Integration Technical Conference 2019

API Connect and DataPower Gateway

Performance Best Practices

IBM **Cloud**

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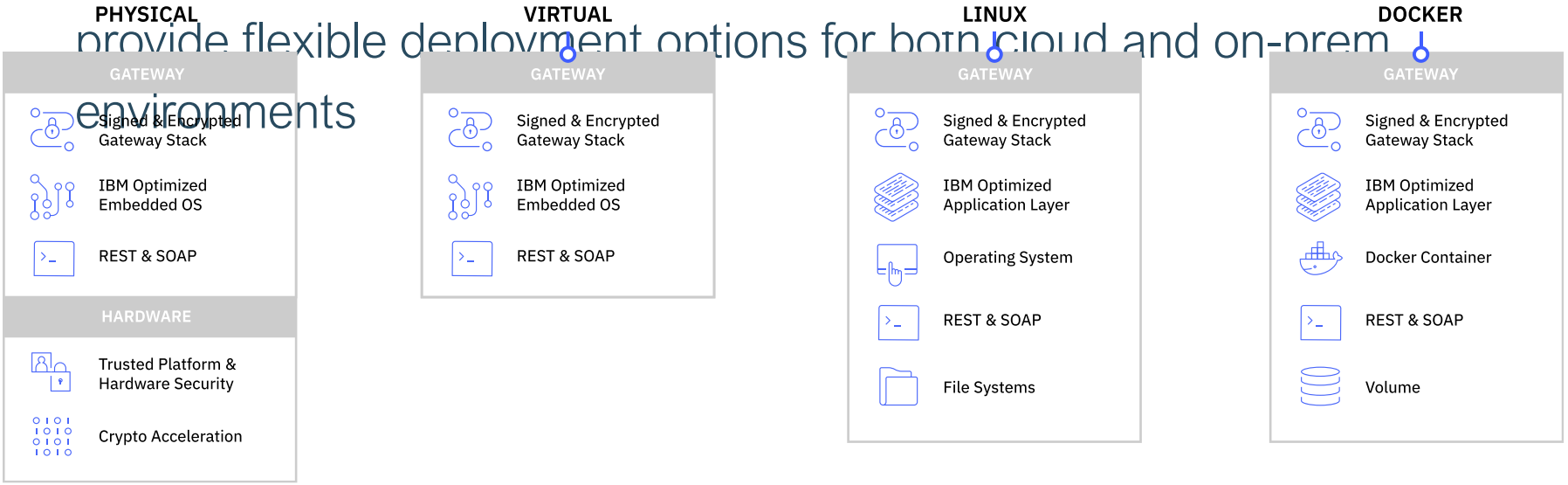
DataPower Gateways can deploy anywhere…

- **Physical appliances**: All-in-one (HW / SW), DMZ-ready with physical security including crypto acceleration and optional hardware security module (HSM)
- **Software**: virtual appliance, application (Linux) & container (Docker) provide flexible deployment options for born cloud and on-prem environments



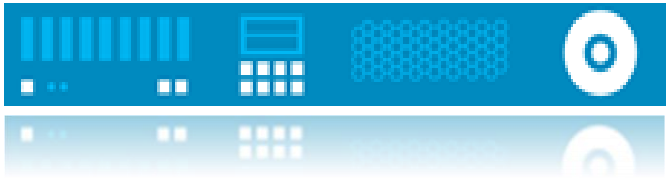
Choosing the right Gateway form factor

Physical appliances provides the most comprehensive security combined physical with firmware security.

Virtual, Linux and Container offer “right sized” units of capacity, as few as 4 CPUs

Container provide ability to leverage auto-scaling and runtime health monitoring

Container is “cloud ready” to facilitate both public and private cloud based deployments



docker

kubernetes

vmware

ubuntu

redhat

Single API Gateway supports 30K TPS with 8 ms latency!

