

5G CICD

Continuous Deployment & Automation Framework

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DGTL-BRKSPM-2002



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Agenda

- Chapter 1 - Introduction 5min
- Chapter 2 - CI/CD Certification challenges 7min
- Chapter 3 - Scaling CI/CD 3min
- Chapter 4 - Software Release Management 10min
- Chapter 5 - Manageable 5G CNF/VNF deployments 5min
- Chapter 6 – Demo 10 min
- Chapter 7 - Rakuten case study 15min
- Chapter 8 – Lessons Learned
- Chapter 9 - Conclusion 5min

Chapter 1 - Introduction

Introduction: Vijay Raghavendran

- Hello I am Vijay Raghavendran.
- I am a Distinguished Engineer in Cisco Customer experience group.
- I started CDAF initiative 5 years and handles Platform Architecture and custom deployment
- I will introduce the CDAF framework and how it can be adopted.

Introduction: Ranjani Ram

- Hello I am Ranjani Ram.
- I am a Principal Engineer in Cisco Customer experience group.
- I have been involved with this CICD initiative for 2-3 years and is handling the AI/ML implementations with the help of a vendor.
- I will discuss what we have implemented and planning for one of our customers.

5G promises

Deliver enhanced mobile broadband services, ultra-low latency and massive IoT communications services for both consumers and enterprises across many vertical industries.

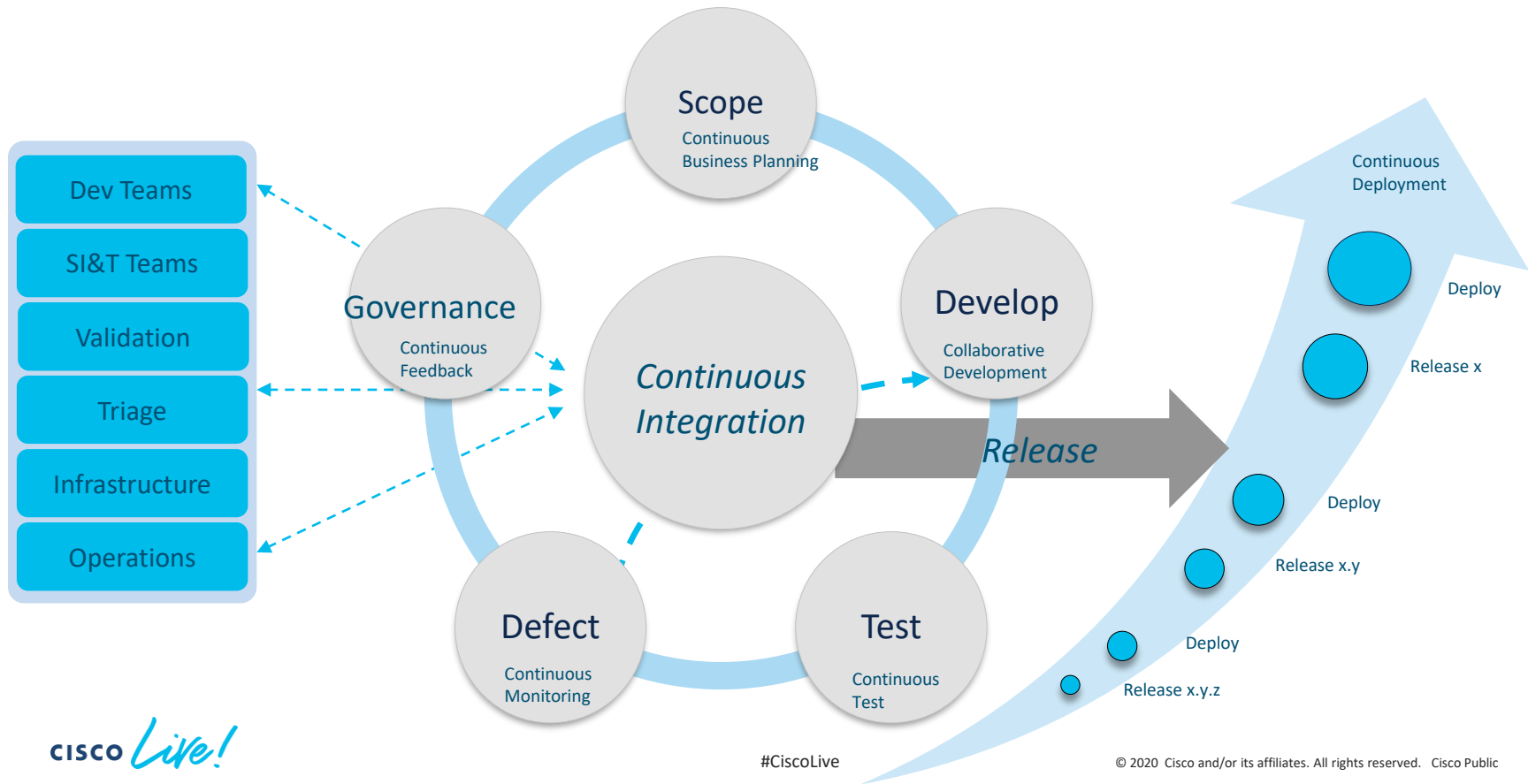
2G, 3G and 4G mobile networks were built for consumer voice and data services

5G networks are being built to support a plethora of use cases that in turn support the digital transformation of entire vertical industries.

Design Principles	Characteristics	Risk
<p>Network slicing</p> <p>Cloud-native computing, multi- access edge computing (MEC)</p> <p>Software-defined networking (SDN)</p> <p>Network function virtualization (NFV)</p>	<p>Flexible</p> <p>Multi-vendor</p> <p>Agile and elastic</p> <p>Rapid Deployments</p> <p>Standardization of Infrastructure</p> <p>Superior Customer Experience</p>	<p>Multi-Vendor & Multi Domain complexity</p> <p>Teams skillset</p> <p>OPEX increase</p>

