

The background is a vibrant, abstract graphic. It features a central bright white light source from which numerous colorful rays emanate, creating a sunburst or starburst effect. The rays transition through a spectrum of colors including yellow, orange, red, and various shades of blue and green. Overlaid on this are several large, semi-transparent, wavy shapes in similar color tones, giving the overall image a sense of motion and energy.

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The bridge to possible

# DevNetOps Automation for 5G & Beyond

Approach to Network Infrastructure Modernization

Sudipta Debnath, Technical Leader  
@sudiptad1

Richard Froom, Director Engineering  
@rfroom029

BRKNWT-2301

CISCO *Live!*

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# Cisco Webex App

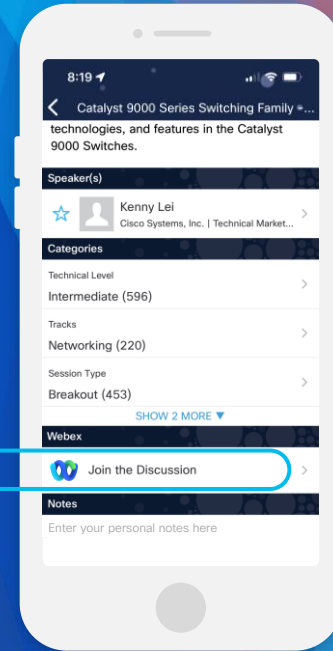
## Questions?

Use Cisco Webex App to chat with the speaker after the session

## How

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Webex spaces will be moderated by the speaker until June 9, 2023.



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# Agenda

- Introduction
- 5G Architecture Overview
- Role of automation in 5G
- CI/CD & DevNetOps
- DevNetOps Use Cases
- Case Study
- Envisioning DevNetOps – Cisco
- So What?

# Introduction



# DevOps and 5G Network Service Providers

- *Network automation does not equal automated networks.*

Most of the networking industry and most network operators feel that network automation does not deliver the outcomes desired – which are actual automated networks.

- *In recent years, the network industry has built products of ever-increasing quality which are also more autonomous and abstracted.*

With software-defined networking (SDN) and intent-based networking, solutions have analytics and observability built-in along with extensibility with APIs and other tools.

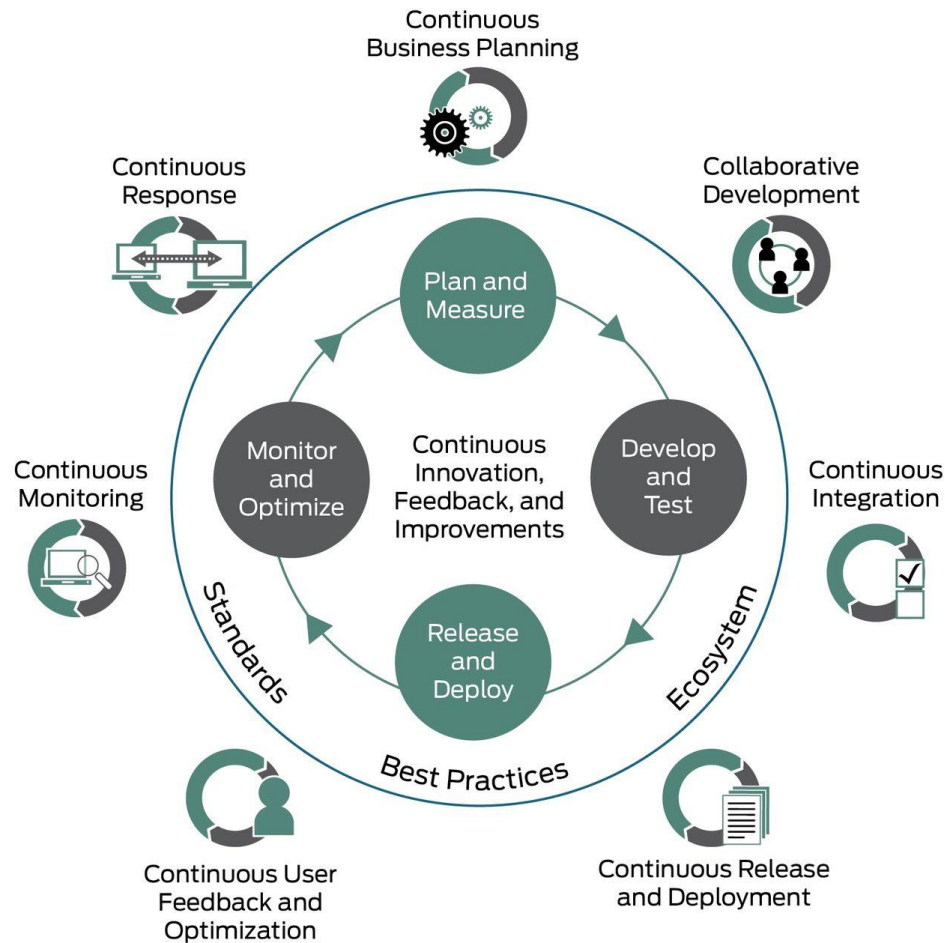


*“Simplicity is prerequisite for reliability.”*

Edsger W. Dijkstra

Father of SPF algorithm

- Desired outcome  
Simplicity
- Process and plan  
Reliability, velocity, and agility by  
effective, and efficient through  
methods and processes
- Means to achieve the outcome  
DevNetOps

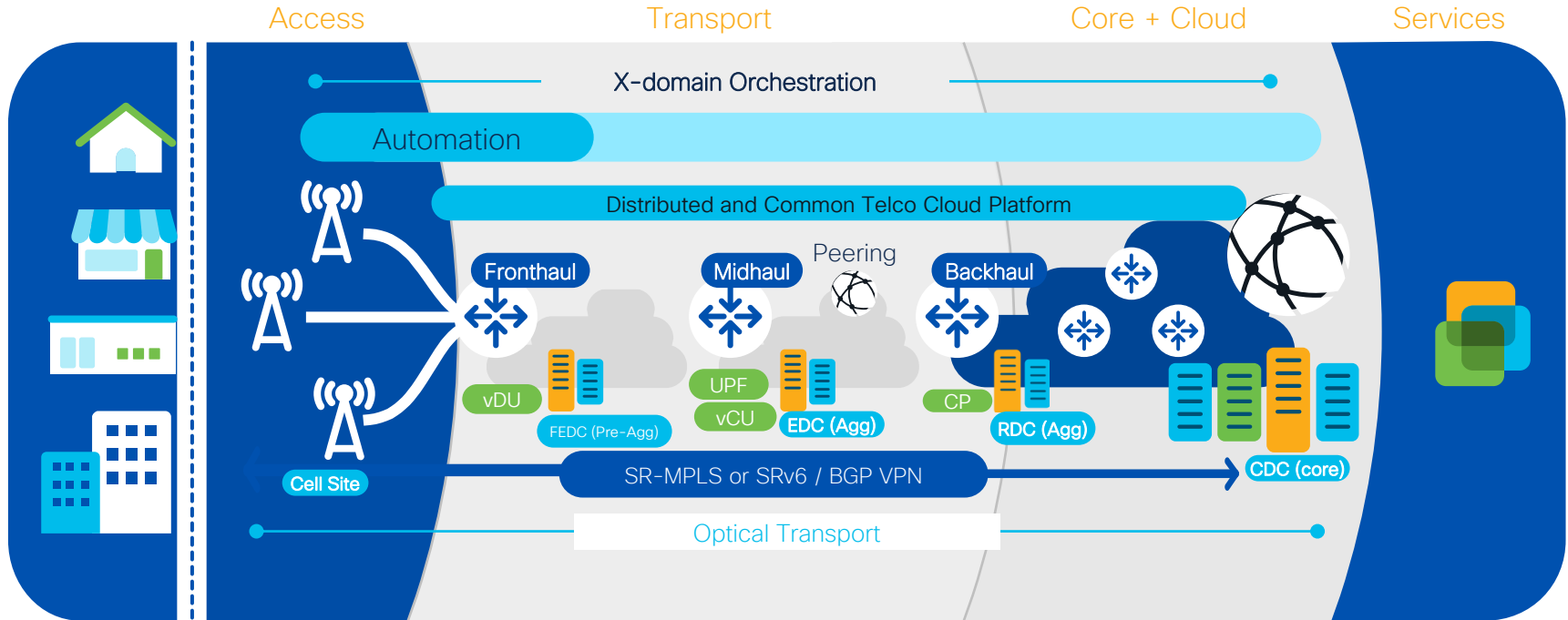




# 5G Architecture Overview



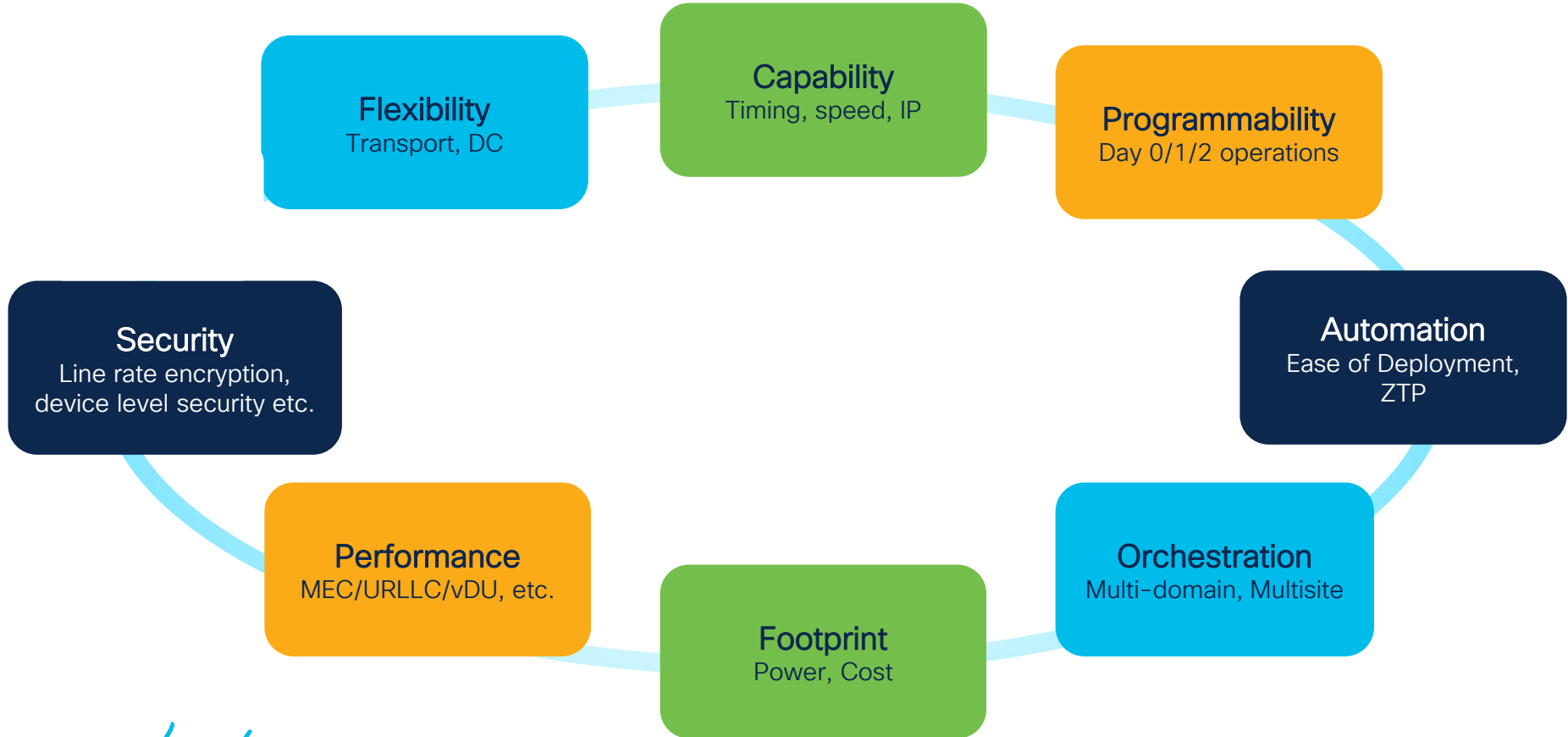
# 5G Programmable Transport Architecture Overview



