The Carrier DevOps Trend

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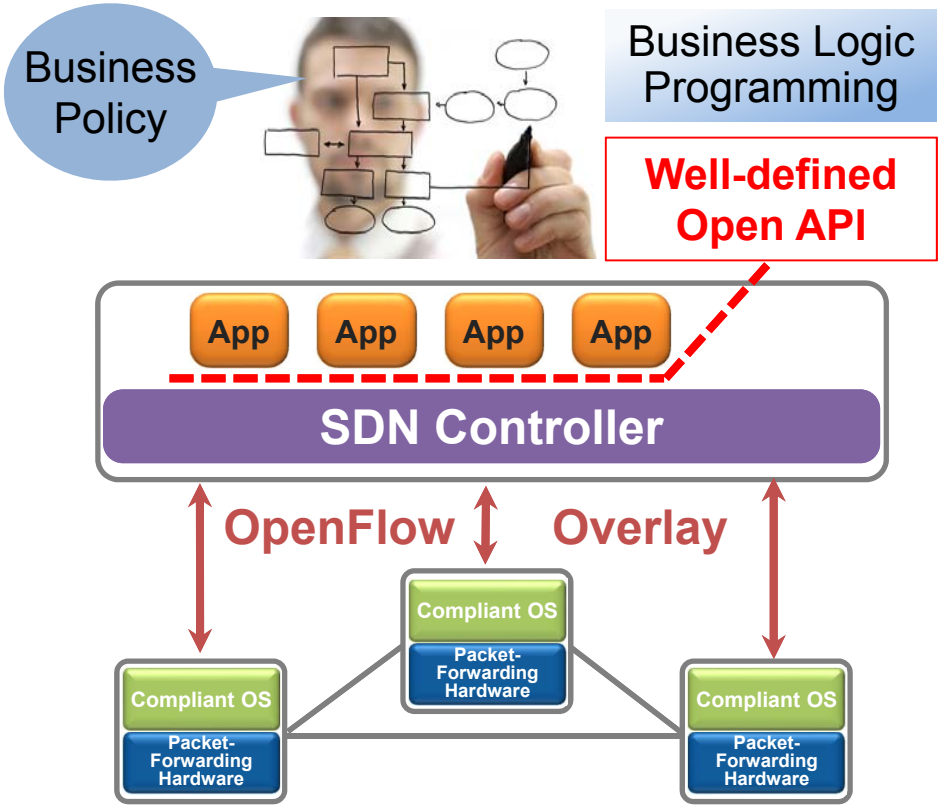
SDN & NFV are Changing Carrier Architectures

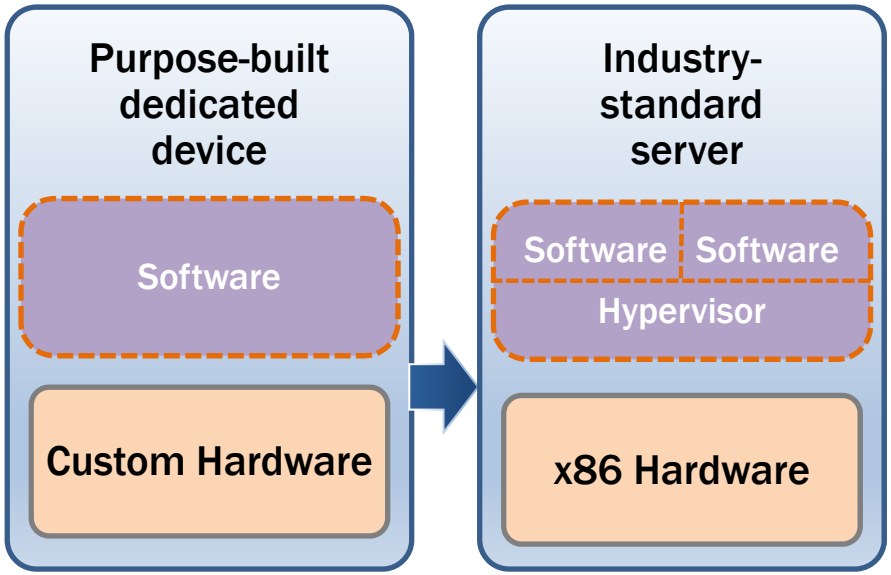
Software Defined Networking



Separate control plane from the data plane in network devices (physical and virtual) with intelligence and programmability centralized in a controller.

