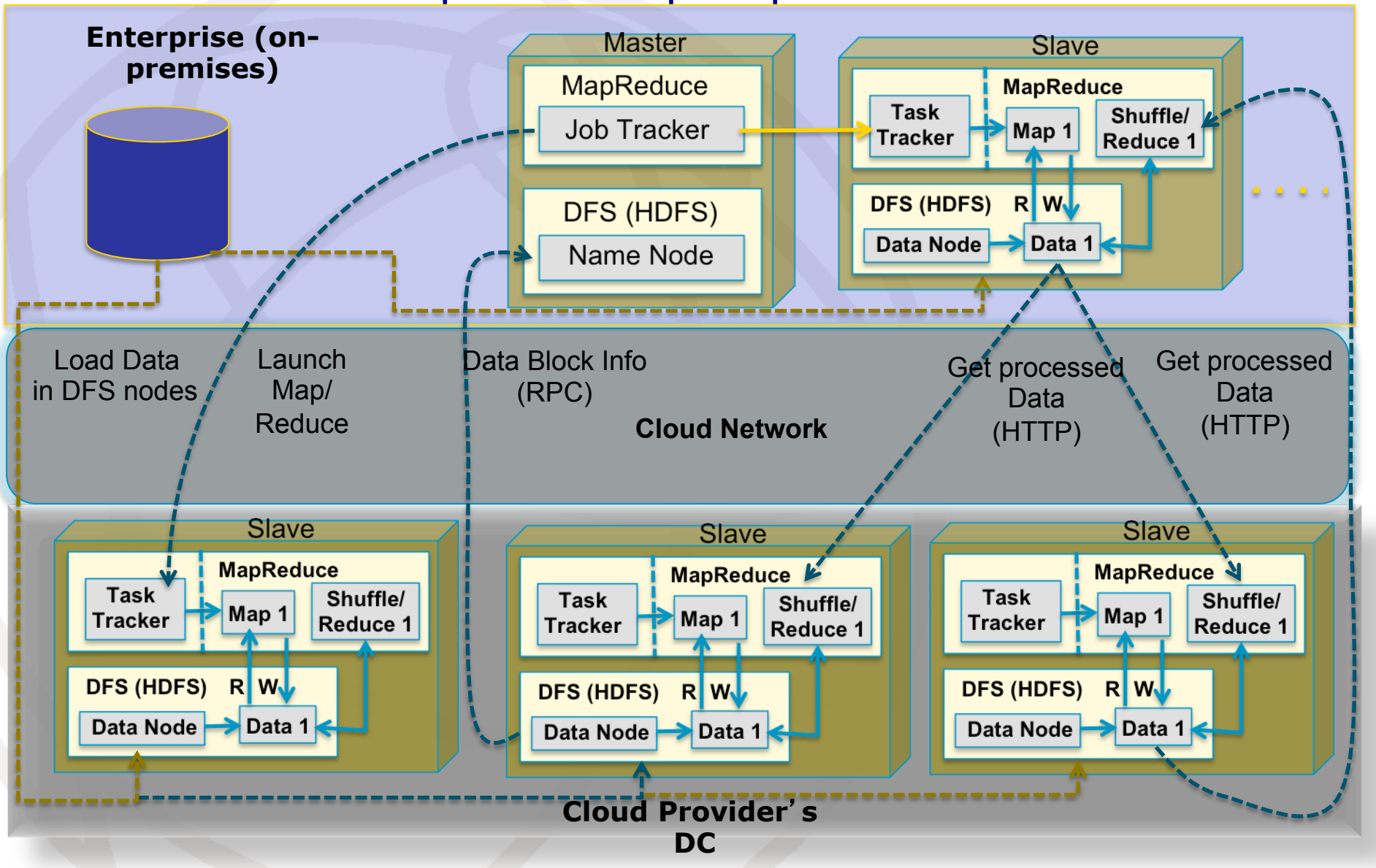
Type of Workload	Example	Implication
Stateful	Shopping cart, collaboration services	Synchronisation
Stateless	HTTP (without cookies)	No synchronisation required
Live	Mission-critical ERP, hosted UC&C services	Performance, distance, application tolerances
Offline	Document management, archives	-
Bursty	Voting system, VoD, ticket booking	Capacity management
Non-bursty	Data analysis	
Time dependent (predictability)	Desktop as a Service (during business hours vs. non-business hours)	'Follow the moon' migration
Shared	Utility hosting (SaaS)	-
Grid	Grand challenge problems – derivatives analysis at NAB, SETI	Higher utilisation possible – requires HPC environments
Transactional	Billing system	Local storage & compute
Batch	Payroll	Storage & compute can be remote