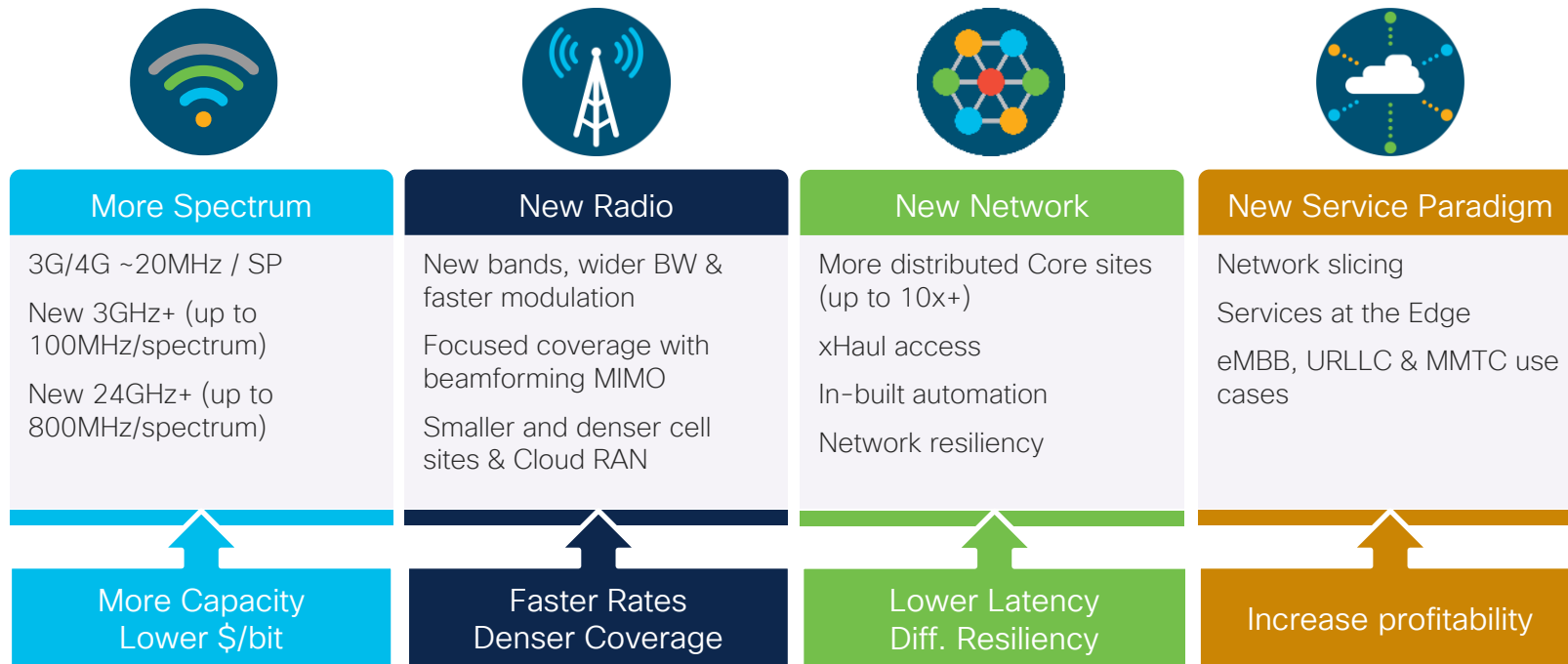
vDU "virtualized Distributed Unit"  
vCU "virtualized Central Unit"  
UPF "User Plane Function"  
CP "Central Processor"

FEDC "Far Edge Data Center"  
EDC "Edge Data Center"  
RDC "Regional Data Center"  
CDC "Central Data Center"

# Cisco's 5G Transport – Building Blocks



# What 5G Brings



SP mobile  
revenue mix:

2025  
Today



# “The 5G promise”

Deliver enhanced mobile broadband services, private networks (private 5G), ultra-low latency, and scalable IoT communications services for both consumers and enterprises across many vertical industries.

- 2G, 3G and 4G mobile networks were built for consumer voice and data services

- 5G networks are being built to support a plethora of use-cases including digital transformation of entire verticals.

## Design Principles

- Network slicing
- Cloud-native computing
- Multi-access edge computing (MEC)
- Software-defined networking (SDN)
- Network Function Virtualization (NFV)

## Characteristics

- Flexible
- Multi-vendor
- Agile and elastic
- Rapid Deployments
- Infrastructure Standardization
- Customer Experience

## Risks

- Multi-vendor & domain complexity
- Skillsets
- Operations
- OPEX increase

*5G promises to connect “anything, anywhere”*

# Challenges for Service Providers

Bandwidth Continues to Grow 50% Year-over-Year

## The world has gone mobile

Changing Customer Expectations  
With AI, VR



3X Mobile Data Traffic Growth  
(13-44 Mbps) From 2018-2023



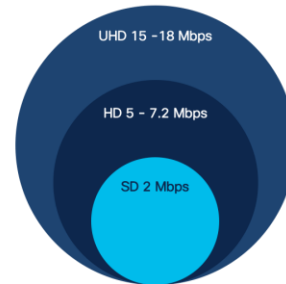
Ubiquitous Access  
to Apps & Services

## Massive IP traffic growth, driven by video

27% CAGR  
2018-2023



Connected  
4K TV Sets (M)



## Rise of cloud computing

Changing SP  
Architectures/  
Service Delivery



Changing Enterprise  
Business Models  
*Efficiency & Capacity*

## Digitization leading to IoT, private 5G

Emergence of the Internet of Things



People



Process



Data



Things

# Role of automation in 5G



# Why automation is needed

The industry is transforming from a traditional **hardware-centric architecture** to a **software-driven, cloud-native environment** based on microservices and open-source applications. As a result, providers need the following:

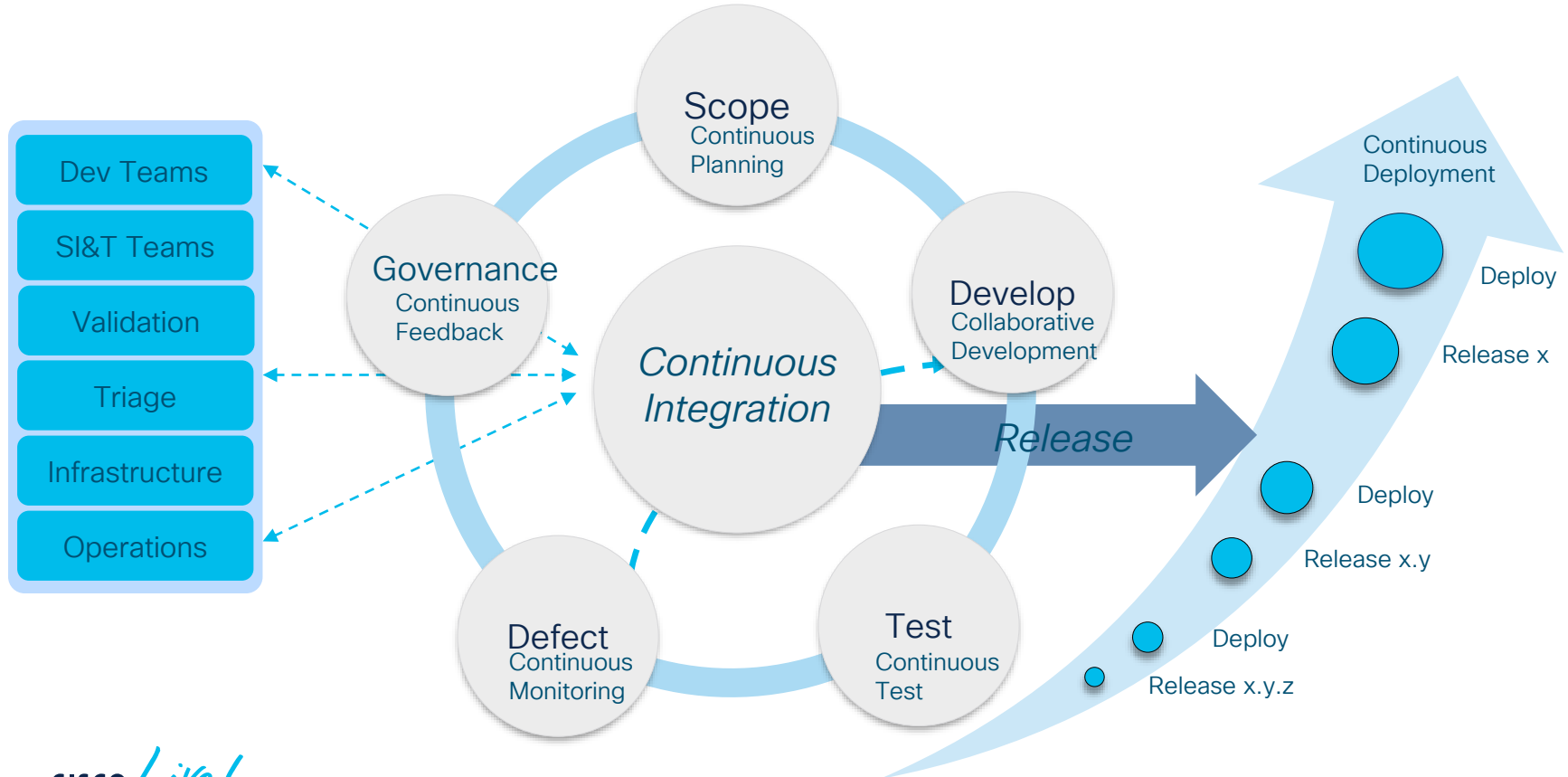


*Zero-Downtime upgrade and No change window*



# 5G Automation

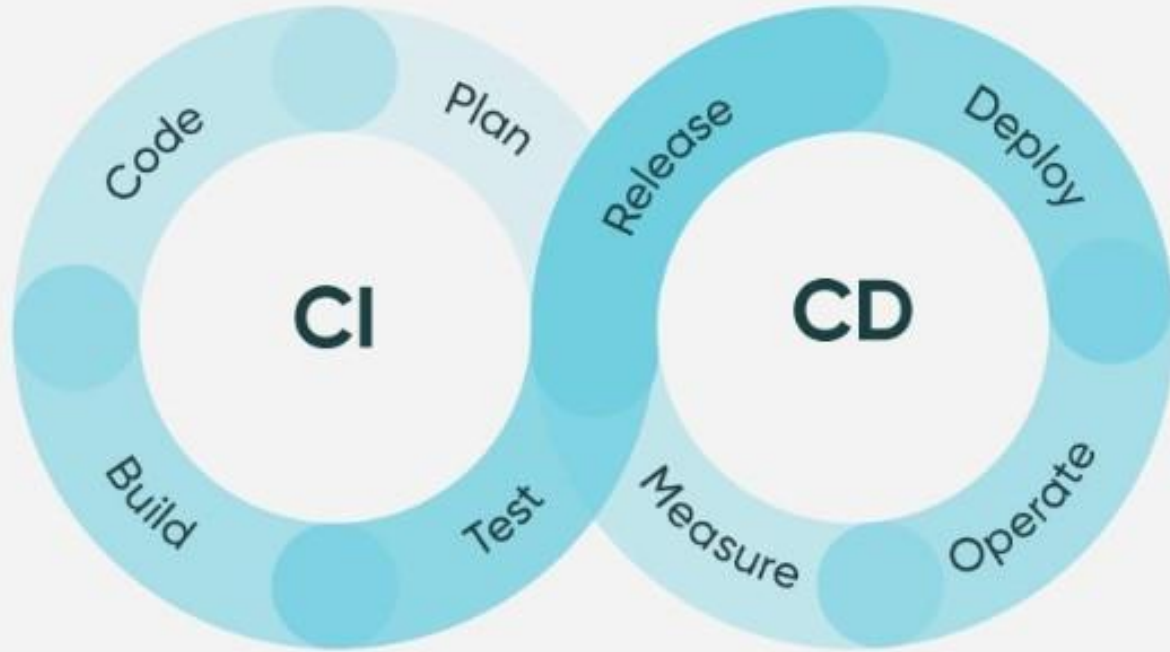
## Software Release lifecycle management