5G Automation

Software Release lifecycle management

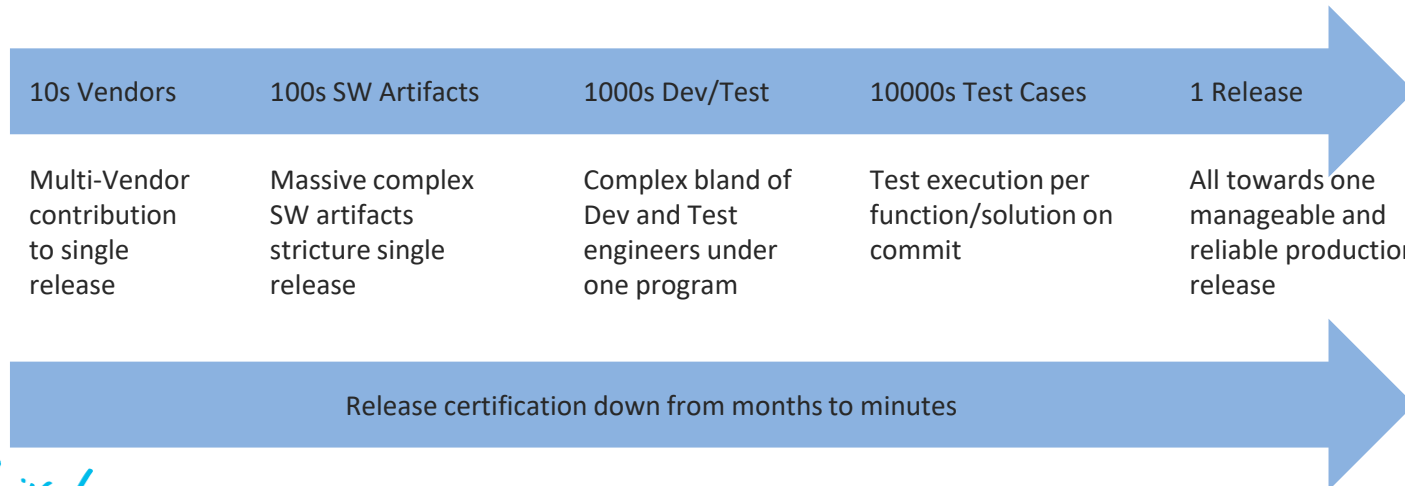


Chapter 2 – CI/CD Certification challenges

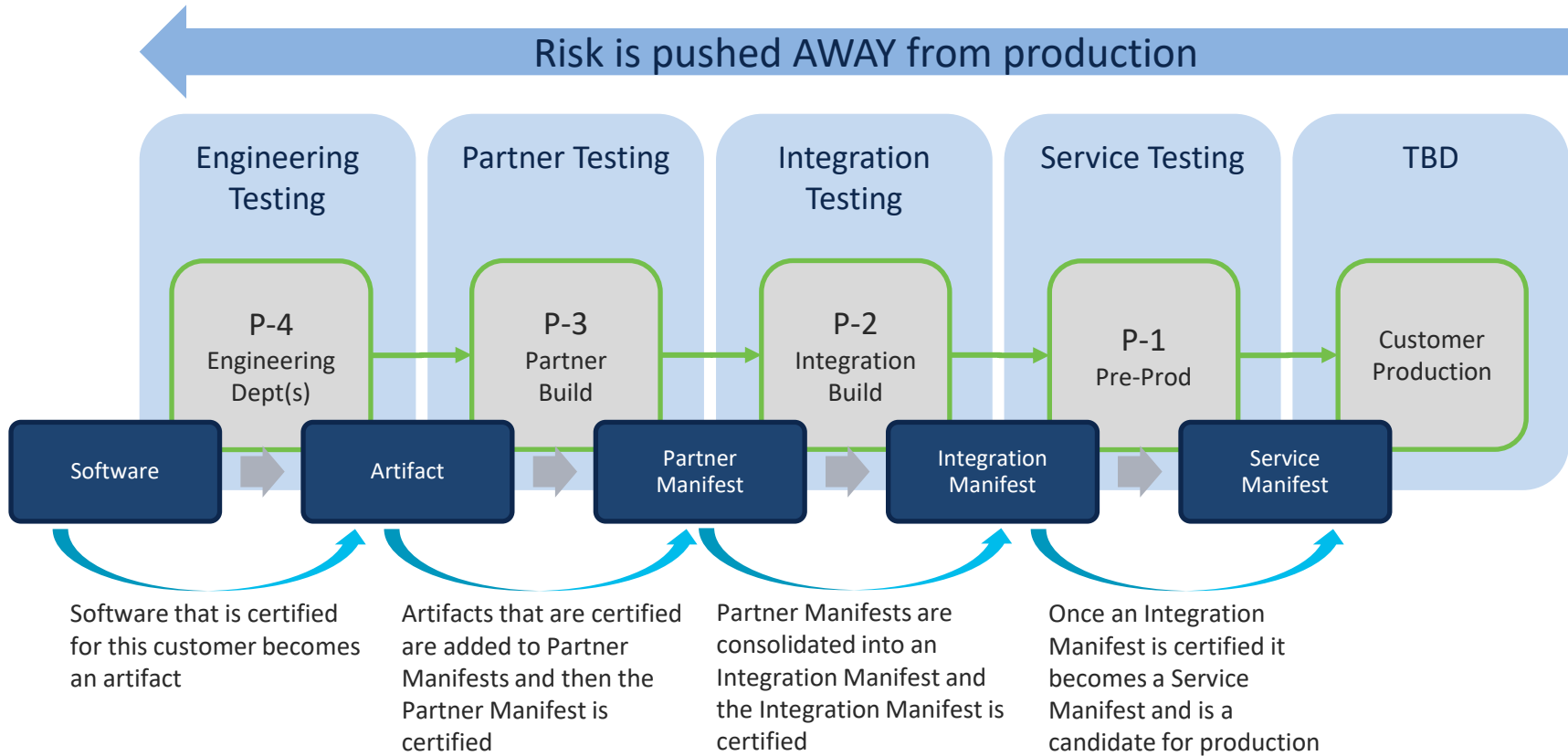
Software Certification

In an agile operations SP environment with multiple suppliers the ability to regulate on a per-software-version basis becomes unmanageable and time consuming. This method is too detailed for successful operations.

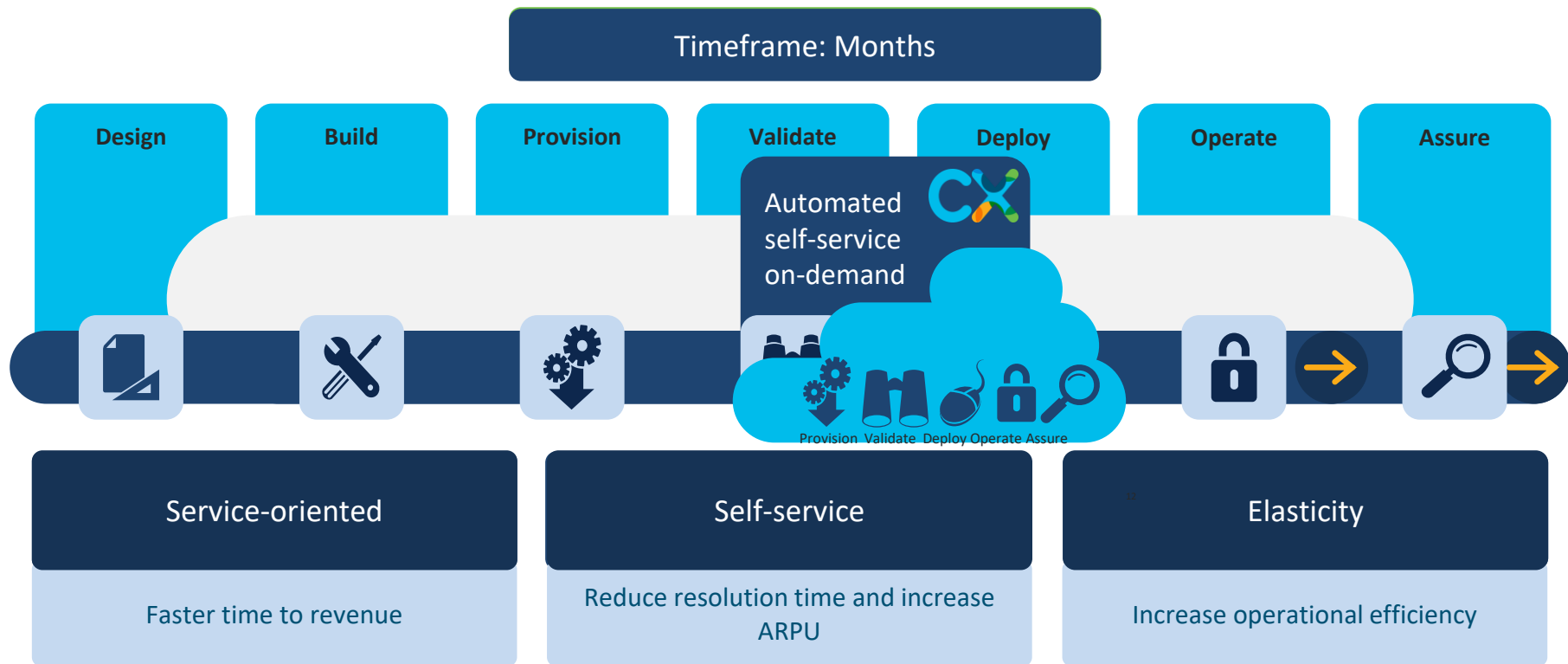
The solution is to organize software on its journey to production. During certification stages software artifacts are tested in logical groups and then aggregated into larger packages for collective deployment to production.