Benefits: Increased agility via automation and increased innovation via programmability

Network Function Virtualization



Consolidate diverse network equipment types (firewall, switching, routing, ADC, BRAS, EPC, etc.) onto industry-standard x86 servers using virtualization.

Benefits: Reduced cost and increased agility

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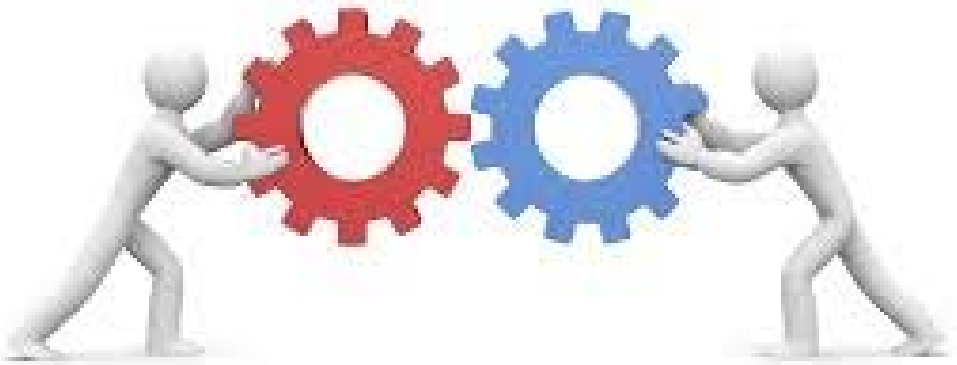
What is DevOps?

Software (or service) development method that stresses communication, collaboration and integration between software developers and information technology (IT) operations professionals



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Why is DevOps the Natural Companion to SDN/NFV?

- SDN/NFV is largely about business agility
- Lots of focus on **production or operational** technology & architecture
- But that's only one side of the business

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SDN DevTest Implications

Network as Utility

- Waterfall timeframes
- Long certification cycles
- Manual, little automation

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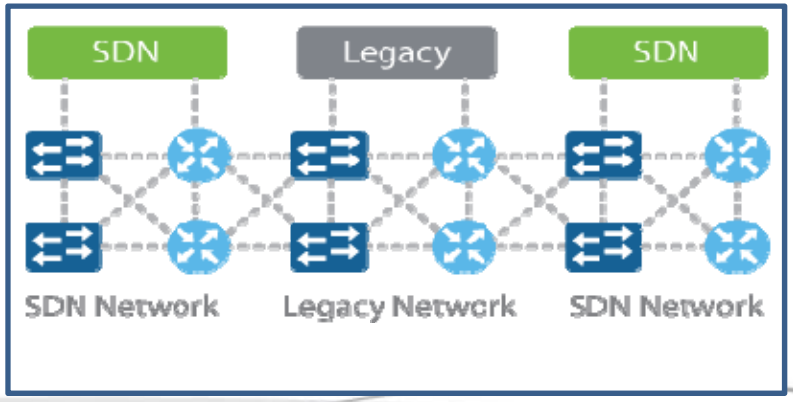
App Lifecycle is Agile