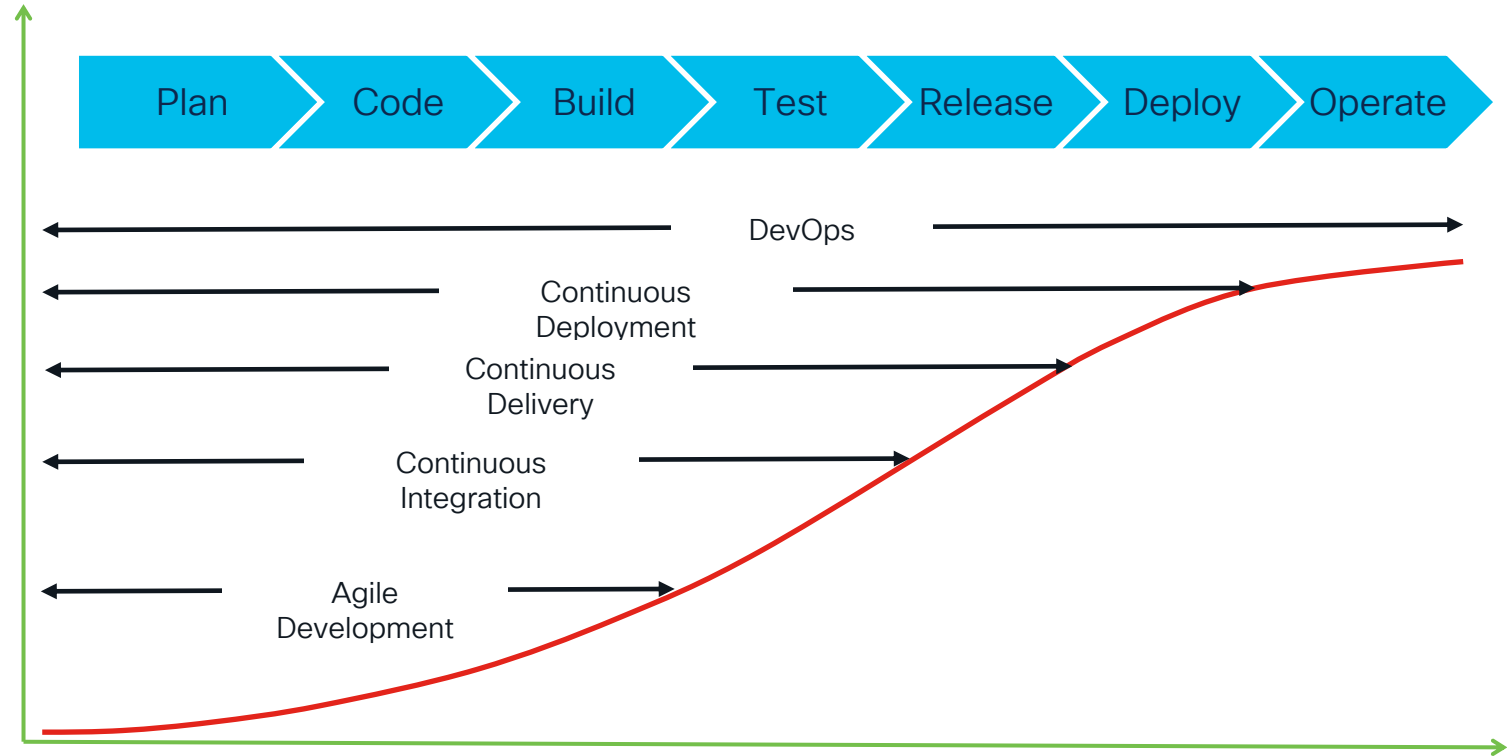
# CI/CD & DevNetOps



# Definition of CI/CD

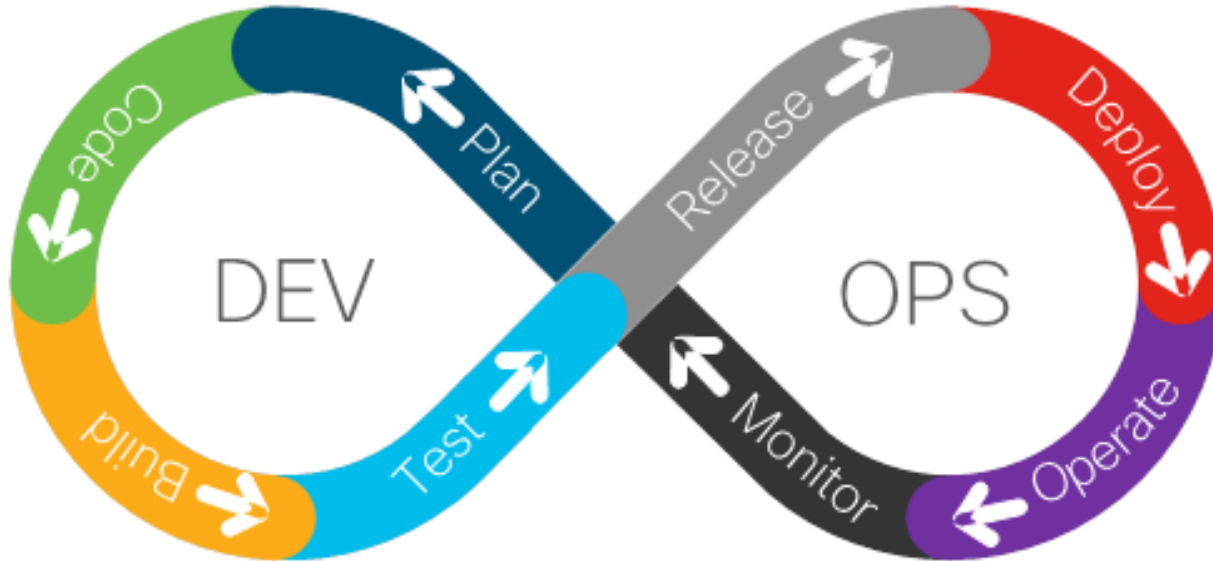


# Continuous What?



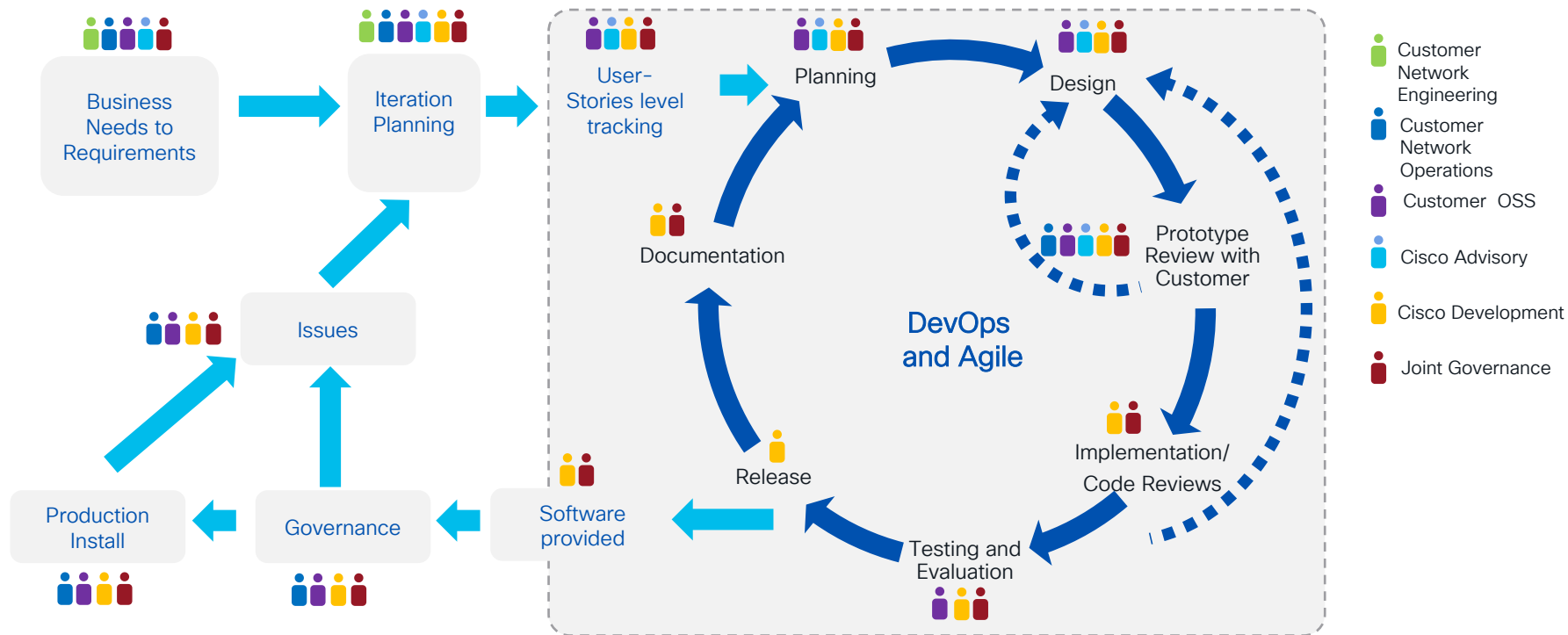
# DevOps Lifecycle

Development + Operations = DevOps



# Software Delivery Lifecycle ...bridging to networking

## People, Process, Tools



# Benefits of DevOps

- Higher customer satisfaction, value, and ROI
- Decreased costs for development and operation
- Increased quality and more time for innovation for delivered products and services.
- Shorter development cycle (with automation) leading to a faster feedback cycle and quicker time-to-market
- Increased communication and collaboration creating a performance-oriented culture

# DevOps to DevNetOps ...*it is a journey*

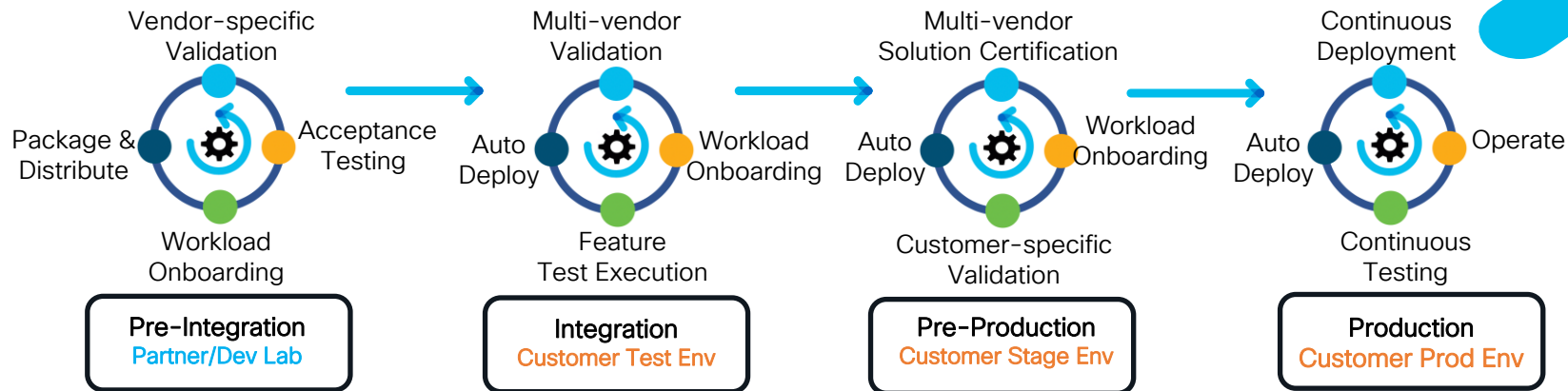
- DevNetOps – the application of DevOps philosophies, principles, and behaviors to network operations (i.e, NetOps).
- Culture, Automation, Lean, Measurement, and sharing (CALMs) – team culture and behaviors drive smaller, more frequent deployments leading to faster outcomes.
- Network site Reliability Engineering (NRE) – a role focused on providing a continuously reliable, agile, automated, high-performance network combined with infrastructure operations.