Artifact to Manifest Journey

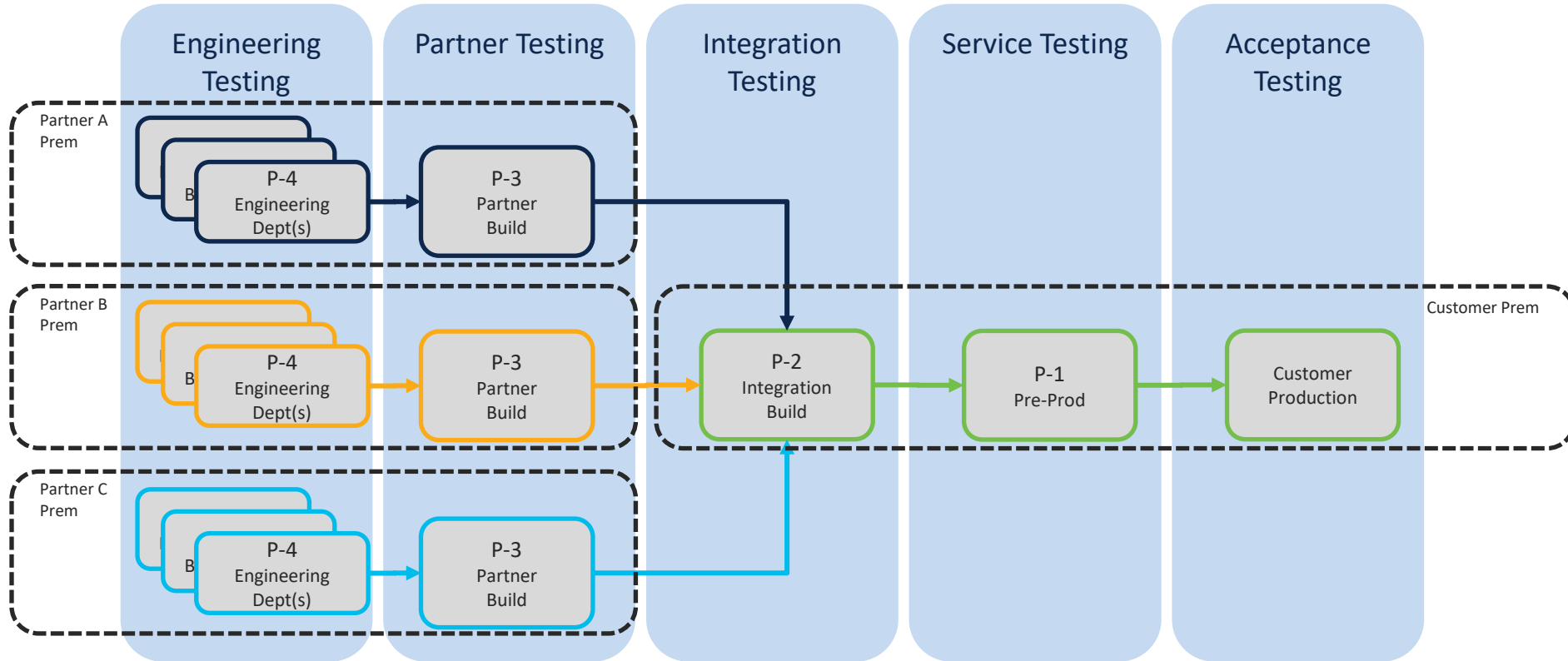


Automating Service Deployment Processes



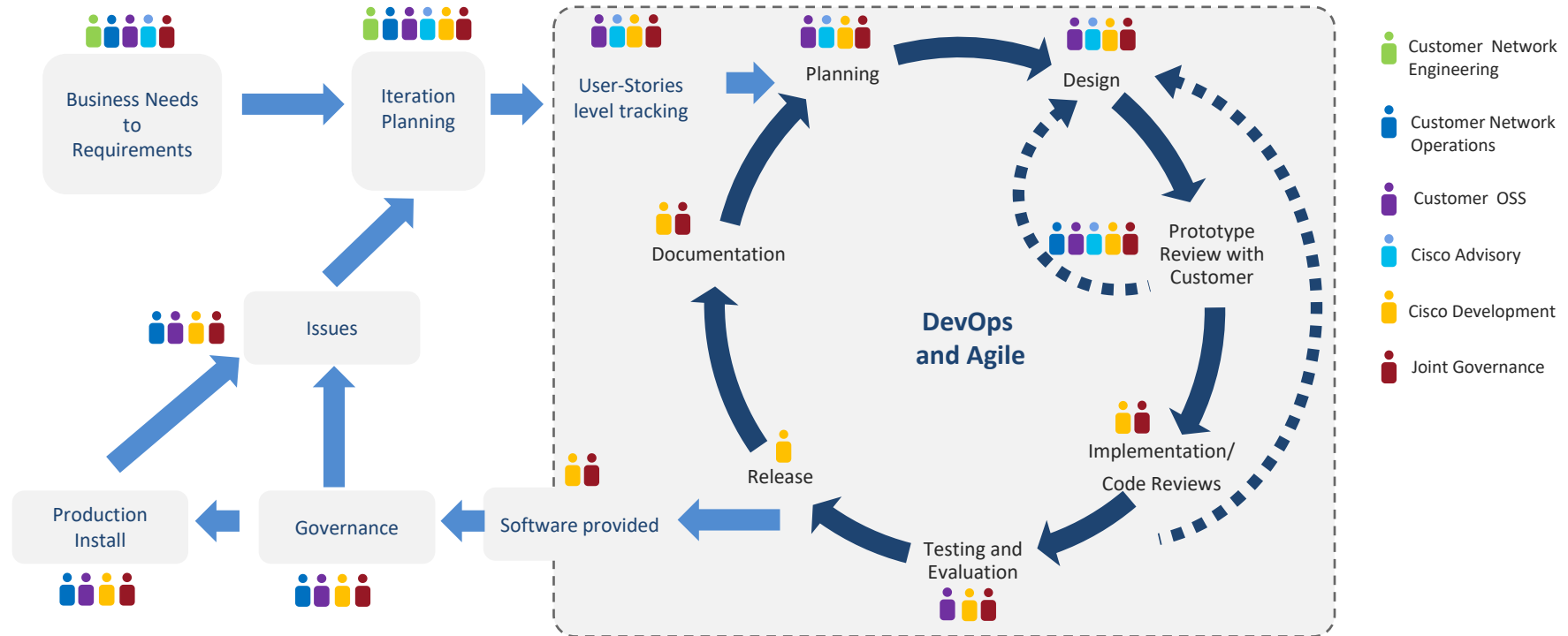
Chapter 3 - Scaling CI/CD

Scale to partners



Software Delivery Lifecycle

People, Process, Tools



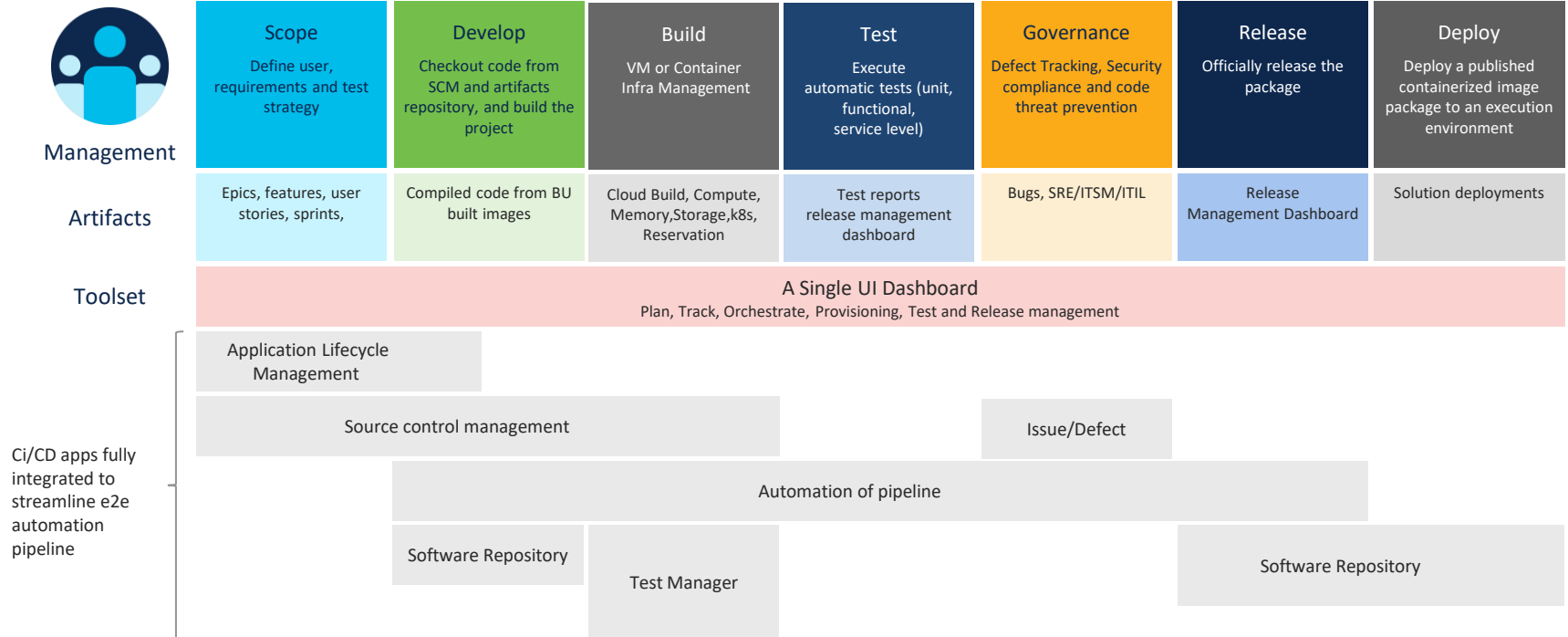
Chapter 4 - Release Management

A DevOps Framework

	Scope/AMO/PMO	Develop	Release/IT Operations
Business Outcomes	<ul style="list-style-type: none">• Process of defining what work is required and making sure all that work is done• Includes the planning, coordination, and management activities that ensure the product scope is achieved.	<p>Bring Development into Alignment with business needs following Agile methodologies</p>	<p>Overseeing the planning, scheduling, and controlling of software builds throughout each stage of development and across various environments.</p>
Processes and best practices applied	<ul style="list-style-type: none">• Stakeholders requirements gathering• Time, Cost, Risk, Quality considerations• Change mgmt.• Continues monitoring	<ul style="list-style-type: none">• Customer satisfaction through early and continuous software delivery• Frequent delivery of working software• Working software is the primary measure of progress• Regular reflections on how to become more effective	<ul style="list-style-type: none">• Faster Service Delivery• Visibility across data• Cost effective service• Experienced DevOps Pro.