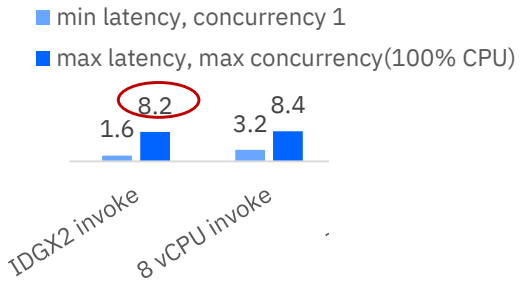
Natively built API Gateway using purpose-built technology for native OpenAPI/Swagger REST and SOAP APIs

Multi-cloud scalability and extensibility to help meet SLAs and improve client user experience

IDG X2 physical appliances use the equivalent of 48 vCPU

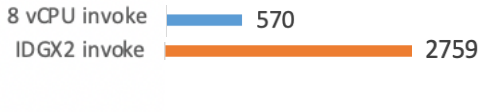
Max Throughput @ 100% CPU

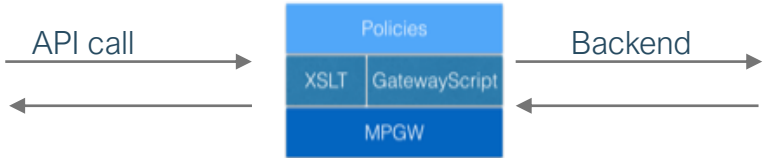
Latency(mS) @ Min/Max Concurrency



10X increased performance with natively built API Gateway

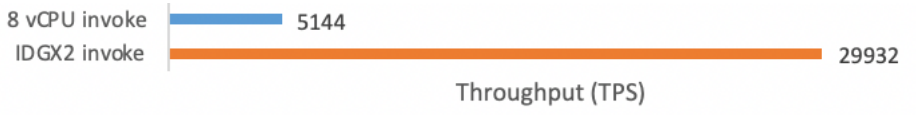
Before: DP Multi protocol Gateway Service

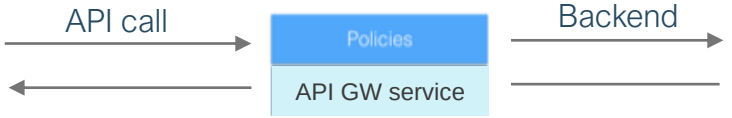




10X increased performance with natively built API Gateway for both virtual and physical appliances

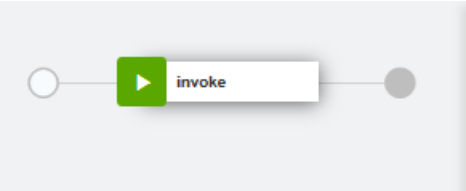
New: Native API Gateway Service

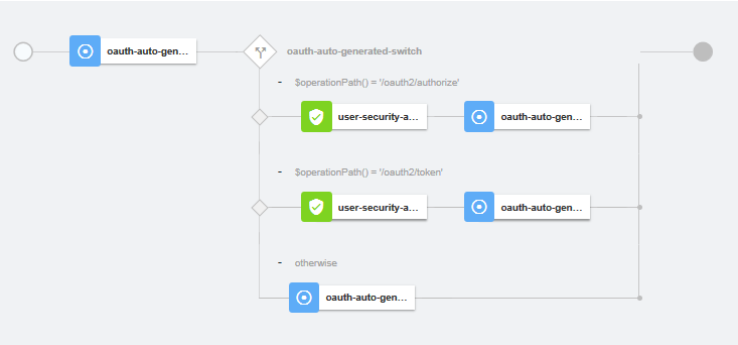


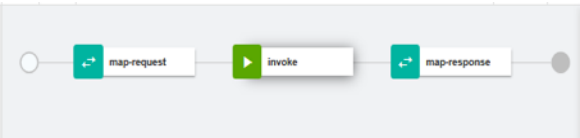


Benchmark APIs

Invoke (Simple)	Invoke + Security (Medium)	Invoke + Transformation (Complex)
Invoke policy	Invoke Policy + OAuth Security	Map + Invoke Policy + Map







Each Benchmark API Assembly includes:

- Rate-limit
- Activity-log
- Client-id validation

Each Benchmark APIs runs with

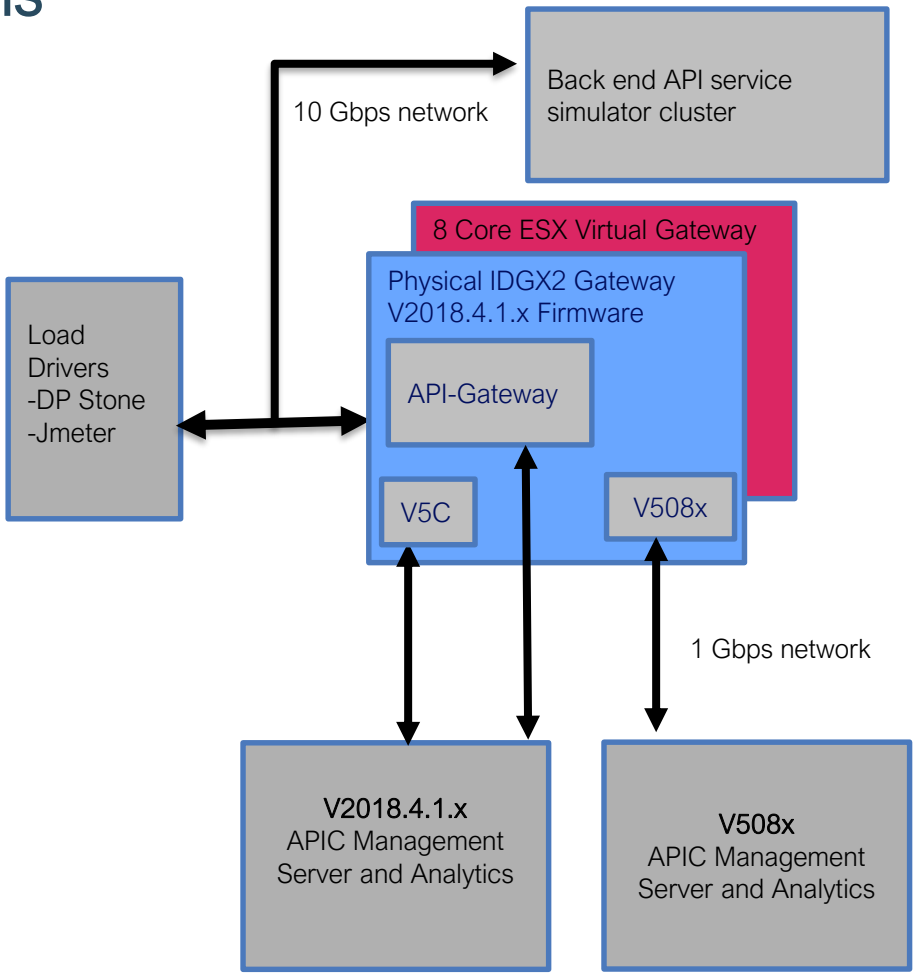
- 4KB request payload
- Running on IDGX2 and 8 vCPU virtual gateways

Performance Measurement Details

Single gateway service used for comparative analysis across three gateway types:

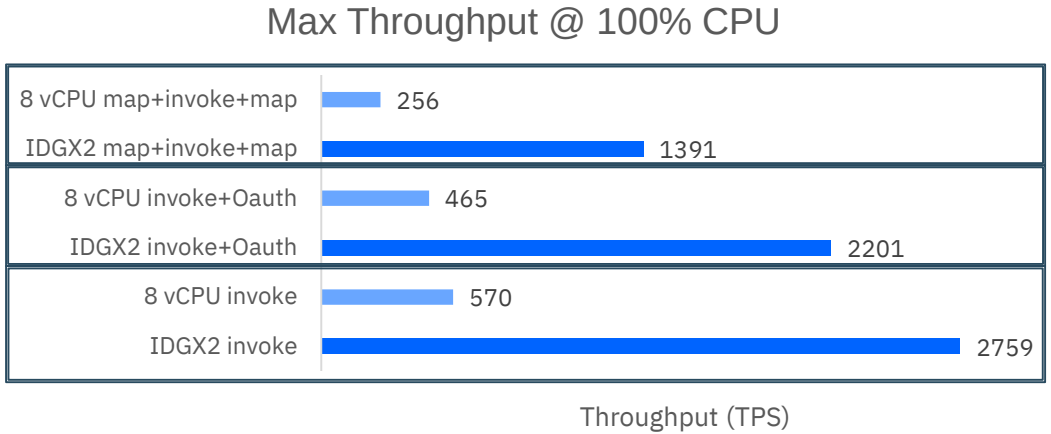
- API Gateway
- V2018 Multi-protocol Gateway (v5c)
- V5 Multi-protocol Gateway