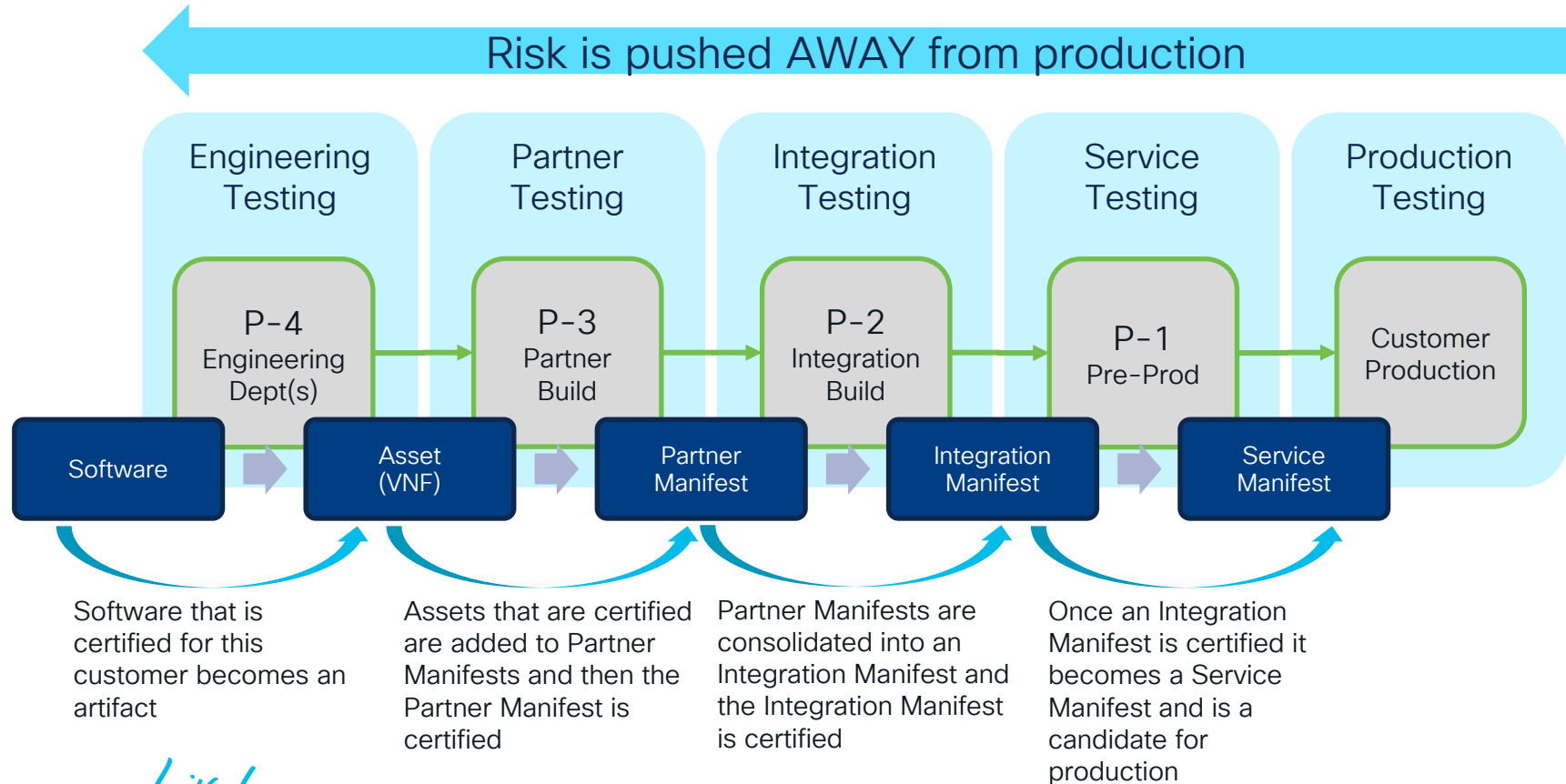
# DevNetOps Tool Chain ...*applied to 5G networking*



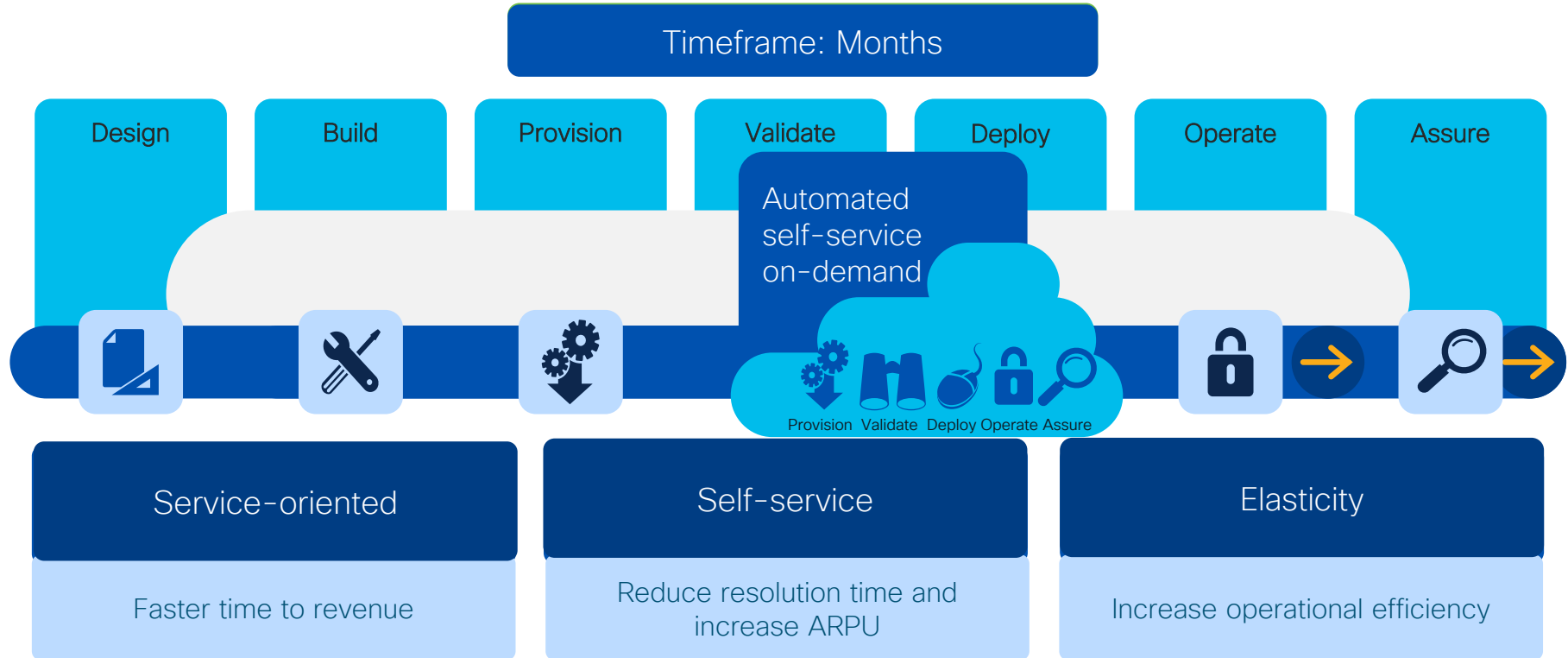
## DevNetOps Automation through Stage Gates



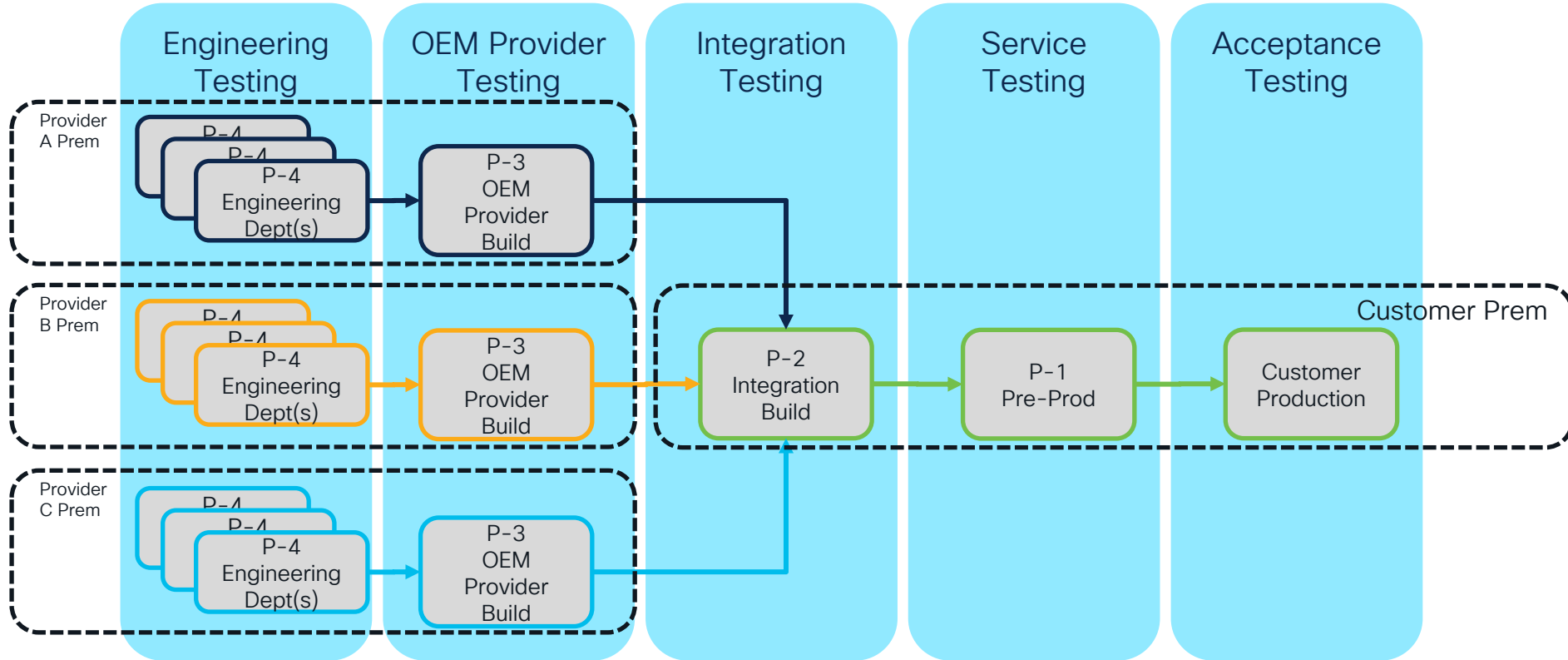
# Development to Production Journey



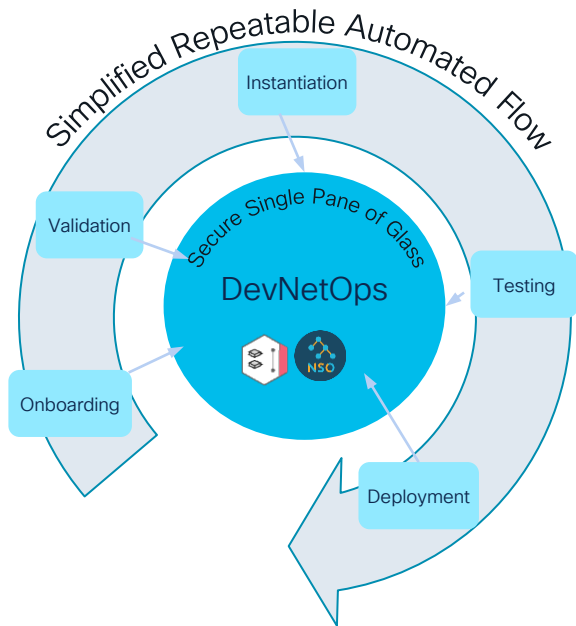
# Automating 5G Service Deployment Processes