People and Functions provided	<ul style="list-style-type: none">• Architecture Management Office*• Program Management Office*• Project Manager	<ul style="list-style-type: none">• Scrum Master• Project Manager• Automation Eng.• Software Tester• Security Eng.	<ul style="list-style-type: none">• DevOps Architect• Automation Eng.• Software Tester• Security Eng.• Integration Specialist• Release Manager

Methodology and components

Continuous deployment



Chapter 5 - Manageable 5G CNF/VNF deployments

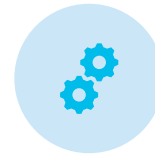
End-to-End CI/CD Automation Use Cases



Software Catalog



Deployment Build



Test Cases
Automation



Release Certification



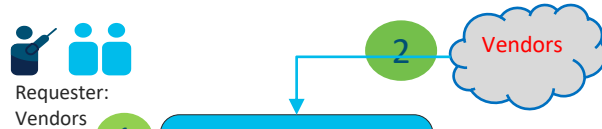
Software Compliance
Check



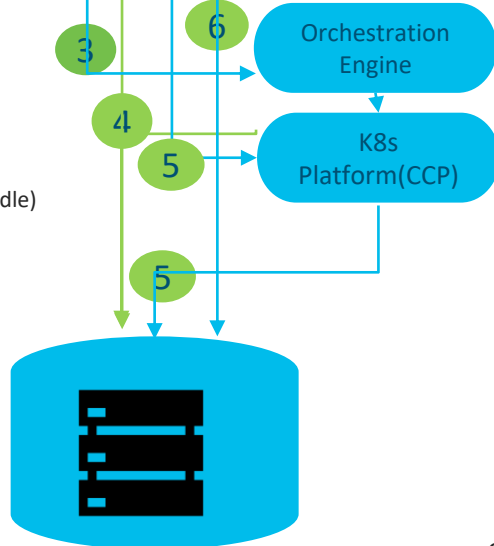
DevOps powered by
AI/ML

CICD Automation for CNF/VNF Deployment

LAB



- 1 Software Registration in Catalog
- 2 Software Download
- 3 Resource Request(Helm/Bundle)
- 4 Resource Inventory Check
- 5 Resource Build & Deployment
- 6 App/SW Release Certification(Test)



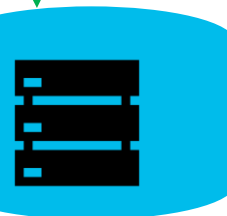
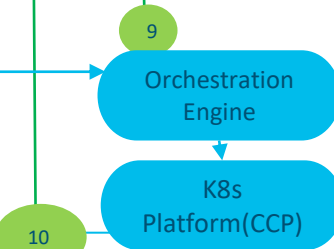
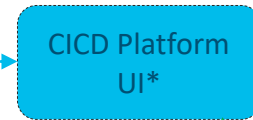
Development/Integration/Pre-prod Environment

CI

- Only CICD tools deployed in Production
- Manifest managed by Single instance of framework

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Production



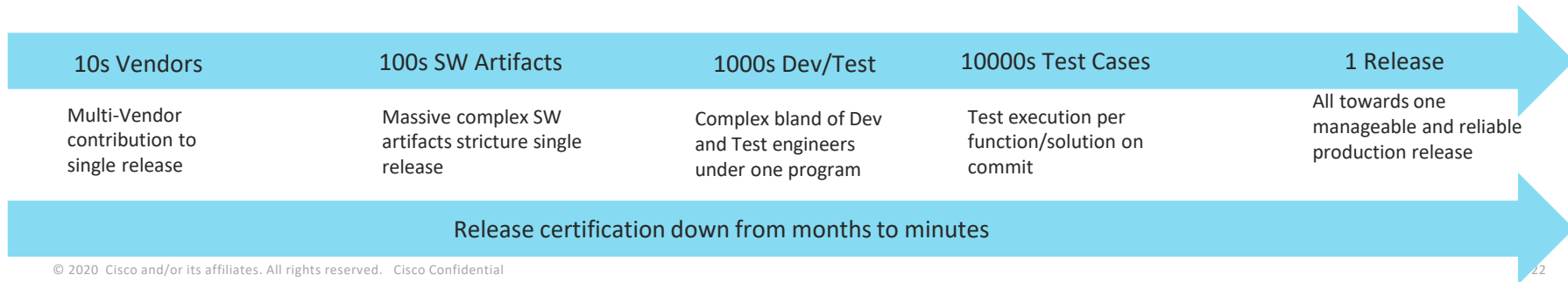
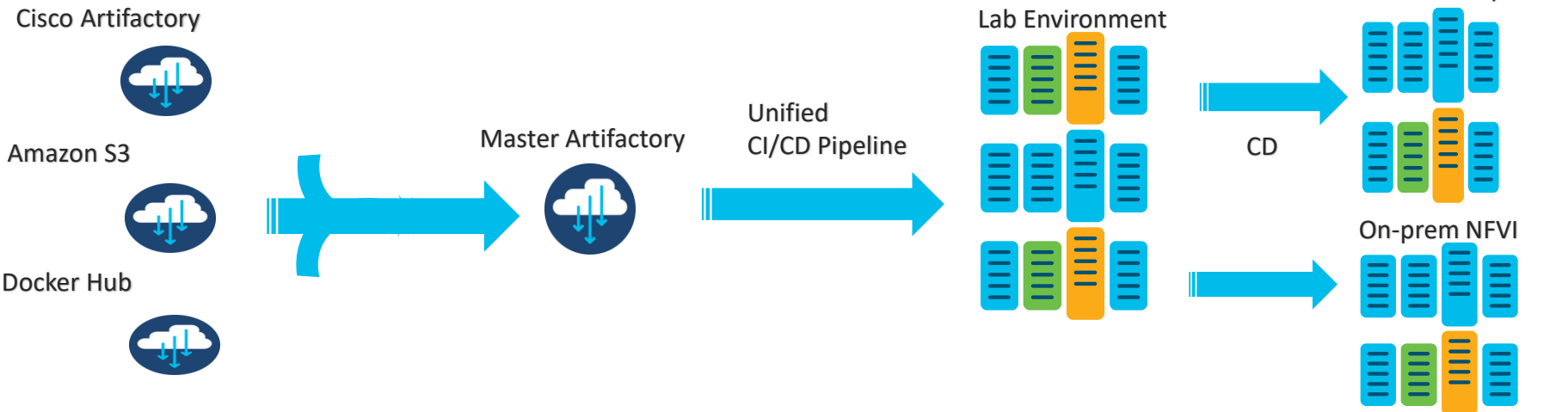
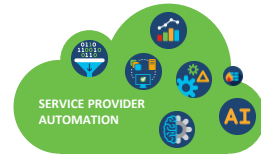
Production Environment