- Agile timeframes
- Implies automation



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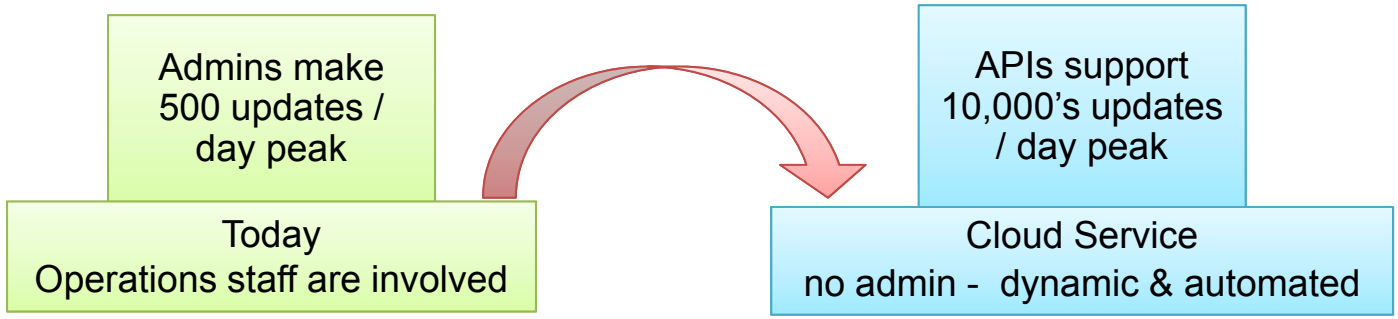
NFV DevTest Implications

Permutations could be endless

- Design permutation of vendor solution when defining the architecture (interoperability)
- Operational permutation at the time of the service instantiation (service differentiation)

Agility = IT rate of change x 100

- Performance and scale testing



How do you qualify and certify these service in an **agile fashion**?

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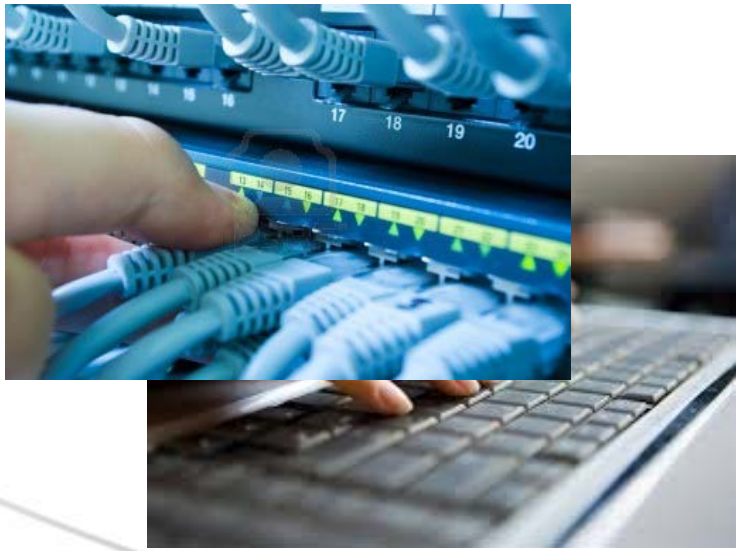
The Carrier DevOps Trend

From AT&T's Domain 2.0 initiative white paper:

"There remains much to do before this vision [Domain 2.0] can be implemented, including pivots from networking craft to software engineering, and from carrier operations models to cloud "DevOps" models. We also see an important pivot to embrace agile development in preference to existing waterfall models."



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What is Carrier DevOps Industry Status?

- DevOps is in early stages at most carriers
- However, there are some key areas in common among carriers who are working on DevOps initiatives
- Observations from discussions with major carriers, mobile operators and cable operators in North America, Europe and Asia-Pacific