# Scale to OEM Providers




# DevNetOps 5G Framework




## DevNetOps Pipeline


### UX

  
Onboarding  
Workflow

  
User Access  
Administration


  
Resource  
Management


  
Scheduler

  
Reporting

### Tool Chain (Example)

GitHub   
Source Code  
Management

Jenkins   
Build  
Automation

Test Framework   
Test  
Automation

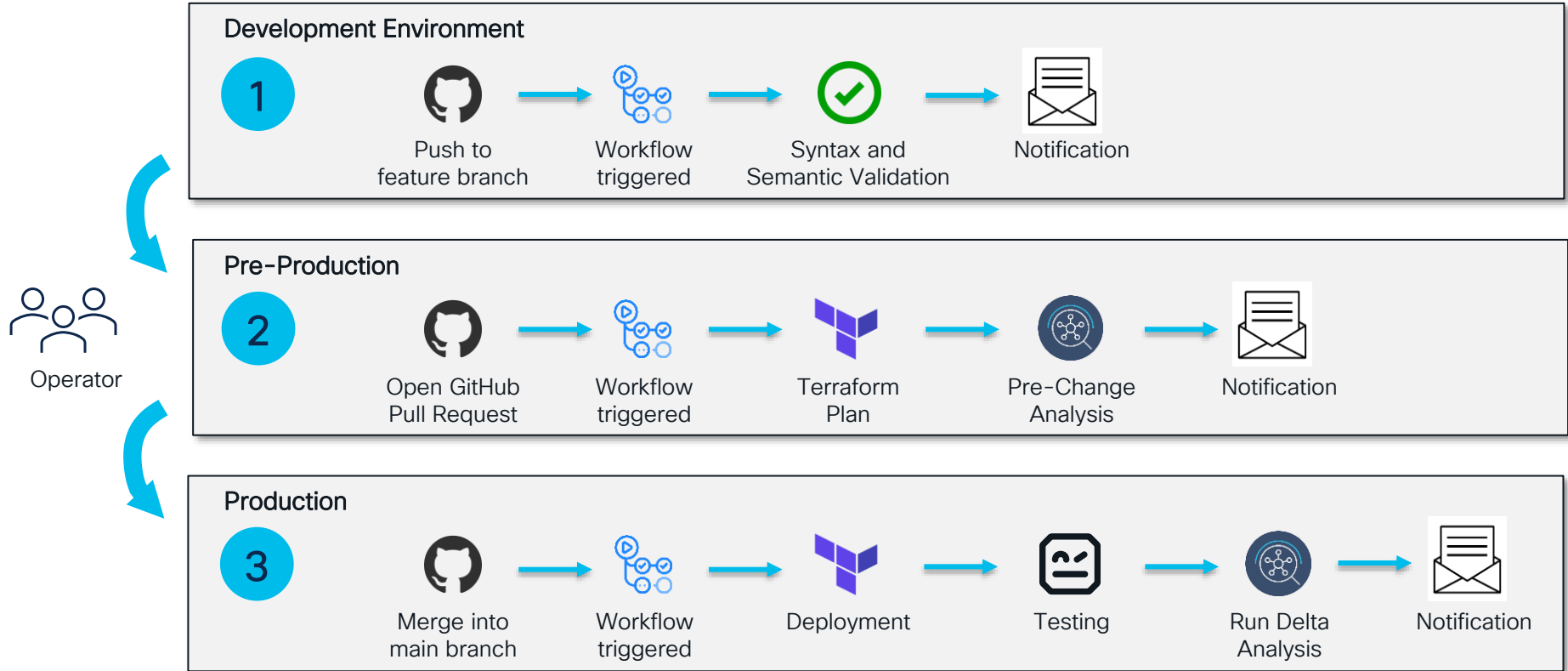
Jira   
Issues & Request  
Management

Artifactory   
Package  
Management

### Infrastructure

## Management And Network Orchestration

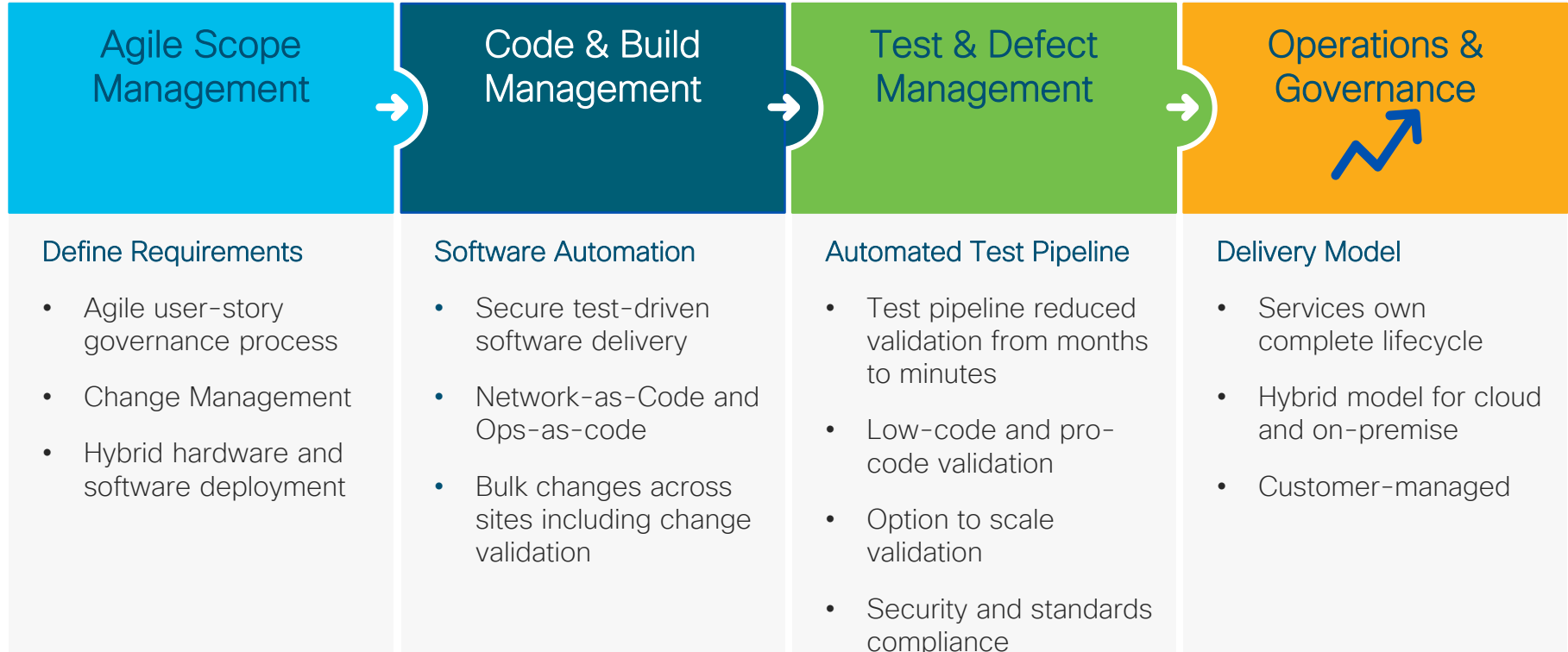
# 5G DevNetOps Workflow



# DevNetOps Use Cases

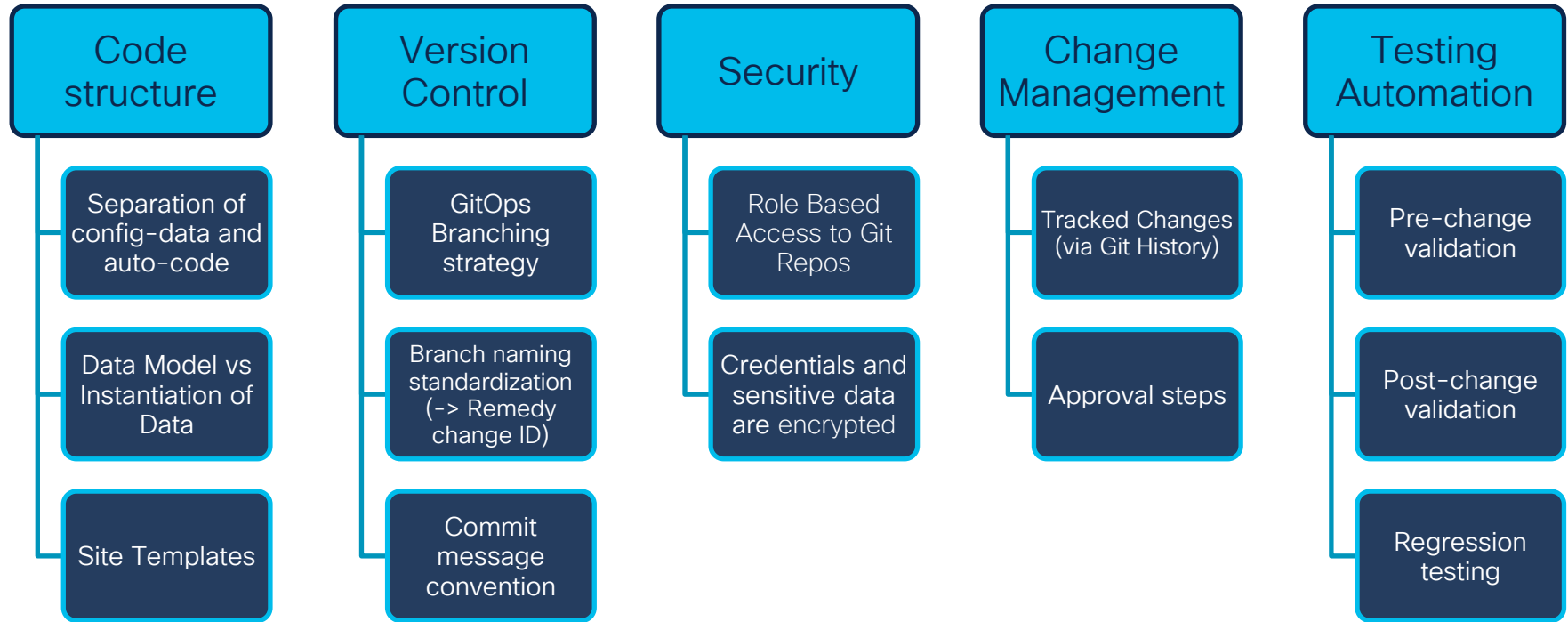


# DevNetOps Strategy

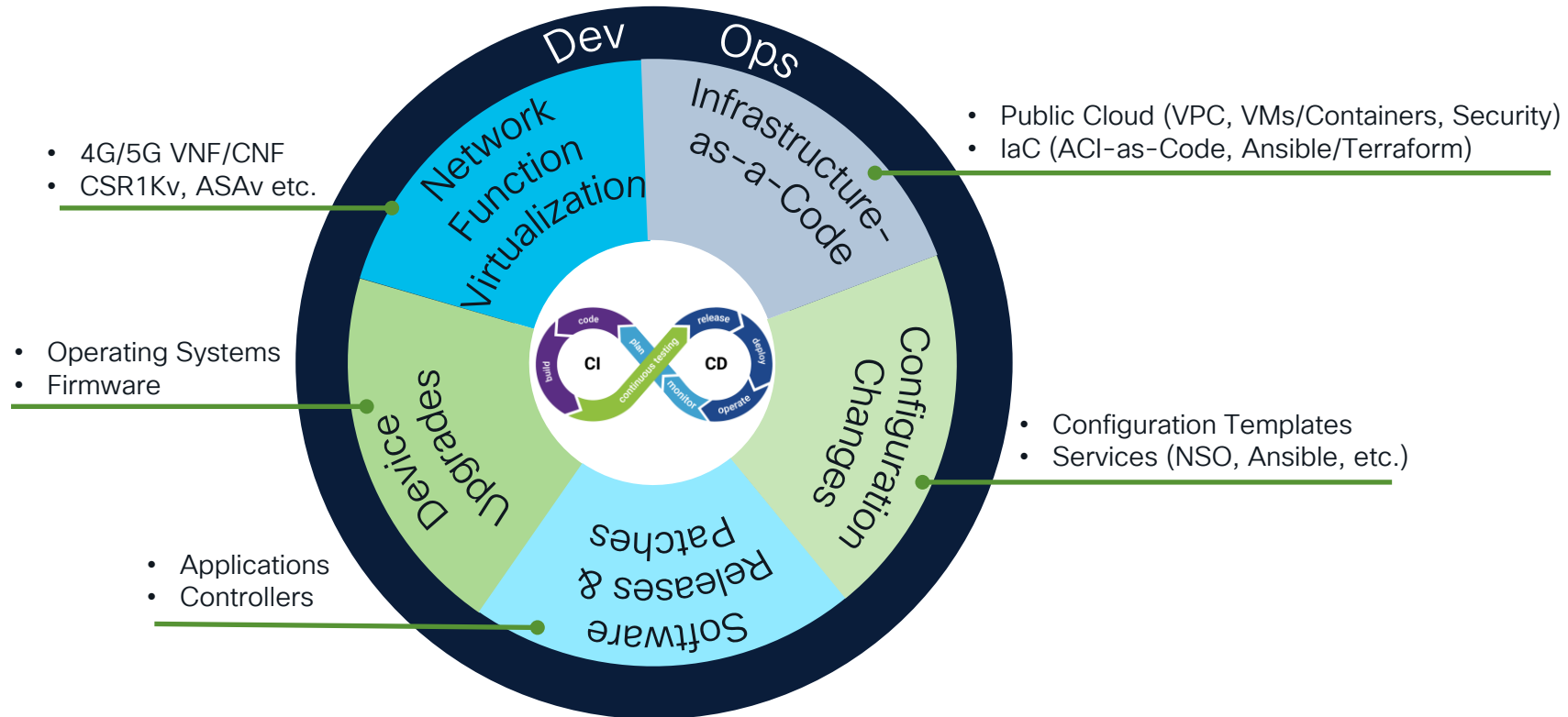





# DevNetOps Design Principles



# DevNetOps Solutions



A woman with dark hair tied in a bun, wearing a light blue denim shirt, is standing at a wooden workbench in a workshop. She is looking at a silver laptop and has her hand on the trackpad. The workbench is cluttered with various tools, including a saw, a hammer, and some wood. In the background, there are large windows and stacks of wood, creating a warm, industrial atmosphere.

## How Cisco visualizes market segment in SP space.

# 5G DevNetOps Use-cases

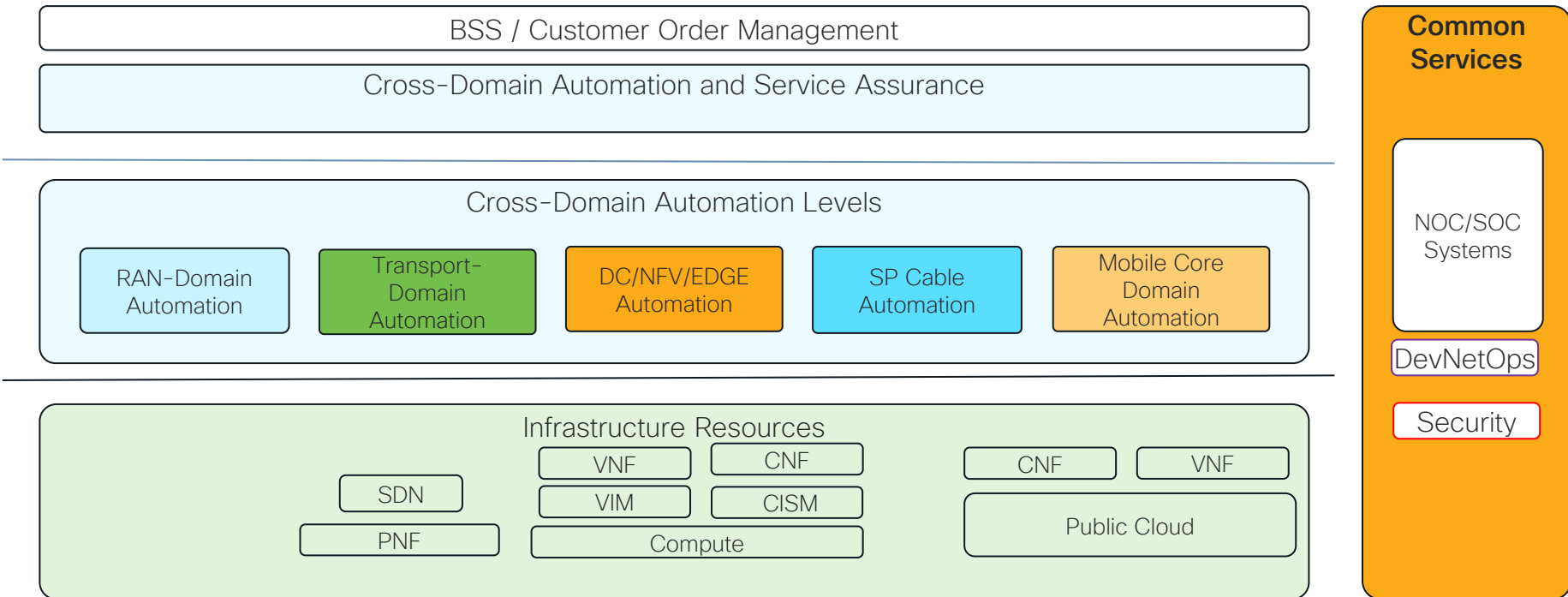
Attribute	Use-Cases	Outcomes
Network Function Lifecycle Management	<ul style="list-style-type: none"> <li>Workflow &amp; pipeline management</li> <li>Software onboarding including upgrades</li> <li>Artifacts management</li> <li>Artifacts deployment and certification</li> <li>Automated testbed deployment of Virtual Functions</li> <li>Test management Integration</li> </ul>	<ul style="list-style-type: none"> <li>Virtual Network Function (VNF) Software Lifecycle Management process automated from multi-vendors across environment</li> <li>Automated onboarding via end-to-end CICD Pipelines with governance</li> </ul>