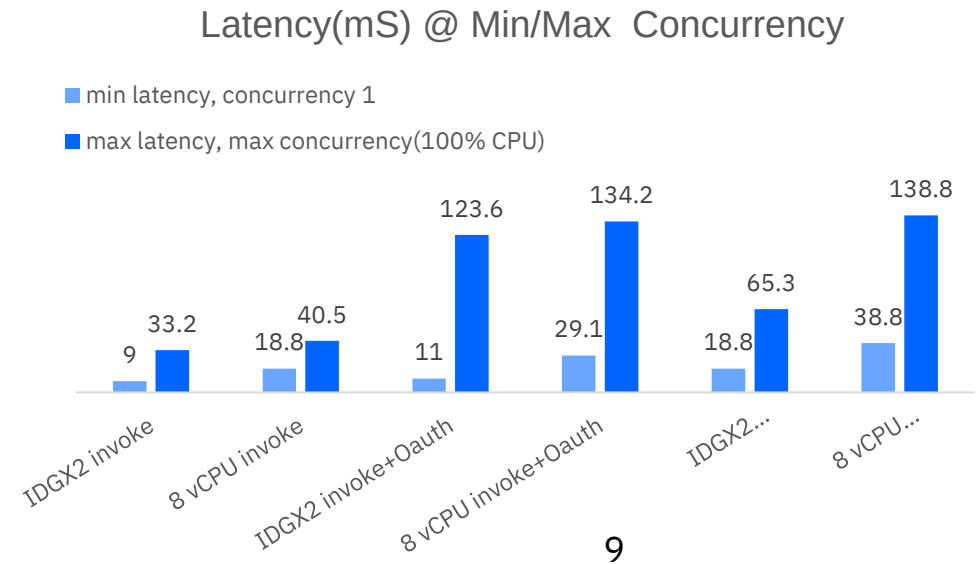
Backend service simulator is a “no-op” that delays response using random uniform distribution between 45 mS and 55 mS



API Connect V5 with v2018 MPGW Gateway

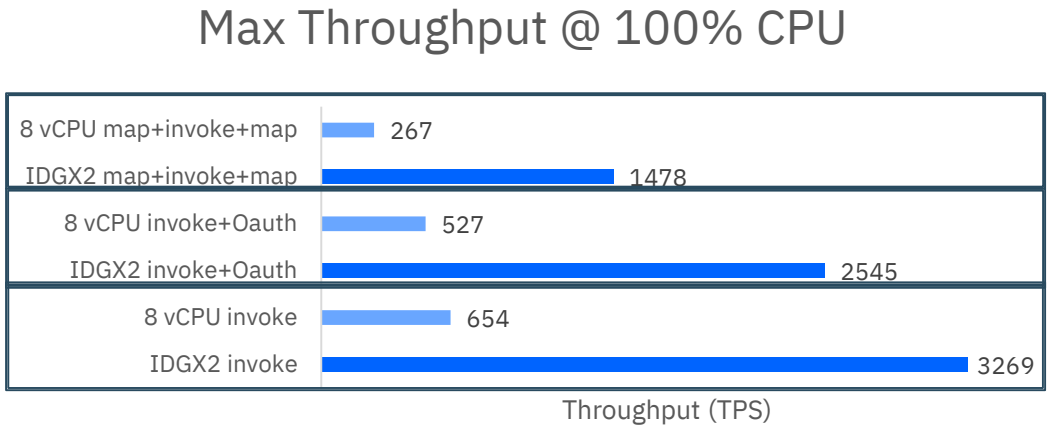
API Connect v5084 running with DataPower version 2018.4.1.1