Putting it All Together: Seamless Cloud



Use case: Distributed Applications on Seamless [Hybrid/Inter] Cloud

Example: Hadoop MapReduce



Cloud Management Framework Architecture

- Cloud Service and Resource Management
- Cloud Abstraction
- Cloud service interfaces to Cloud Service Consumers

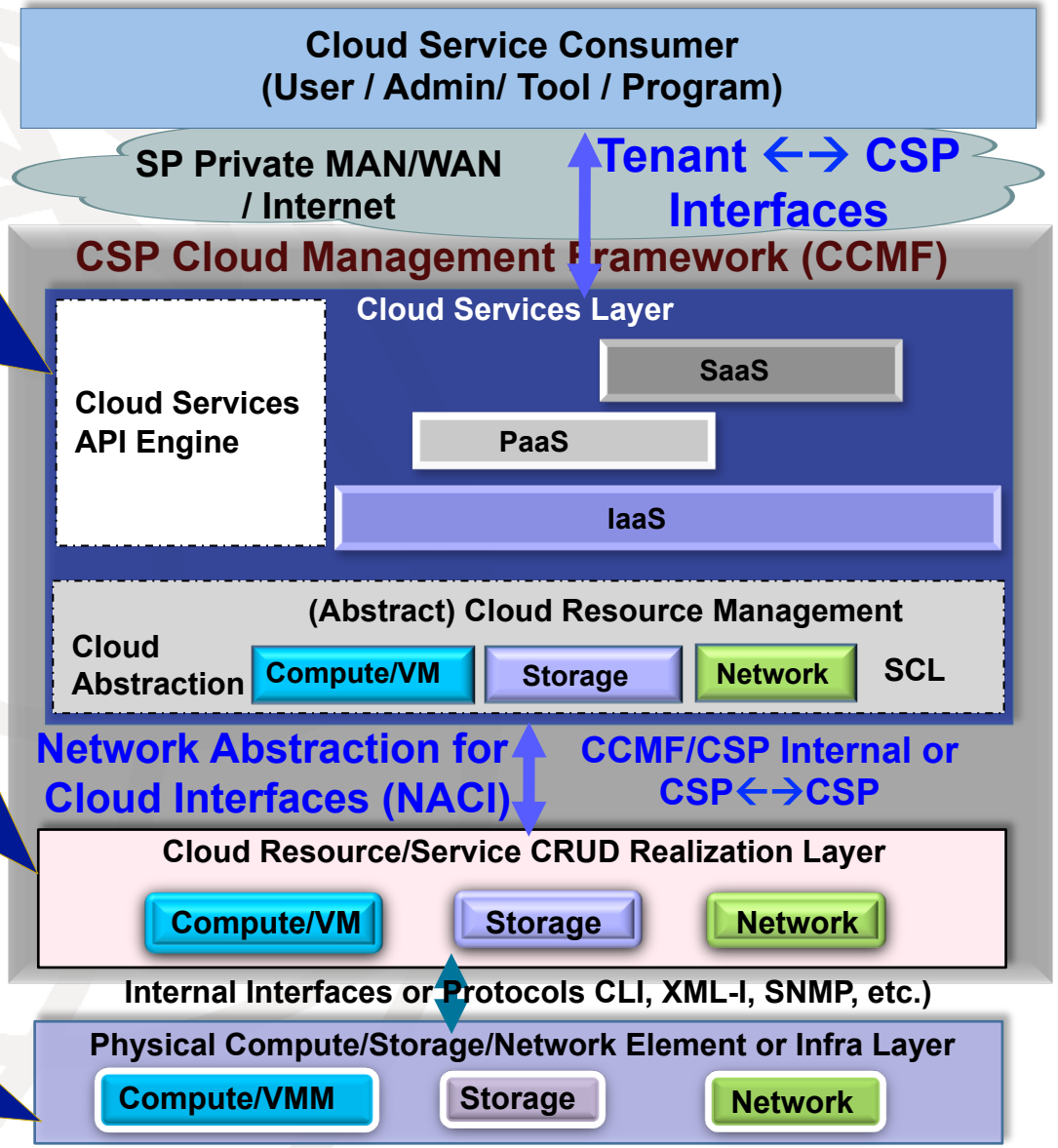
→ Software :Examples: vCloud Director, Amazon AWS, **OpenStack (Cloud Abstraction)**