Unified Experience	<ul style="list-style-type: none"> <li>Self-Service portal</li> <li>Artifacts management &amp; reporting</li> <li>Test reporting</li> <li>Defects management</li> <li>User management of multiple pipelines</li> </ul>	<ul style="list-style-type: none"> <li>Single pane of glass and control points across multi-vendor Network Function lifecycle activities</li> <li>Automated pull and download of new software</li> <li>KPI dashboards</li> <li>Release deployment pipeline and certification report</li> </ul>
Test Case Automation	<ul style="list-style-type: none"> <li>Vendor-specific test automation libraries</li> <li>Re-usable libraries easily customizable if needed</li> <li>Life-cycle, service chain, and feature test cases</li> </ul>	<ul style="list-style-type: none"> <li>Test case automation</li> <li>Reduced time and effort.</li> <li>Consolidated data of test results, issues and defects</li> <li>Production-readiness and confidence</li> </ul>
Infrastructure Automation	<ul style="list-style-type: none"> <li>Automate network device configs</li> <li>Infrastructure-as-code and Zero Touch Provisioning deployments (ZTP)</li> </ul>	<ul style="list-style-type: none"> <li>Automated network configuration provisioning as part of VNF instantiation</li> <li>Deployment</li> </ul>

# Case Study



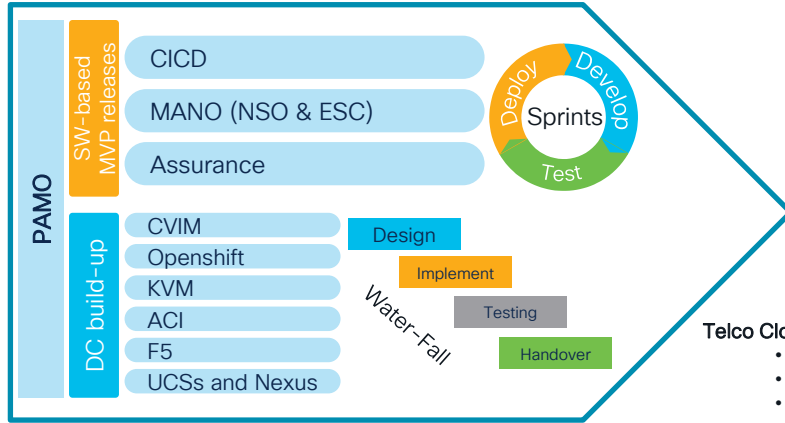
# Automation and Service Assurance Landscape

## Cross-Domain Levels



# DevNetOps journey ...*begins here!*

## Flexibility



## Predictability

### MVP 1

- Foundation ready to onboard VNF
- Minimal operation tools to monitor the node

### MVP 2

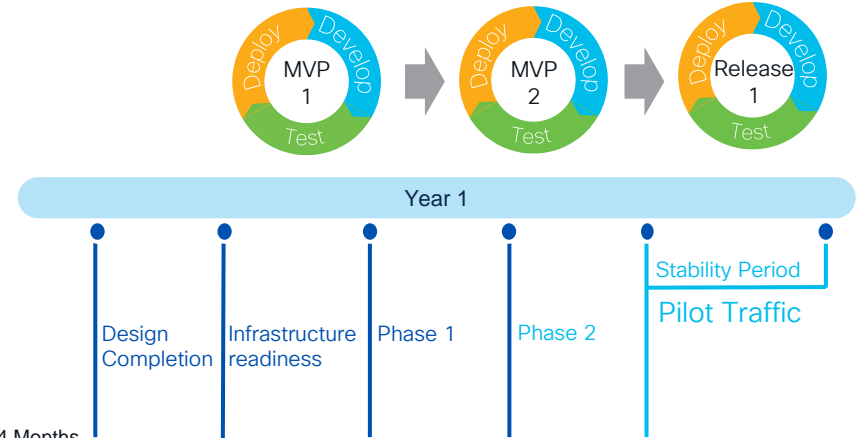
- Having featured Cisco stack capability
- Capacity management