CD

CISCO *Live!*

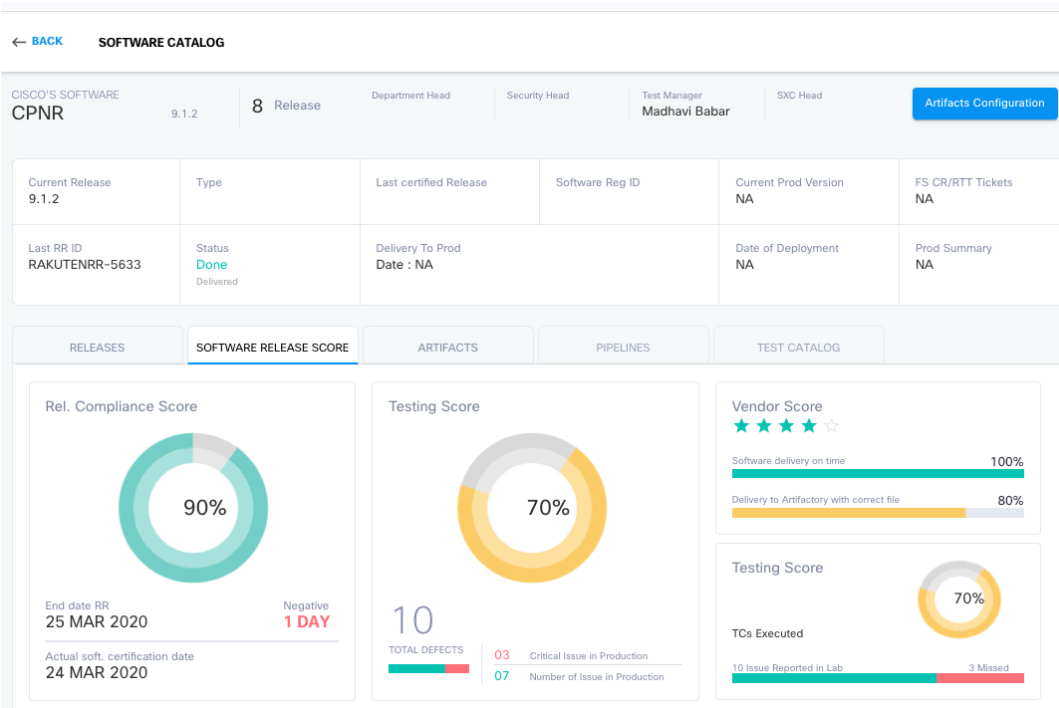
Continuous Integration | Delivery | Deployment

Automated Delivery Pipeline



Software Catalog

Highlights



Self-Onboarding Vendors

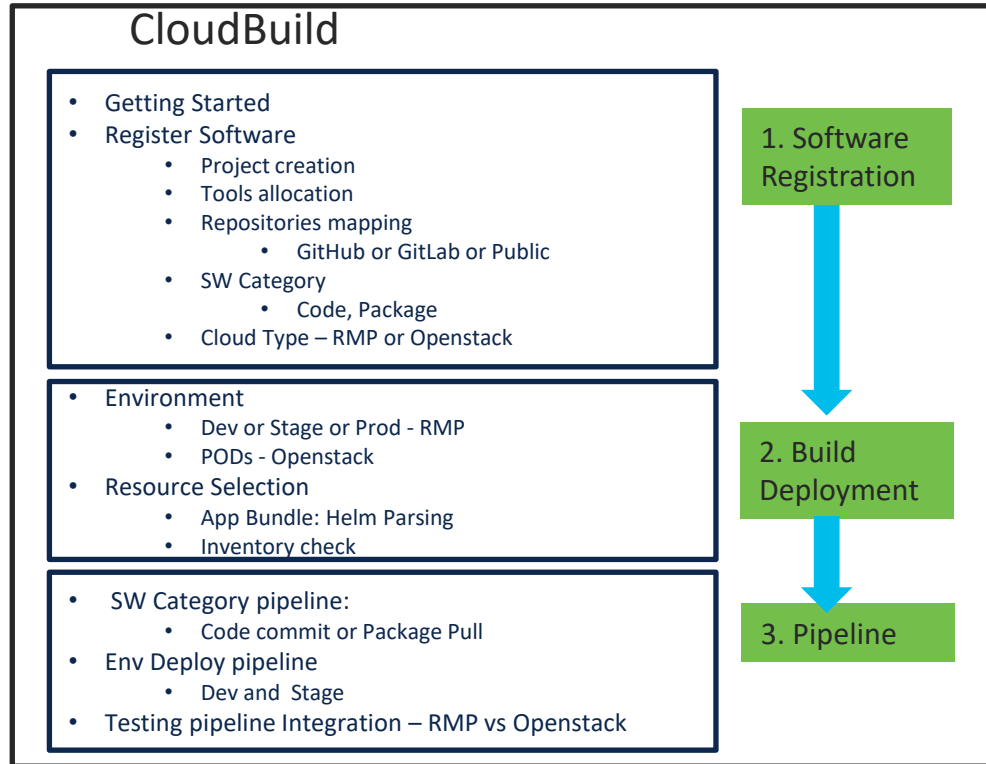


Automated Pull of Software



Release KPI Dashboard

Automating CNF/VNF Deployment Build



Software Registration:

1. Register Software
2. Helm or Request Resource

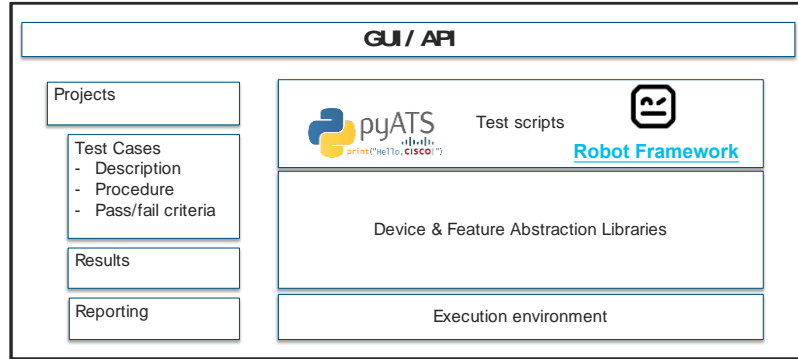
Build Deployment:

1. Infrastructure Resource check
2. Resource Request
3. Build Tenant/Project
4. Deploy Applications

Orchestration Engines(Configs):

1. Openstack – NSO/ESC
2. K8s – Jenkins+Ansible

Test Management



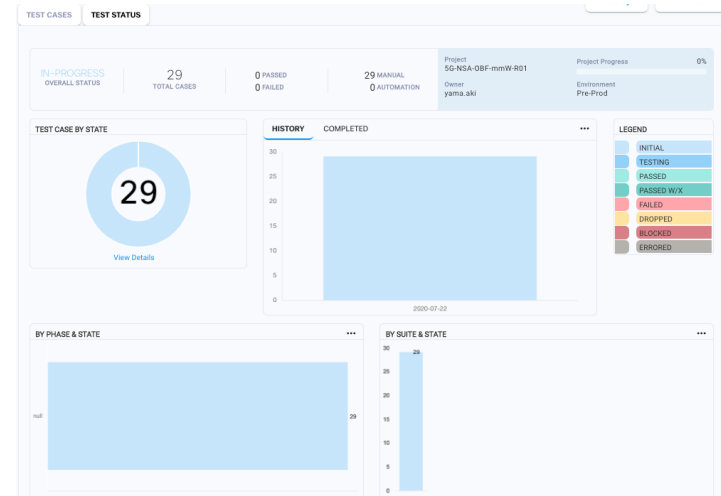
Key Tenants:

- Enhanced Test Manager
- Master Catalog
- Test Case Automation
- Test Result Dashboard

The screenshot shows the Test Management interface with the following elements:

- Navigation Bar**: HOME, TEST MANAGEMENT (active), REQUEST MANAGEMENT, DEFECT MANAGEMENT, RESOURCE MANAGEMENT, ADMIN MANAGEMENT.
- Filters**: Vendor (Rakuten), Select Solution (Volte-E2E-Master-Project), and a plus icon for additional filters.
- Actions**: Download Template, Copy, Share, and a plus icon.
- Summary**: 4 Test cases found. Items per page: 25. 1 - 4 of 4. Add Test case button.
- Table**:

<input type="checkbox"/>	TITLE	VNF (TAG)	SUITE	PASS FAIL CRITERIAS	
<input type="checkbox"/>	VoLTE to VoLTE, UE-A clears (UE-B in LTE radio access Read More)	Volte-system	E2E	OSS Counters for call completion increments by 1e Read More	



Release Certification

Highlights



Consolidated
CI/CD Data



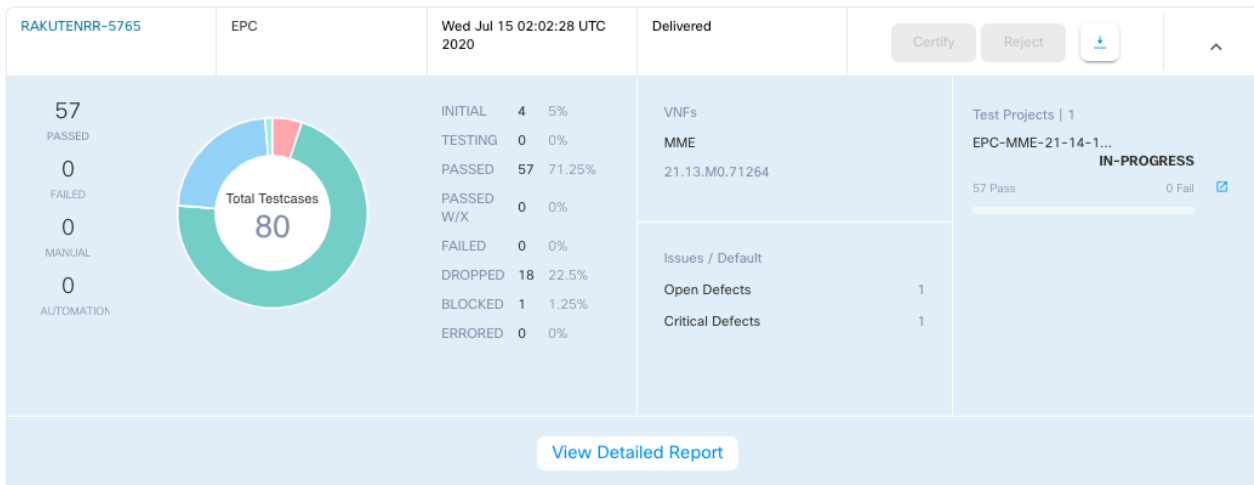
Test Results



Issues/Defects




Production Baseline



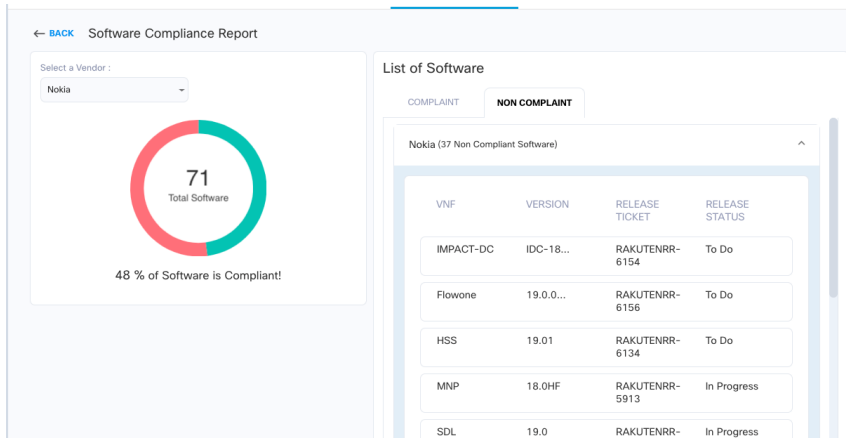
Software Compliance

Multi Vendor Software Inventory

Select a Vendor : Nokia  [View Software Compliance Report](#) [Upload New Software For Nokia](#)

KIBA TOTSUKA Totsuka-FS Inventory

VNF	VERSION	TYPE	DELIVERY MANAGER	RELEASE MANAGER	TEST MANAGER	RELEASE DATE	RELEASE TICKET	RELEASE STATUS
AAA	19.0	Early-Releases	Graham, Neil	Yadav, Brijesh	Babar, Madhavi	2019-May-21	RAKUTENRR-5883	Dept Approved
ASBC	19.0	Early-Releases	Graham, Neil	Chaudhry Atul	Babar, Madhavi	2019-May-21	RAKUTENRR-5964, RAKUTENRR-5722, RAKUTENRR-6034, RAKUTENRR-6035	Rejected,Open,Plan
CBAM	18.5.1	Early-Releases	Graham, Neil	Yadav, Brijesh	Babar, Madhavi	2019-May-21		
CFX	19.0-SP1	Early-Releases	Graham, Neil	Chaudhry Atul	Babar, Madhavi	2020-Feb-28	RAKUTENRR-6028	Deployed
CGF-DR	19.0	Early-Releases	Graham, Neil	Yadav, Brijesh	Babar, Madhavi	2019-May-21		



Highlights



Release Certified

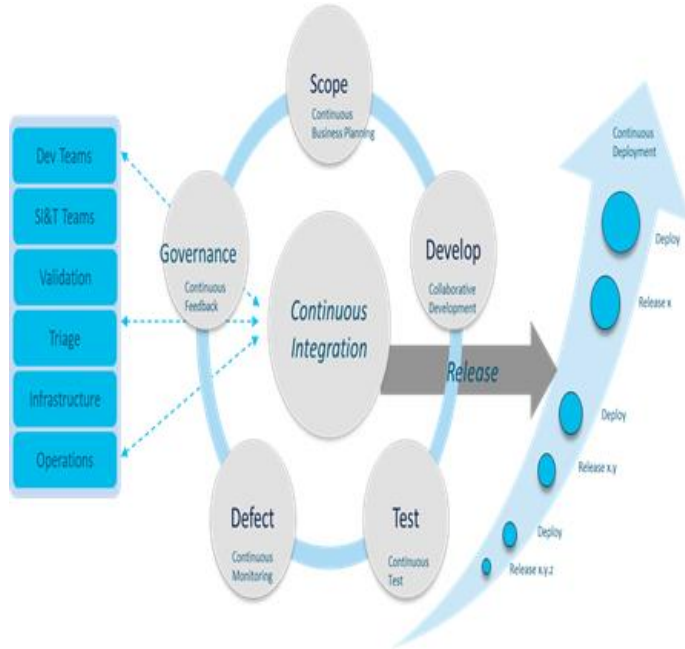


Production Deployed



Compliance Check

DevOps powered by AI/ML– Problem Statement



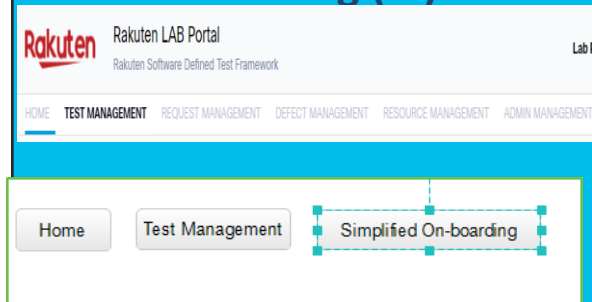
- AI/ML use cases are tailored to improve productivity in the CI/CD lifecycle
- Use cases are built based on user interviews and are data driven
- Prototyping and getting acceptance before putting in production

Expected outcomes:

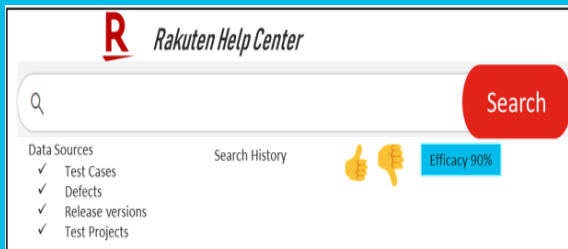
- **shortening the software development lifecycle**
- **Cost savings to customer**
- **Improving accuracy of data**
- **Reduce user fatigue with AI and UI**
- **Delivering as microservices that can be reused in other environments**

DevOps powered by AI/ML: Initiatives

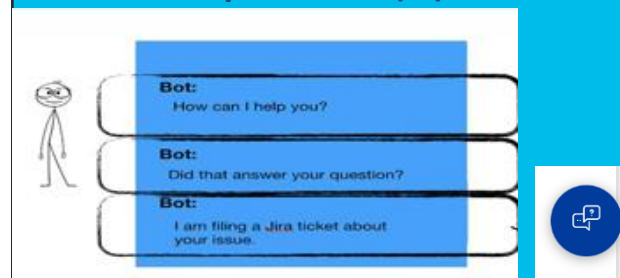
Simplified Test Project On-boarding (CI)



Intelligent Search and Suggestions- (CI)



Chatbot for triage of simple issues- (CI)



Software Recommendation for Release certification- (CD)

Release Name	Solution	Date	ML Prediction	
Release 123	EPC	2020/01/22		<input type="button" value="Certify"/> <input type="button" value="Reject"/>
Release 456	NSO	2020/01/06		<input type="button" value="Certify"/> <input type="button" value="Reject"/>

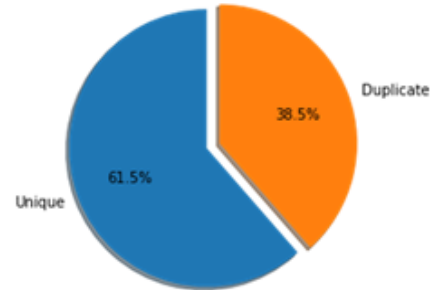
AI/ML based test project “onboarding”

Category Test case quality Improvement

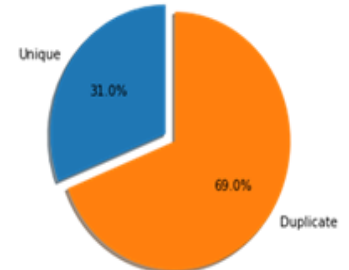
Context	Need to start with high quality test cases in master catalog. Use good duplicate detection algorithms
Findings	Exact duplicates and “near duplicates” found in the master catalog
Root Cause	Copying existing test cases and giving them different id

□ Test case definition

- Title
- Description
- Pass-Fail Criteria
- Setup
- Procedure



Exact Duplicates



“Near” duplicates

AI/ML based Simplified Test project On-boarding

Category	Test case Ranking --Based on the query “select” all relevant test cases but order in terms of relevance and other criteria that is needed in that environment
Context	Text based search with suggestions and ranking algorithm to get top-K documents, relative ordering using "learning to rank" methods
Findings	Users today search test cases based on certain criteria like vendor and or software and so on and get a large set of test cases from which they select a few and test. So the test case selection varies from user to user no uniformity of what they test, what they drop etc.
Root Cause	Different products from vendors, different vendors writing test cases, selection of test cases is based on what user decides they can accomplish

AI/ML based Simplified Test project On-boarding (continued)

Attachments



[Choose File](#)

Test Planning

Test Project(s)
Lorem ipsum dolor

Select Project Onboarding Type

AI / ML Beta

Advanced

[BACK](#) Test Project



Add Project & Test Cases

Enter Project Name

Lorem ipsum

Select Project Onboarding Type

AI / ML Beta

Advanced

Note: Enter Project Name to add test project(s)...

Add Test Cases



Search for Test Case Name, Tag, VNF

Recent Searches: [All Test Cases](#)

1336
TOTAL TEST CASES

0
ADDED TEST CASES

1336 | Test Cases | 0 | Selected Test Cases | 0 | Added Test Cases | [Reset](#)

[Add Test Cases](#)

<input type="checkbox"/>	TITLE ⓘ	TAG ⓘ	SUITE ⓘ	
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼
<input type="checkbox"/>	Top-up/renewal of KDDI bucket to verify KDDI bucket...	EPC_CONF	KDDI-Throttling	▼

Showing 01 - 8 of 1336 Records

Page 23 of 000 with page size 5

PREV 1 21 22 23 24 25 000 NEXT

Cancel

Next

AI/ML based Knowledge base creation

Category	<ul style="list-style-type: none">- “Help Center” is a topic search platform, suggestions during query,- personalization based on who searches- Searches across different areas, search of complex objects, not just documents
Context	<ul style="list-style-type: none">- Query analysis, parsing and indexing of complex objects (release notes, defects, test cases, releases, HLDs, production issues, CR,SR,RR, deployment issues)- external signals and popularity/importance of document are also considered-- open source search algorithms will be used
Findings	No such facility exists today
Root Cause	Information is scattered in different areas and a facility like this needed

AI/ML based “Chatbot” for Triage

Category	Search using Q and A format. Chatbot will answer some questions for which it is programmed, and the rest will be found from the "Help center" and a pointer given to customer, in some cases it will open a Jira ticket for further troubleshoot
Context	Opensource Chatbot frameworks will be used.
Findings	Today developers and testers are asked questions via chat tools when an urgent issue happens. Some of these urgent issues which has a solution, can be easily be solved using a chatbot
Root Cause	Known issues can be found easily and BOT can point the user to the right information

AI/ML based Software recommendation for certification

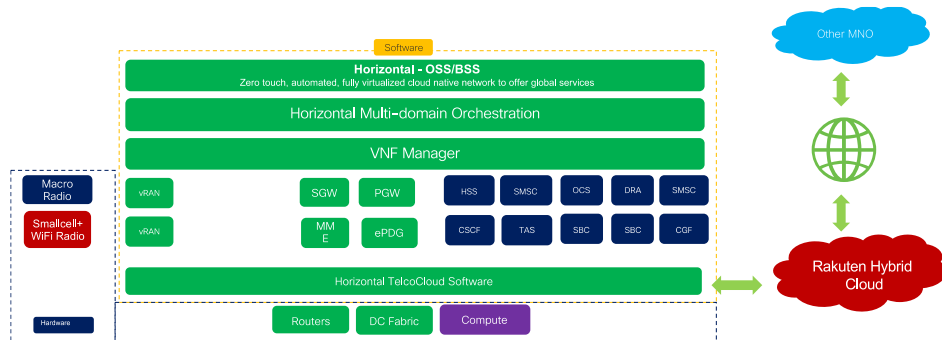
Category	- Find software readiness for certification
Context	<ul style="list-style-type: none">-Complex decision-Multiple vendors, multiple software from a vendor with multiple releases- Several Release notes to be looked at, defects, test projects, Change requests, Service requests, issues in production, how the software performs in production- Suitable algorithms will be used in this "supervised learning" problem
Findings	Manual process today, this solution would give predictions on the software, based on historical data
Root Cause	Manual process with no help for an executive who wants to certify

Chapter 6 - Demo

Chapter 7 - Rakuten case study

Rakuten MNO Architecture

Simplest, agile, disruptive Mobile Network Architecture



Rakuten Architecture



Rakuten LMP Outcome – CY2019

Tareq Amin (CTO, Rakuten) was quoted in an SDxCentral news article dated May 1, 2020:

“Typical radio access software development and new releases maybe happen twice a year. From the beginning of June 2018 till today, we have north of 350 software releases, all being agile, working in a continuous integration and continuous delivery (CICD) manner.”