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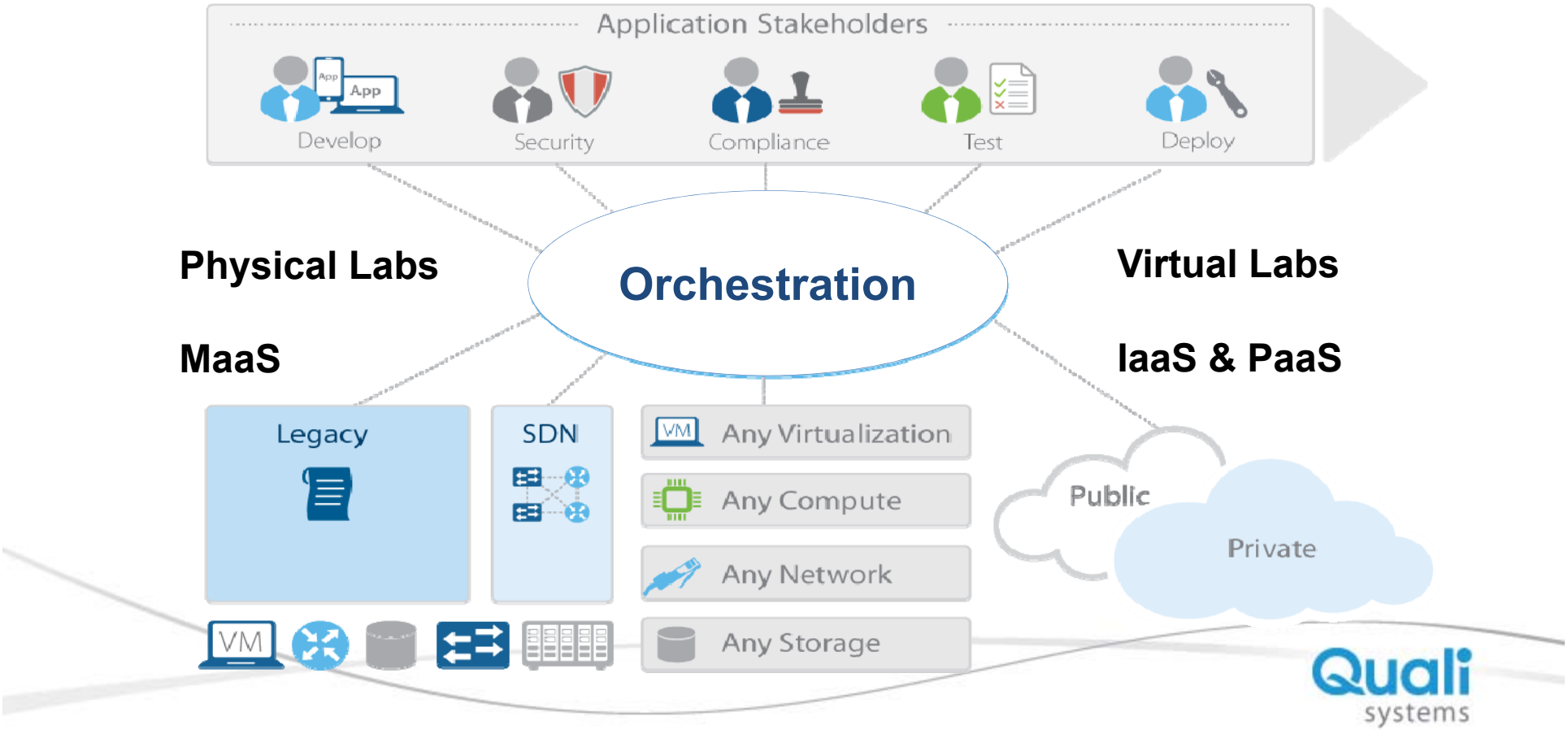
Orchestration to 'Virtualize' **all** DevTest Infrastructure

- Many carriers are building virtual labs to help support agile process
- Many carriers are also working to make physical labs into "clouds"
- Important to do both so that no infrastructure slows DevOps/agile process



Carrier DevOps Must Support Networking Concepts

Carriers adopting infrastructure orchestration to build DevOps have found that most cloud management platforms only support compute concepts