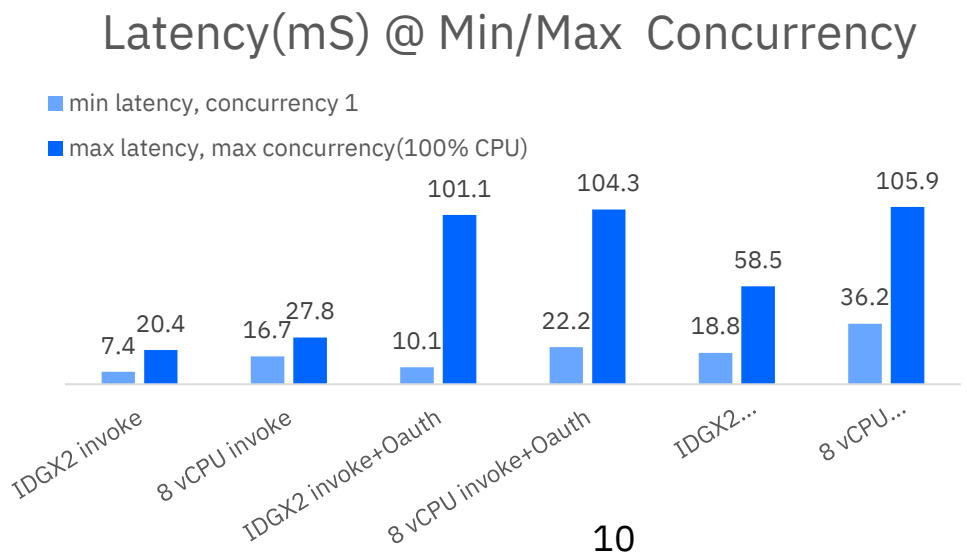




API Connect V2018 with v2018 MPGW Gateway

API Connect v2018.4.1 with DataPower version 2018.4.1.1, running V5c (Multi-protocol Gateway)

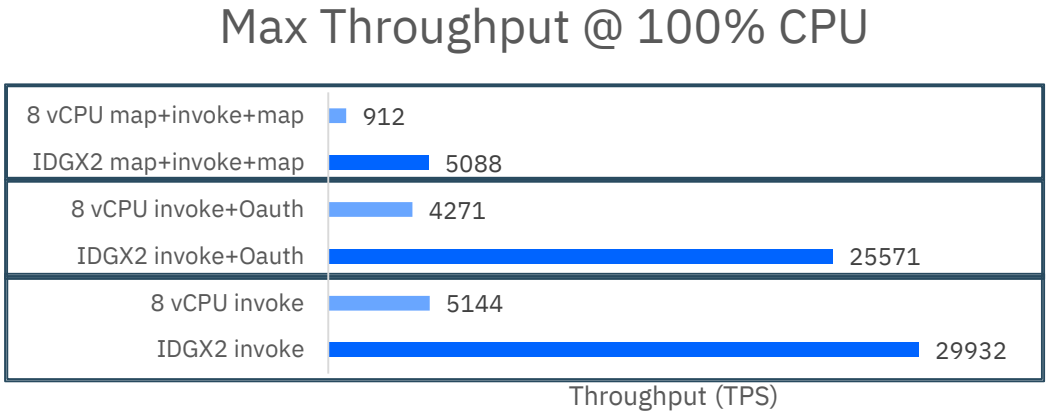


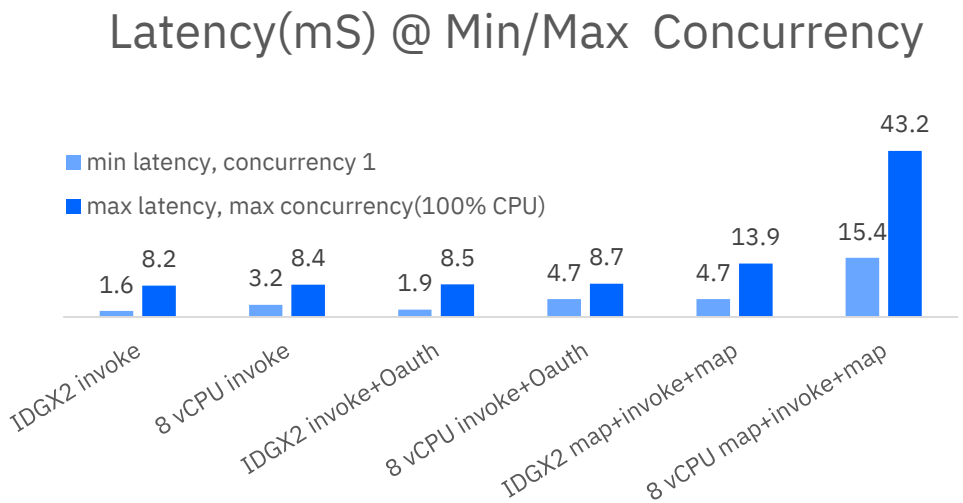


API Connect V2018 with v2018 API Gateway Service

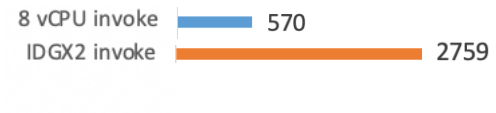
API Connect v2018.4.1 with DataPower version 2018.4.1.1, running API Gateway Service