Compute, Storage, Network abstraction & Management (config / provisioning / monitoring), Orchestration and Automation

→Software
Example: NMS/EMS, Orchestrator/ Management Systems, Libvirt API, **OpenStack NACI for Inter-Cloud, DQCS**

Embedded Management, Control in devices

→ Software and Hardware

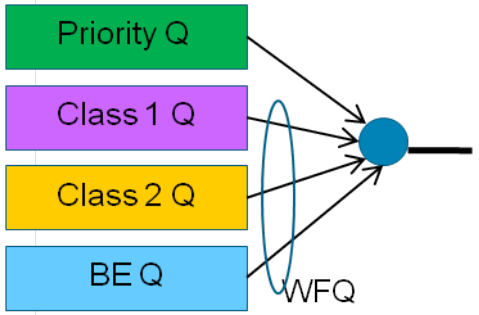


Service Class based DQCS

RFC 4954

Service Class Name	DSCP Name	DSCP Value	Application Examples
Network Control	CS6	110000	Network routing
Telephony	EF	101110	IP Telephony bearer
Signaling	CS5	101000	IP Telephony signaling
Multimedia Conferencing	AF41,AF42 AF43	100010,100100 100110	H.323/V2 video conferencing (adaptive)
Real-Time Interactive	CS4	100000	Video conferencing and Interactive gaming
Multimedia Streaming	AF31,AF32 AF33	011010,011100 011110	Streaming video and audio on demand
Broadcast Video	CS3	011000	Broadcast TV & live events
Low-Latency Data	AF21,AF22 AF23	010010,010100 010110	Client/server transactions Web-based ordering
OAM	CS2	010000	OAM&P
High-Throughput Data	AF11,AF12 AF13	001010,001100 001110	Store and forward applications
Standard	DF (CS0)	000000	Undifferentiated applications
Low-Priority Data	CS1	001000	Any flow that has no BW assurance

- Application or Service class based
- T2CSP: specify service class (such as Multimedia Streaming) when acquiring compute/storage resource
- CSP-I/NACI: Realize_QoS (DSCP, BW, …, points_in_network)
- CSP-CSP
  - Delegate T2CSP request



ITU Y.1541

Network performance parameter	Nature of network performance objective	QoS Classes					
		Class 0	Class 1	Class 2	Class 3	Class 4	Class 5 Unspecified
IPTD	Upper bound on the mean IPTD	100 ms	400 ms	100 ms	400 ms	1 s	U
IPDV	Upper bound on the 1 to 10^{-3} quantile of IPTD minus the minimum IPTD)	50 ms	50 ms	U	U	U	U
IPLR	Upper bound on the packet loss probability	1×10^{-3})	1×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-3}	U
IPER	Upper bound	1×10^{-4}					U
NOTE: For clarity several important footnotes to this table contained in ITU-T Recommendation Y.1541 [5] have been omitted from the present document. Providers should consult the full table and notes in ITU-T Recommendation Y.1541 [5] before implementing these Classes.							
"U" means "unspecified" or "unbounded".							