Important to have orchestration capable of handling network topologies

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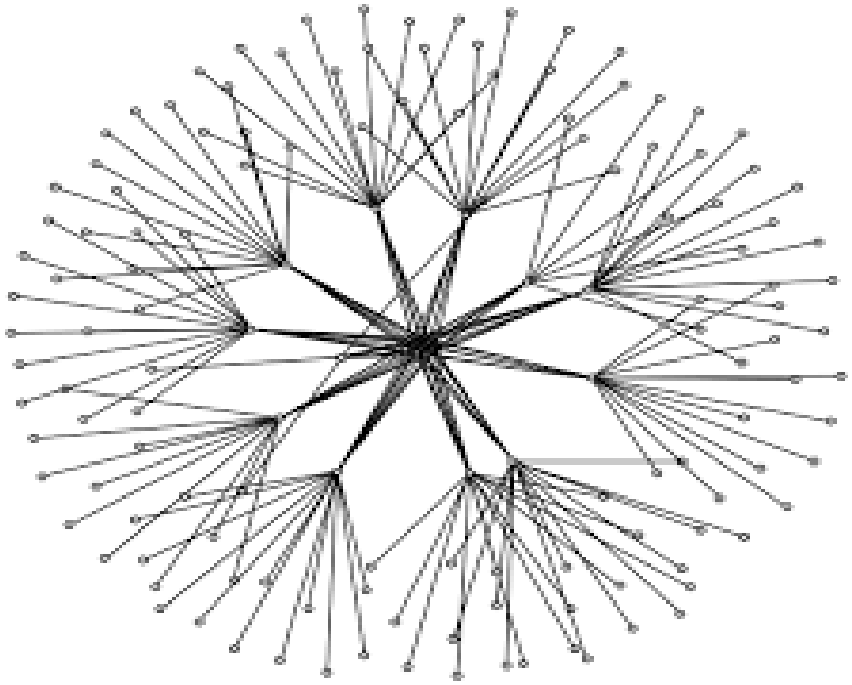

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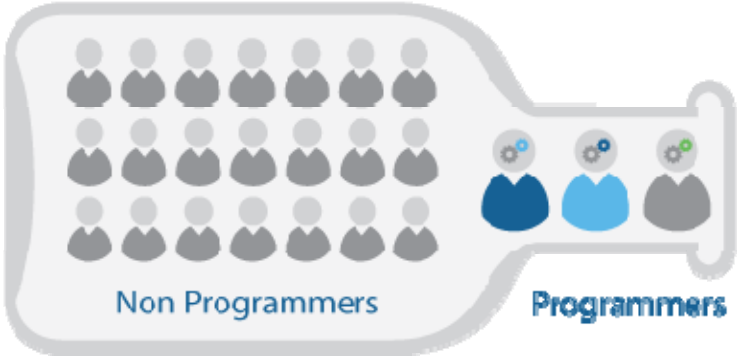
Carrier DevOps Challenge: Skills & Culture Evolution

- Network teams have few programmers, majority are non-programmers
- App developers aren't network engineers
- Need to avoid programmer bottleneck
- Need to systematize knowledge
- Need non-programmer productivity:



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What Helps the Skills & Culture Evolution

Best Practice # 1

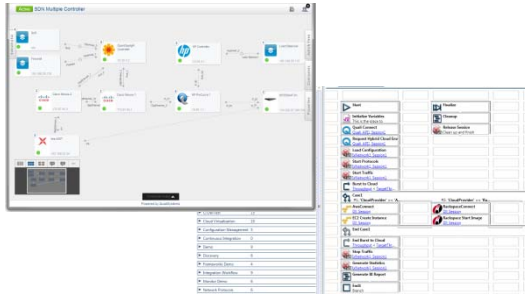
Low level automation objects are created by few programmers

Best Practice # 2

Open integration of existing automation scripts so teams don't lose previous work

Best Practice # 3

Visual tools allow non-programmer network engineers to build automation



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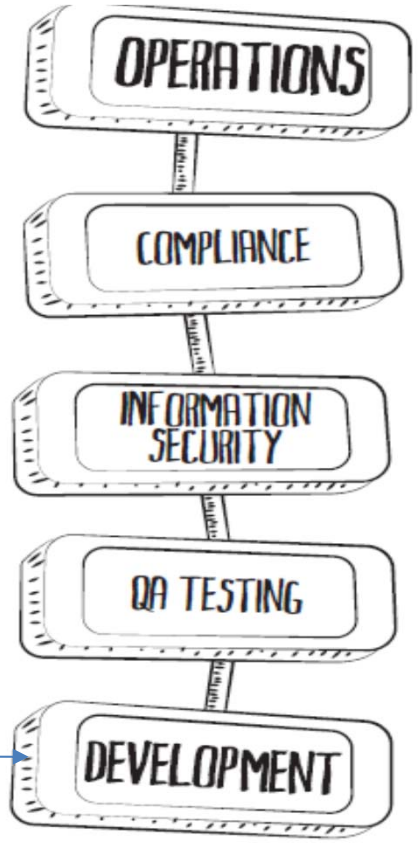
Innovate, Permutate, Validate, Deploy