Container form factor has same throughput and latency characteristics as Virtual using same underlying hardware





V2018 API Gateway Service vs V5 Multi-Protocol Gateway Service



10X increased performance with natively built API Gateway for both virtual and physical appliances

Thank You

Reserve Capacity For Planned and Unplanned Outages

HA events include planned and unplanned events

Best practices recommends HA planning with an assumption of 2 concurrent members failed, one planned and one unplanned

Active-active solutions are required

Each member of the cluster MUST have a reserve capacity in order to absorb the workload no longer being handled by failed members

Under an assumption that A% resource utilization is the upper limit under cluster member failure conditions
The equation to calculate resource utilization ceiling, during non failure conditions, as a function of number of cluster members N, with B members failed, is:

$$A = \left(\frac{n}{n-B}\right) * x$$

where: A is the maximum utilization by surviving members during a failure event, typically 80%
n is the number of cluster members
B is the number of failed cluster members
x is the maximum utilization in absence of member failure(s)

Substituting A=.8, B=1, and solving for x leaves:

$$x = \frac{.8n - .8}{n}$$

Substituting A=.8, B=2, and solving for x leaves:

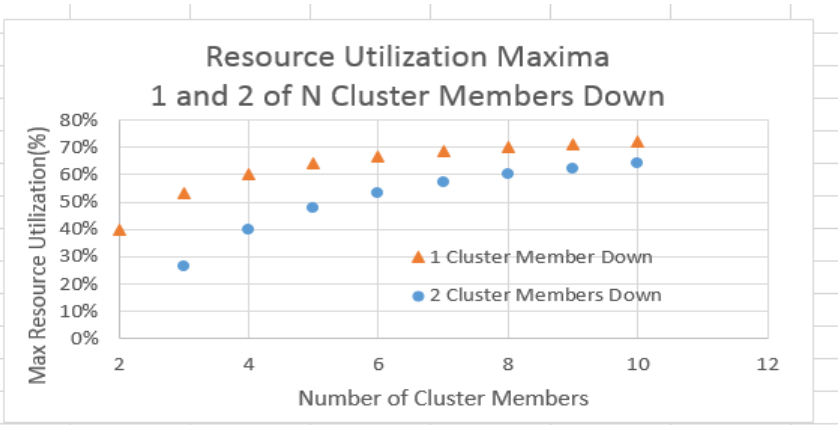
$$x = \frac{.8n - 1.6}{n}$$

Reserve Capacity For Planned and Unplanned Outages

Single member failure case:

- 2 member HA solution there is a 40% resource utilization ceiling, 60% reserve
  Therefore, when one member fails the other member will continue at 80% utilization
- 3 member solution we have a 53% ceiling and when 1 member fails its 53% is divided evenly on the 2 remaining members which would then run at 79.5%
- 10 member solution has 72% ceiling and we have 72+72/9 = 80%

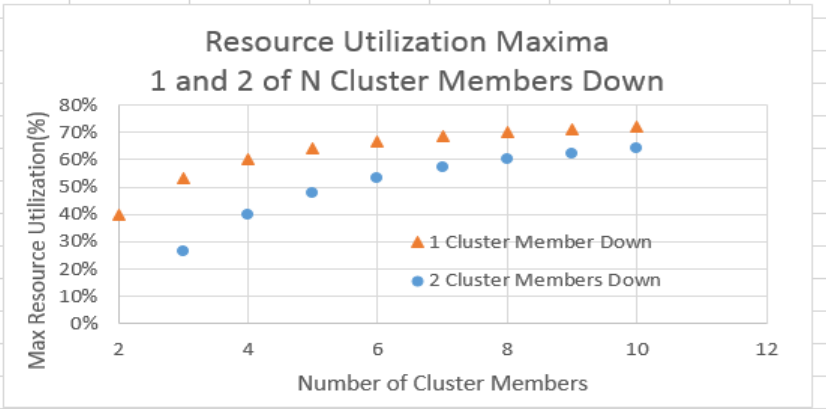
Max utilization during HA failure event:		0.8
Number of nodes down:	1	2
Number of nodes		
2	40%	
3	53%	27%
4	60%	40%
5	64%	48%
6	67%	53%
7	69%	57%
8	70%	60%
9	71%	62%
10	72%	64%