### Release 1

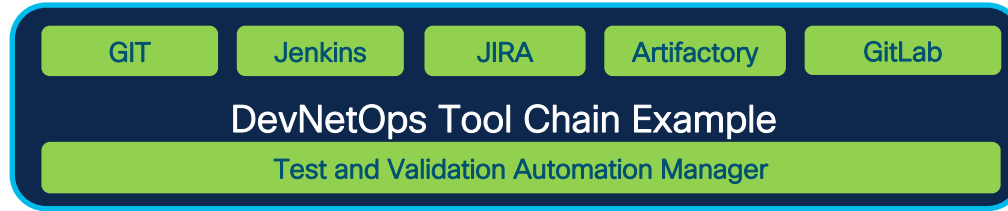
- Enable Capacity Planning

#### Telco Cloud KPIs

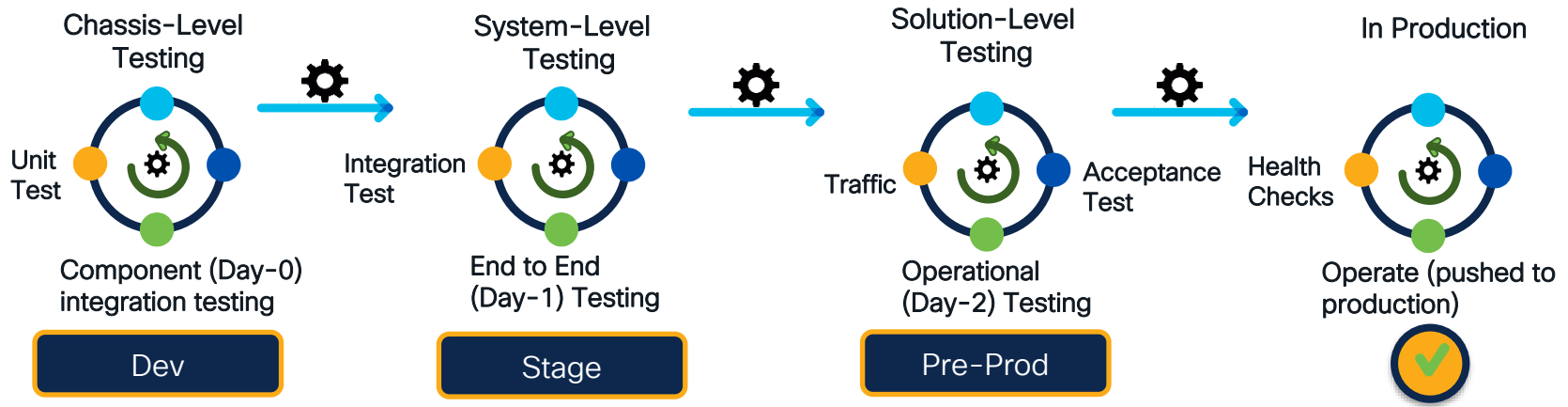
- CIP Foundation in 4 Months
- Pilot Traffic in **2 Months**
- Stability Period in **3 Months**



# DevNetOps – value of continuous testing



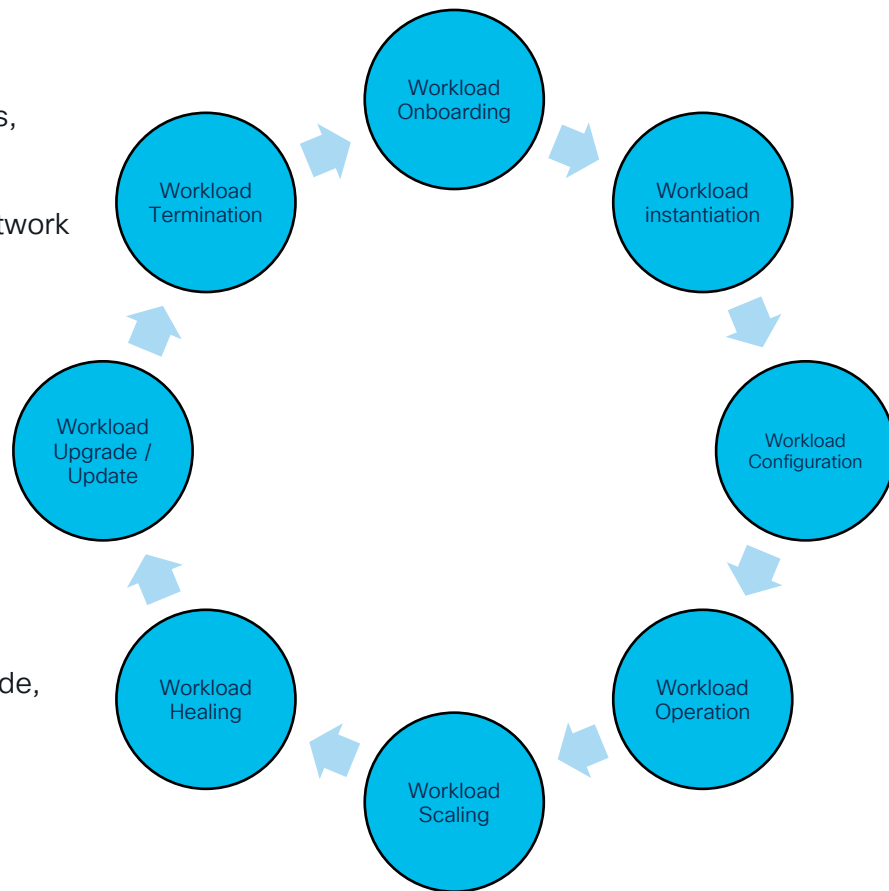
## Continuous Testing Levels In-Depth





# Workload Test Scenarios

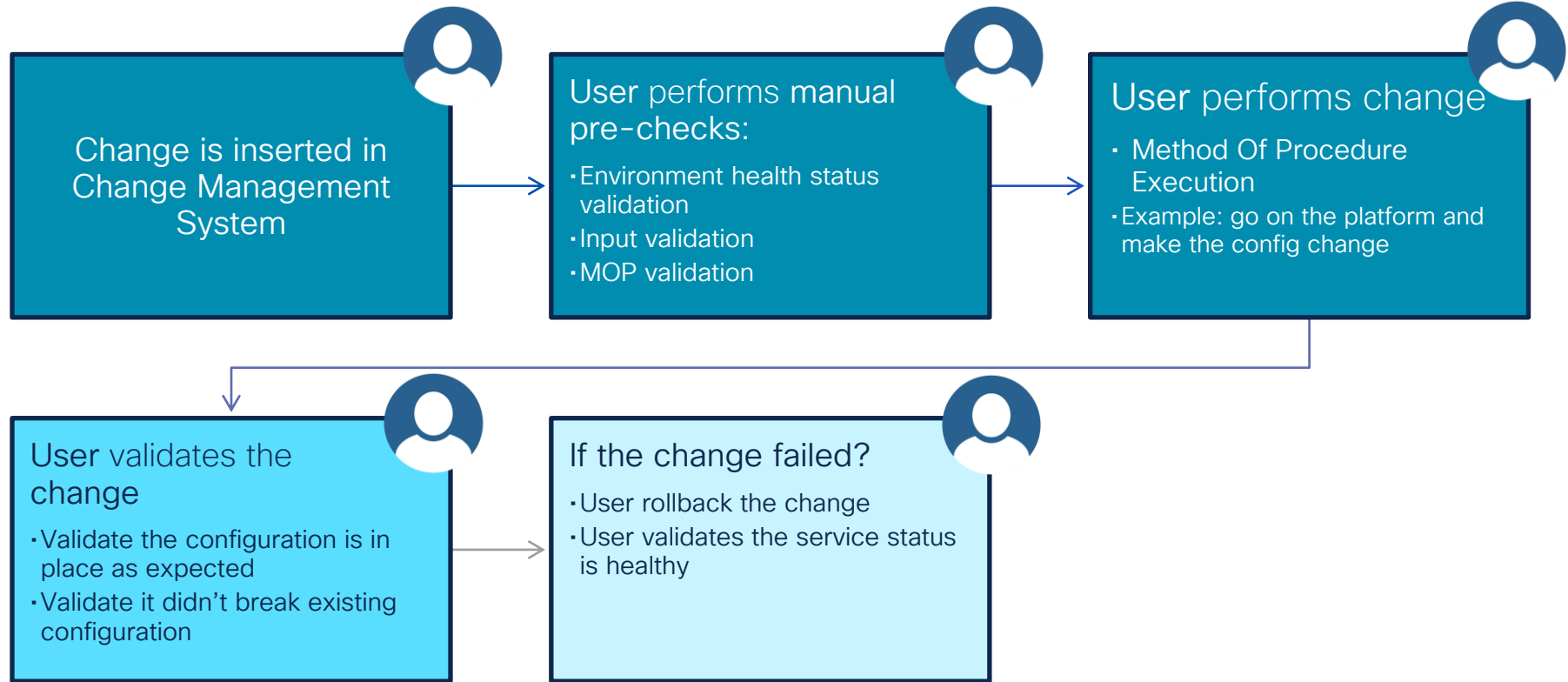
Workload Onboarding	Artifacts upload to catalogue, create descriptors, create package, upload package to catalogue
Workload Instantiation	Pre-processing, workload bootup, workload network connectivity
Workload Configuration	Post-processing, workload configuration
Workload Operations	Start, stop, suspend, resume, monitoring
Workload Scaling	Scale-Up/Down, Scale-In/Out
Workload Healing	Workload failure and recovery
Workload Update/Upgrade	Workload image update, workload image upgrade, lossless processing
Workload Termination	Workload image removal, network connectivity termination