A helpful concept for carriers is to have infrastructure automation create portability between different stages of the DevOps process

Validate and Deploy

Permutate New Concepts into Real-World Test Scenarios

Innovate New Concepts: Example: OOL Sandbox



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Innovate: Dev Stage Sandbox Cloud

- Live sandboxing allows innovation of new service concepts.
- OOL is example of such a sandbox cloud.
- It is not yet common in carriers, but we see many carriers exploring this concept.

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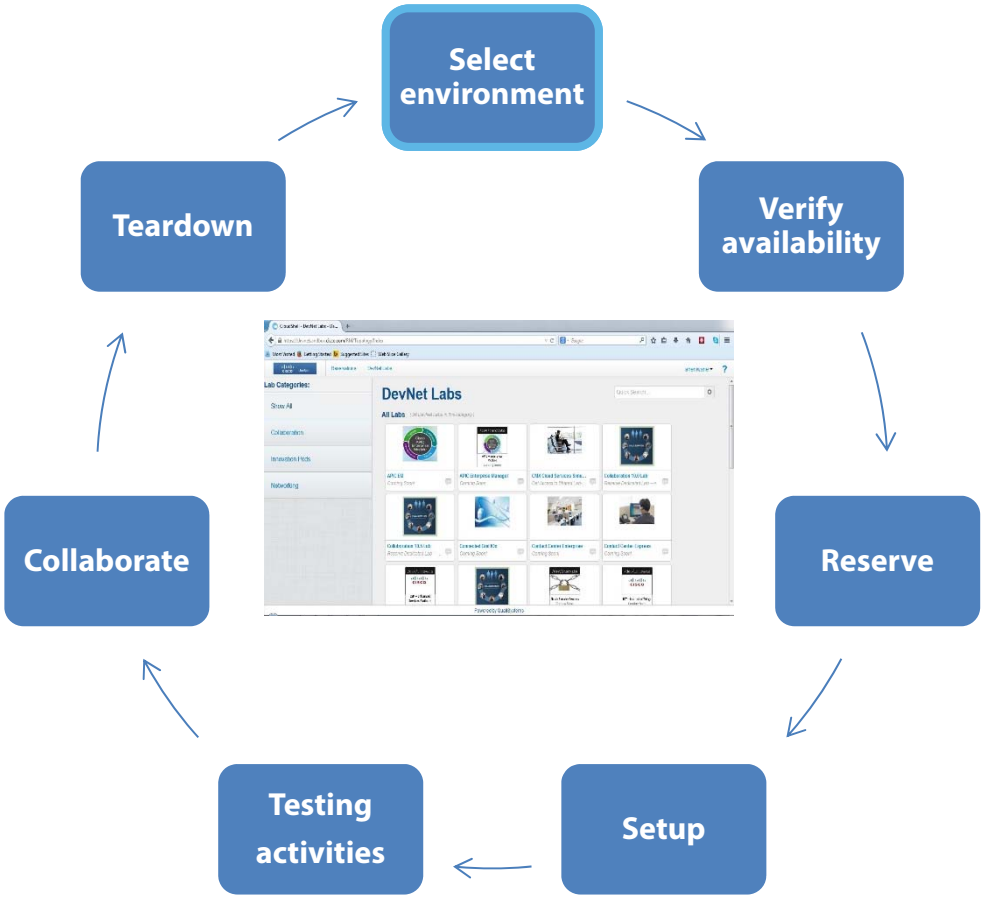
Permutate: Test Lab Cloud to Cover Many Test Cases



- Test lab cloud is more common automation in carriers today
- Most large carriers have at least one automated test lab

Key goals:

- Increase efficiency utilization of test lab resources
- Reduce ratio of setup to test time

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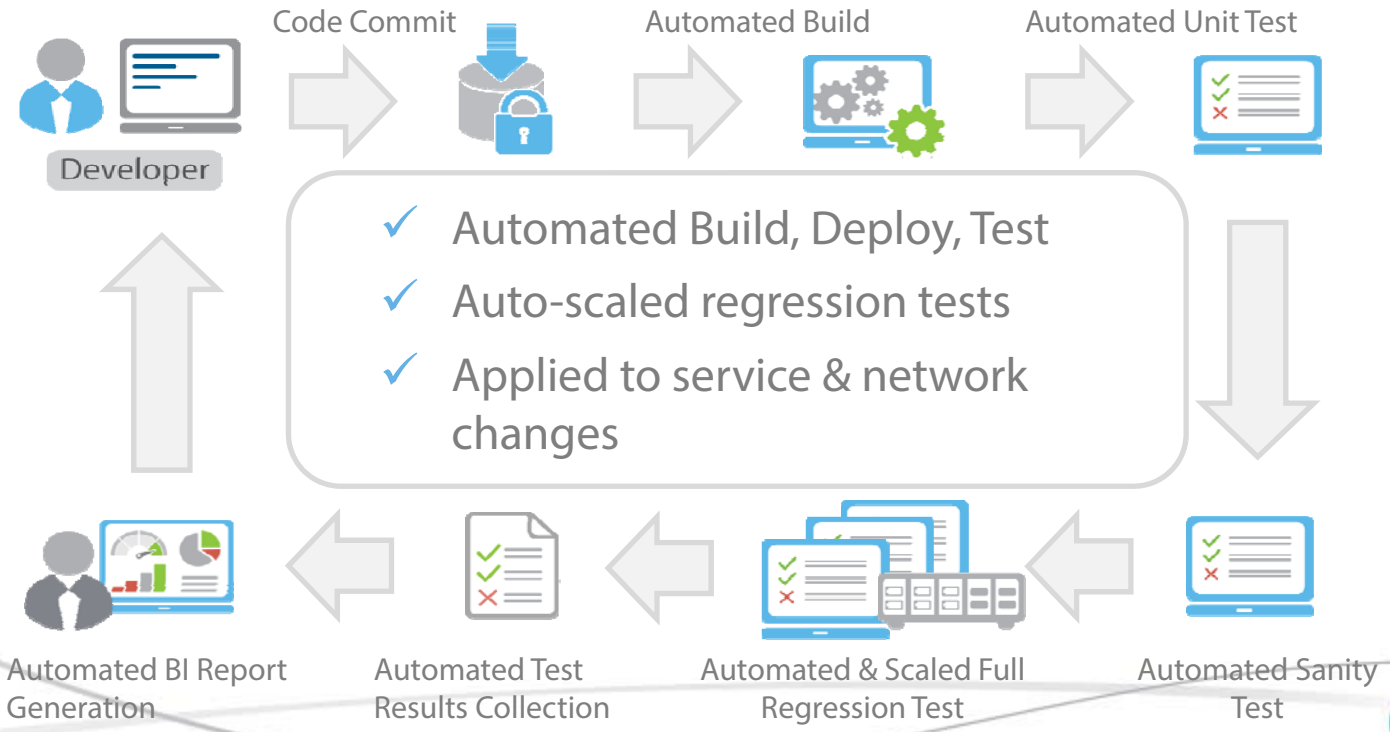
Test Automation & Continuous Integration

- Most carriers have some test automation in place
- Some carriers have moved beyond test automation to continuous integration
- However, this requires either a fully automated test lab cloud or many duplicated, dedicated test beds. Without test lab cloud, cost of dedicated test beds is very high



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Conclusions

SDN and NFV require a change in devtest operational practice to become agile

A combination of:

- Network DevOps process
- Lab infrastructure cloud and automation enablers
- Skills and culture evolution

Can lead to a highly efficient, agile dev, test and pre-production operation

Carriers are in early stages but aggressively embracing this change

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