QoS class	Applications (examples)	Node mechanisms	Network techniques
0	Real-time, jitter sensitive, high interaction (VoIP, VTC)	Separate queue with preferential servicing, traffic grooming	Constrained routing and distance
1	Real-time, jitter sensitive, interactive (VoIP, VTC)		Less constrained routing and distances
2	Transaction data, highly interactive (Signalling)	Separate queue, drop priority	Constrained routing and distance
3	Transaction data, interactive		Less constrained routing and distances
4	Low loss only (short transactions, bulk data, video streaming)	Long queue, drop priority	Any route/path
5	Traditional applications of default IP networks	Separate queue (lowest priority)	Any route/path

- IPTD: one way
- Y.1541 defines IP Delay Variation in terms of the difference between the minimum and maximum transmission delays during some time interval.
- IPTDmin = Minimum IP transmission delay
- IPTDupper = 99.9% percentile of IP transmission delay
- IPDV = IPTDupper – IPTDmin

RFC 4594, Y.1540/1 and other Recommendations

Service Class Name	Traffic Characteristics	Tolerance to Loss	Tolerance to Delay	Tolerance to Jitter	ITU Y.1540/1
Network Control	Variable size packets, mostly inelastic short messages, but traffic can also burst (BGP)	Low	Low	Yes	Class 3
Telephony	Fixed-size small packets, constant emission rate, inelastic and low-rate flows	Very Low	Very Low	Very Low	Class 0
Signaling	Variable size packets, some what bursty short-lived flows	Low	Low	Yes	Class 3
Multimedia Conferencing	Variable size packets, constant transmit interval, rate adaptive, reacts to loss	Low - Medium	Very Low	Low	Class 0
Real-Time Interactive	RTP/UDP streams, inelastic, mostly variable rate	Low	Very Low	Low	Class 0
Multimedia Streaming	Variable size packets, elastic with variable rate	Low - Medium	Medium	Yes	Class 4
Broadcast Video	Constant and variable rate, inelastic, non-bursty flows	Very Low	Medium	Low	Class 1
Low-Latency Data	Variable rate, bursty short-lived elastic flows	Low	Low - Medium	Yes	Class 3
OAM	Variable size packets, elastic & inelastic flows	Low	Medium	Yes	Class 4
High-Throughput Data	Variable rate, bursty long-lived elastic flows	Low	Medium - High	Yes	Class 4
Standard	A bit of everything	Not Specified			Class 5
Low-Priority Data	Non-real-time and elastic	High	High	Yes	Class 5

IPLR/IPTD/IPDV
Loss/Delay/Jitter

Ignore IPER (BER)

Class 0:
.001/100ms/50ms

Class 1:
.001/400ms/50ms

Class 2
.001/100/U

Class 3:
.001/400ms/U

Class 4:
.001/1s/U

Class 5:
U/U/U

Other recommendations:

Streaming video:
Loss: 2% (2 loss every 100)
Delay: 5s
Jitter: Unspecified

Video Conferencing:
Loss: 1% (1 loss every 100)
Delay: One-way 200ms
Jitter: Average 30ms
Bandwidth: Extra 20% for burst

Voice:
Loss: <=1%
Delay: One-way 200ms
Jitter: Average 30ms
Bandwidth per call: 21-106 kbps based on sampling rate, codec, frame/packet overhead

Conclusions and Recommendations

- Now looking at offering Differentiated Cloud Services
- Inter-Cloud and so called Federated Constructs now
- Prototyping Service capabilities in progress
- Cloud Standards Activities very active