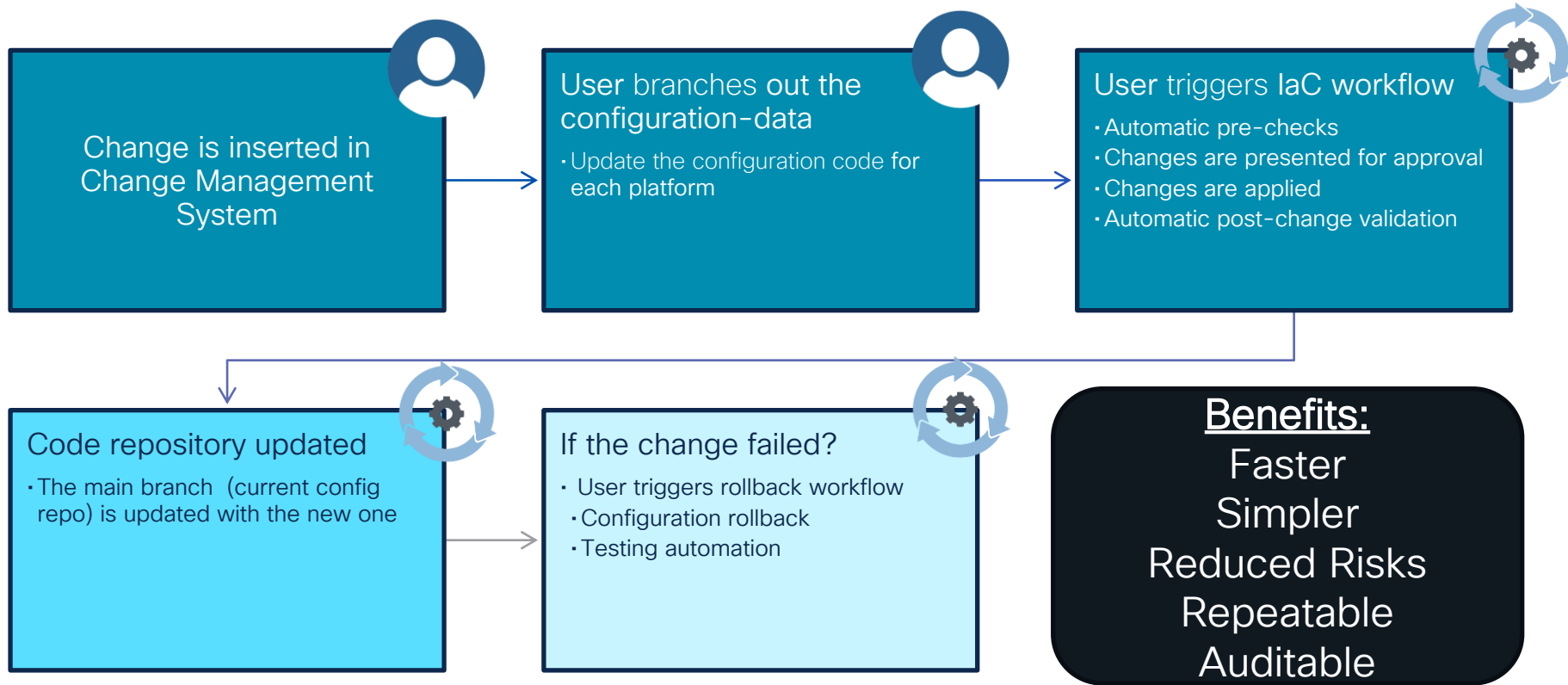
# Envisioning DevNetOps – Cisco



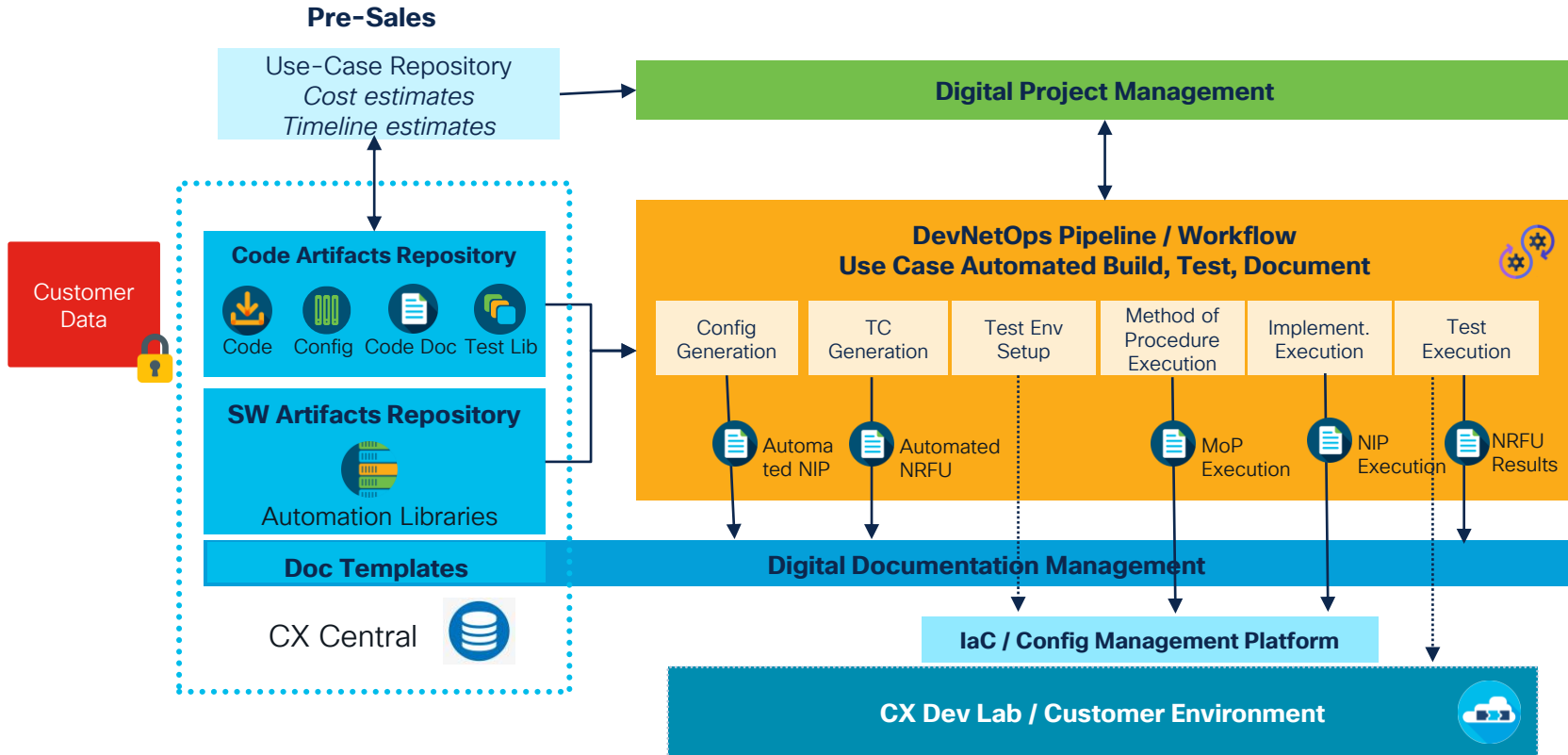
# Operational Model – making planned change – manual



# Operational Model – making planned change – Automated



# Digitized Cisco DevNetOps: Blueprint



# Consumer decision points

- Technical buying factors
  - Cisco + Open Source + multi-vendor / 3rd party
  - DevNetOps & CICD
  - Greenfield & brownfield
- Visibility for performance, improved troubleshooting, security posture
- Trust to support AI / ML based features
  - Visibility to how automation works
  - Understand efficacy in closed loop solutions
- Assistance to build and maintain their own automation
  - Increase accessibility of automation through no code, low code frameworks
  - Sophisticated consulting paired with a DevOps environment and supporting tool chains
- Streamline, standardize workflow & process automation across multiple domains for simplified integration and interoperability

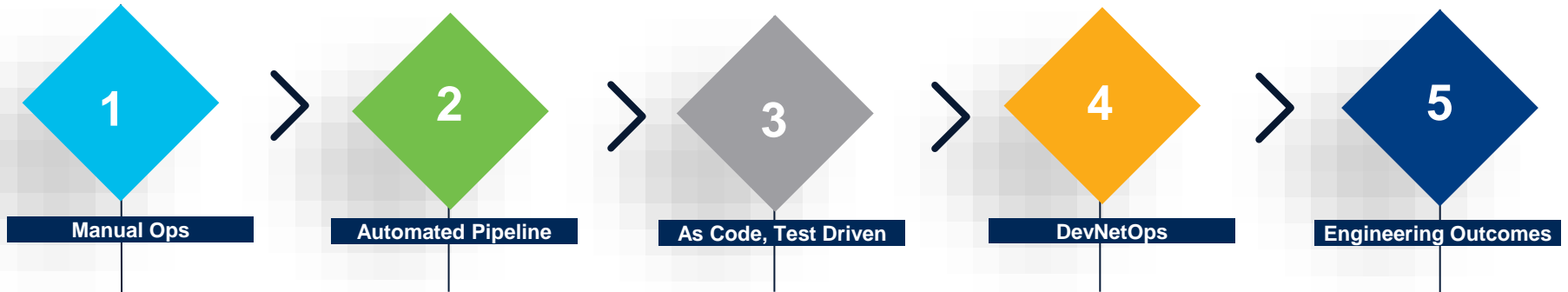
# So What?



# DevNetOps – promises secure reliable networks

- Simplicity and agility
- Faster deployments and outcomes
- Higher success change-rates
- Shorter change windows
- Abstraction of details and complexity
- Standardization

## Your DevNetOps Journey



People: Network  
Reliability Engineers



Process: DevNetOps



Technology: automated,  
simplicistic, agile, reliable



# DevNetOps Key Takeaways



5G mobility networks gain reliability, velocity, and agility



Industry standard open-source tools and vendor tools & services are both available to assist in your journey of DevNetOps



DevNetOps brings together end-to-end visibility across multiple points in networks.



Digital Transformation



Reduce risk



Cost reduction



Demonstrate compliance



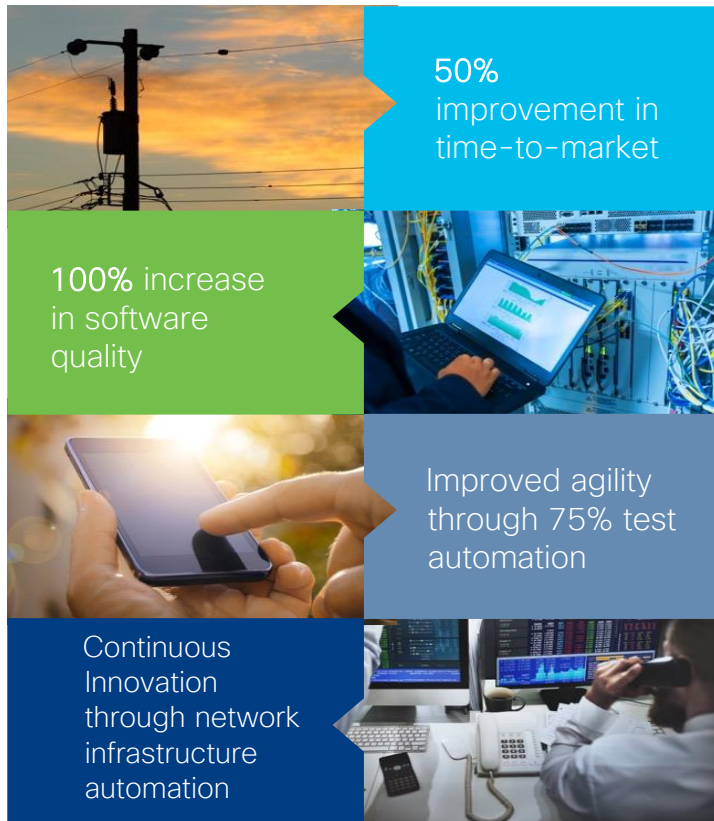
Optimized productivity



Improve user experience



Bridging E2E Visibility



50%  
improvement in  
time-to-market

100% increase  
in software  
quality

Improved agility  
through 75% test  
automation

Continuous  
Innovation  
through network  
infrastructure  
automation

# Acknowledgements

Idea was originally submitted by:

- Ankush Arora, Distinguished Architect
- Srinjoy Chakraborty, Technical Leader

# Additional Information & Sessions



- Checkout the CX Automation booth and the Services-as-Code demo
- BRKATO-1003: Automated and simplified network operator experience for managing multi vendor network with Cisco and third-party domain controllers
- BRKATO-2102: Accelerate Time to Value Through Automation Across IT Technologies
- BRKDCN-2906: Infrastructure as Code for ACI with Ansible and Terraform
- LTRDCN-3325: ACI Automation & Programmability Lab

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Attendees will also earn 100 points in the **Cisco Live Challenge** for every survey completed.



**These points** help you get on the leaderboard and increase your chances of winning daily and grand prizes

# Continue your education



- Visit the Cisco Showcase for related demos
- Book your one-on-one Meet the Engineer meeting
- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs
- Visit the On-Demand Library for more sessions at [www.CiscoLive.com/on-demand](https://www.CiscoLive.com/on-demand)



The bridge to possible

# Thank you

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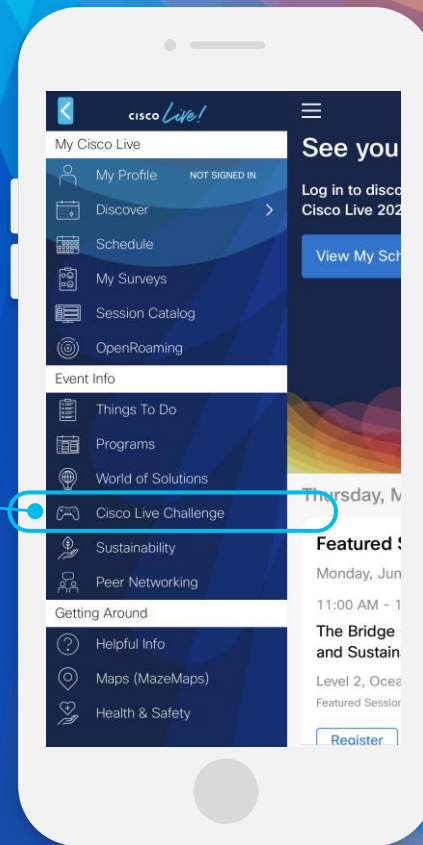
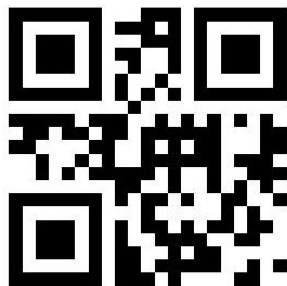
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- 1 Open the Cisco Events App.
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The background is a vibrant, abstract graphic. It features a central bright white light source from which numerous colorful rays emanate, creating a sunburst or starburst effect. The rays transition through a spectrum of colors including yellow, orange, red, and various shades of blue and green. Overlaid on this are large, flowing, wavy shapes in similar colors, giving the overall impression of energy and movement.

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