Dual member failure case:

- First, it is obvious that for the dual failure case we have to start with minimum of 3 members
- 3 member solution with 2 failures has a 27% ceiling, so the utilization on the single remaining member CPU is 27+(2*27)=81%
- 4 member solution has ceiling of 40%, so the utilization on the 2 remaining members CPU is 40+((2*40)/2)=80%
- 10 member solution, 8 remaining members CPU is 64+((2*64)/8)=80%

Max utilization during HA failure event:		0.8
Number of nodes down:	1	2
Number of nodes		
2	40%	
3	53%	27%
4	60%	40%
5	64%	48%
6	67%	53%
7	69%	57%
8	70%	60%
9	71%	62%
10	72%	64%



Little's Law
Relationship Between Throughput and Latency

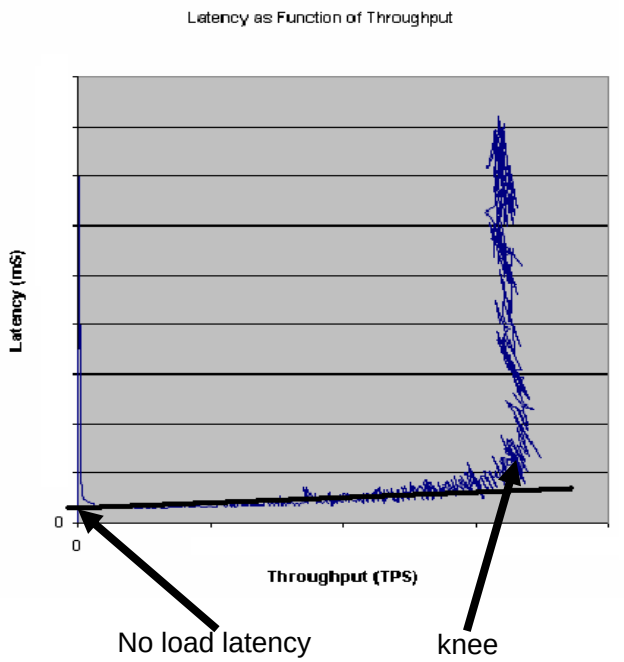
This characteristic pattern was proven as mathematical law by Professor John Little of MIT. More on Little's Law in next slide

It is helpful to describe a few key points on this characteristic pattern

- The "no load" latency:
  This is the latency when throughput is minimal. By definition it can not be 0. It is the Y-Intercept.
- The "linear region" of system operation:
  This is the portion of the graph where the throughput increases linearly with concurrency
- The "knee" value of TPS:
  This is the maximum value of throughput where added concurrency only adds latency. The peak value of measured TPS is the saturation value.

Solution architects work to push the knee as far to the right as required by providing adequate infrastructure: CPU count, disk IO rate, network bandwidth and memory

Product architects and development teams work to move the knee as far to the right as possible for a given set of CPU/disk/network/memory resources, this also tends to reduce the slope and Y intercept of the linear region



Little's Law
Relationship Between Throughput and Latency

Little's Law: (https://en.wikipedia.org/wiki/Little's_law)
occupancy = latency x throughput

Applied to transactional systems:
concurrency = latency x throughput
= S x T/S

The concurrency control in the load drivers, Jmeter for example, is generally described as number of "virtual users"

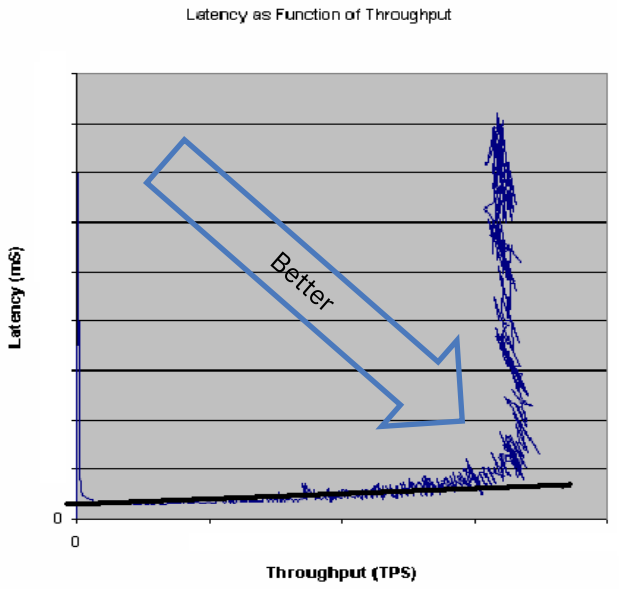
- Each virtual user has 1 and only 1 transaction live in the system at any time
- Nth transaction will not initialize until the N-1 transaction completes

When the system is stable the arrival rate = the completion rate

- The concurrency control and transaction latency govern the throughput
- The greater number of users, the greater the transaction arrival rate, the greater the completion rate

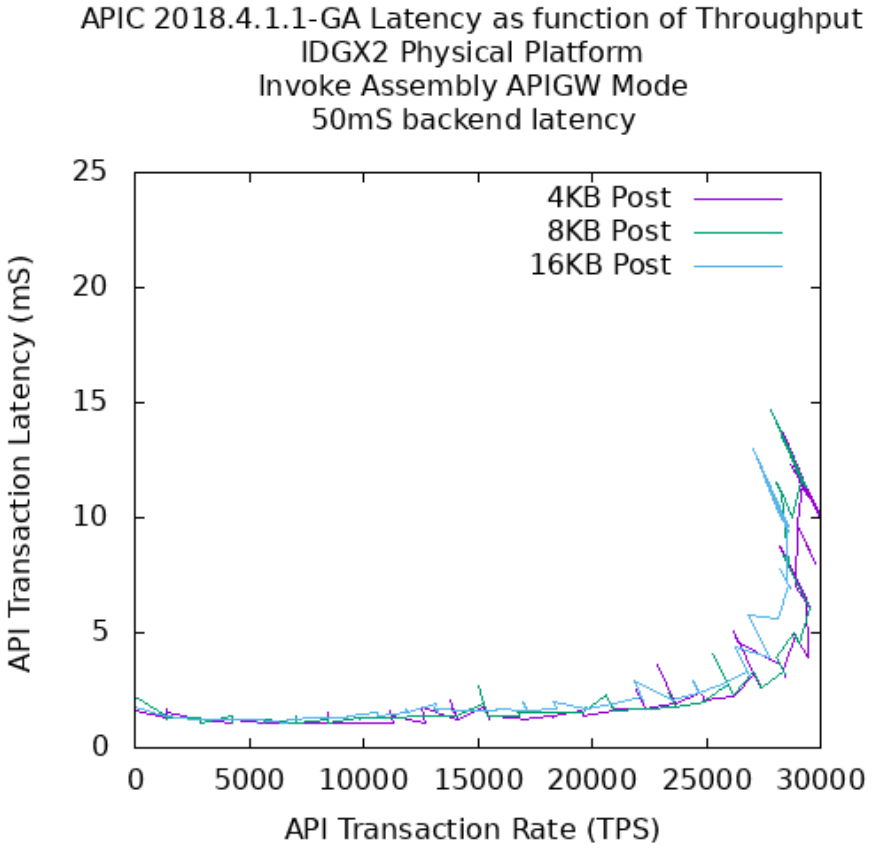
When the system is unstable, the throughput can not increase due to a constraint, then the arrival rate > completion rate

- 100% CPU, or network link speed, or IOPS capacity of disks, or memory utilization
- add more users, increased transaction arrival rate, the TPS can not increase so the latency MUST increase and the transaction completion rate saturates at constant a value



APIC Runtime on DP view of Little's Law
API Gateway Mode

- Note very small latency growth as TPS increases in the linear region of operation, CPU < 80%
- "no-load" latency ~2 mS
- "knee" throughput of 30K TPS
- "knee" latency of < 10 mS



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