502 Certified Releases Deployed



25000 Test Cases with 30% automated



1600+ Multi vendors Issues/Defects



Chapter 8 - Lessons Learned People, Process, Technology

5G Readiness – People (Before LMP)

Scope
Management

Develop
Management

Test
Management

Defect
Management

Release
Management

Business Initiatives are communicated in meetings and discussions (manual)

Other Challenges : People and Process

- Different tools were used to capture requirements
- Agile transformation was new to many vendors
- Confusion in taxonomy classification on User stories vs Use Cases

Addressing Business Initiatives and Requirements – With LMP

Business Initiative – Initiative(Agile Framework) – High Adoption
VNF/CNF – Features(Agile Framework) – High Adoption
Use Cases - User Stories(Agile Framework) – Lack of Adoption

[← BACK](#) **Business Initiative Details** [Take me to Rally](#)

1880 EPC				Plan Estimate <div><div></div></div> 15.22%		14 Total VNFs	
Owner George Oakes		Category None	Start Date 08 Feb 2019	End Date 09 Oct 2019	Count <div><div></div></div> 3.05%		0 Completed
							14 In-Progress

Select a VNF:
MME

VNF Details

No. Of Projects	Total Task Hours	To Do Hours	Feature Progress
23	0	0	<div><div></div></div> 87.5%

[Add VNF](#)

5G Readiness – Process and Technology (Before LMP)

Scope
Management

Develop
Management

Test
Management

Defect
Management


Release
Management


Continuous delivery from vendors is not tracked for certification

Challenges : People, Process, Technology

- Images were delivered from vendor to customer using non-standard methods
- Non-availability of certified images per VNF, yet were mapped to solution release
- Quality of code across vendor varied
- Too many early releases from vendors with limited testing
- Target platform was different from VNF certified platforms

Continuous delivery from vendors -with LMP

 **CDAF Portal**
Continuous Deployment and Automation Framework

Lab Portal Laster_20  narpothu

RELEASES SOFTWARE RELEASE SCORE **ARTIFACTS** PIPELINES TEST CATALOG

DOCKER **HELM** GENERIC

Download Image


Select Image



Image source

Enter Image Version

Download Image

Refresh

All Downloaded Images

 Search for Images by name

1
TOTAL IMAGES

1
AVAILABLE

0
SECURITY SCANNING

0
DOWNLOADING

1 | Images

IMAGE NAME	VERSION	IMAGE TYPE	DATE	STATUS
mariadb	latest	docker	2020-07-21T17:36:11	AVAILABLE

Current status
AVAILABLE

Security Scanning
-

Security Scanning report
-

Artifactory

5G Readiness – People and Process (Before LMP)

Scope
Management

Develop
Management

Test
Management

Defect
Management

Release
Management

Test managers do not have any efficient collaboration and approval with architects

Challenges : People, Process, Technology

Non-standard format of test cases from vendors

Duplication of test cases across vendors

Complexity in test cases with VNF feature mapping approved by architects

Huge amount of test cases with limited resources (Quality, Resources and Time)

Resolve Complexity of test case selection – with LMP

Standard Test Format in Test Catalog

Vendor

Cisco

Select Solution

Cisco-Master-Project

Download Template

1186 | Test cases found

Items per page: 251 - 25 of 1186

Add Test case

<input type="checkbox"/>	TITLE	VNF (TAG)	SUITE	PASS FAIL CRITERIAS			
<input type="checkbox"/>	Continuous VoLTE With Handover	VDU,VCU	Macro_Rakuten_Fujitsu_Basic sa (Read More)	To be updated			
<input type="checkbox"/>	Check Kibana Process	INAS	DASAN-INAS	To be updated			

Detection and merging Duplicate test cases using AI/ML

[← BACK](#) Merge Duplicate Test Cases

Duplicate Test Cases

5 | Clusters of Duplicate Test Cases

TEST CASE	DUPLICATES	ACTION
Device Maker submits the "Mobile Device Requirement Sheet and RMS checks it	392	
FDUL TestInventMcs0	64	
FDUL356QamTos TtsTvedMcs21.CW	58	
RKNTTEST-127553 04_E_ATP_0nb_Deact_W_S_PP_140120_30	40	
Verify UDP DL and UL throughput with DRX(Enabled), CLPC(Disabled) in 4x4 TM4	40	

Test case search and selection using AI/ML

Add Test Cases

Search for Test Case Name, Tag, VNF

Recent Searches - All Test Cases

1336 TOTAL TEST CASES 0 ADDED TEST CASES

Filter by

by VNF: All VNFs by Tag: All Tags by Type: All Types by Defect: All Defects

by Release: All Releases

[Reset](#) [Apply Filters](#)

5G Readiness – People and Technology

Scope
Management

Develop
Management

Test
Management

Defect
Management

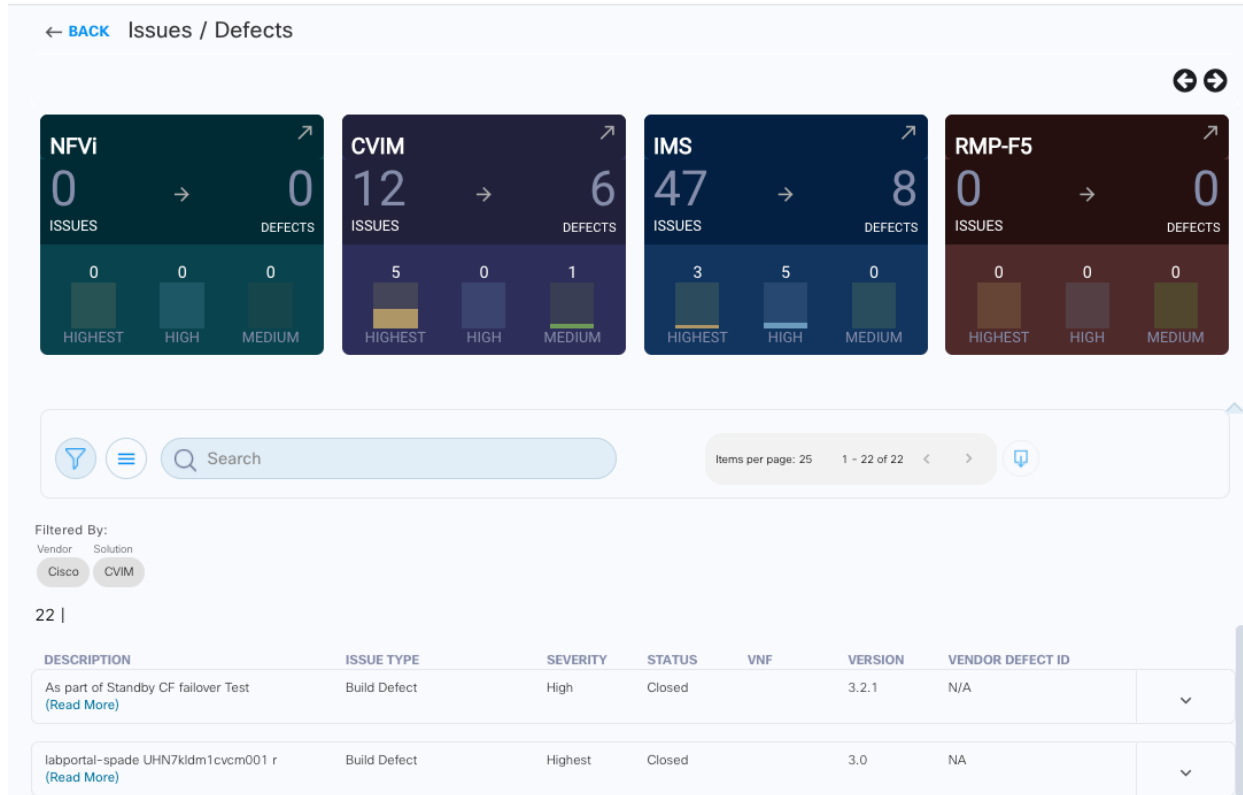
Release
Management

Defects were not tracked and resolved efficiently

Challenges : People, Process, Technology

- Various tools were used to track defects
- No mapping from defects to features or user stories or releases
- Defects from various environments (Integration and Pre-prod)
- Challenge in providing feedback to vendor engineering when defects found

A single Issue/Defect Tracking System – with LMP



- One common Issue/Defect Creation Tool
- Negotiate with vendor on Types, Ownership
- Integrate with vendor defect system
- Transparent Exec level Dashboard

5G Readiness – Process and Technology

Scope
Management

Develop
Management

Test
Management

Defect
Management

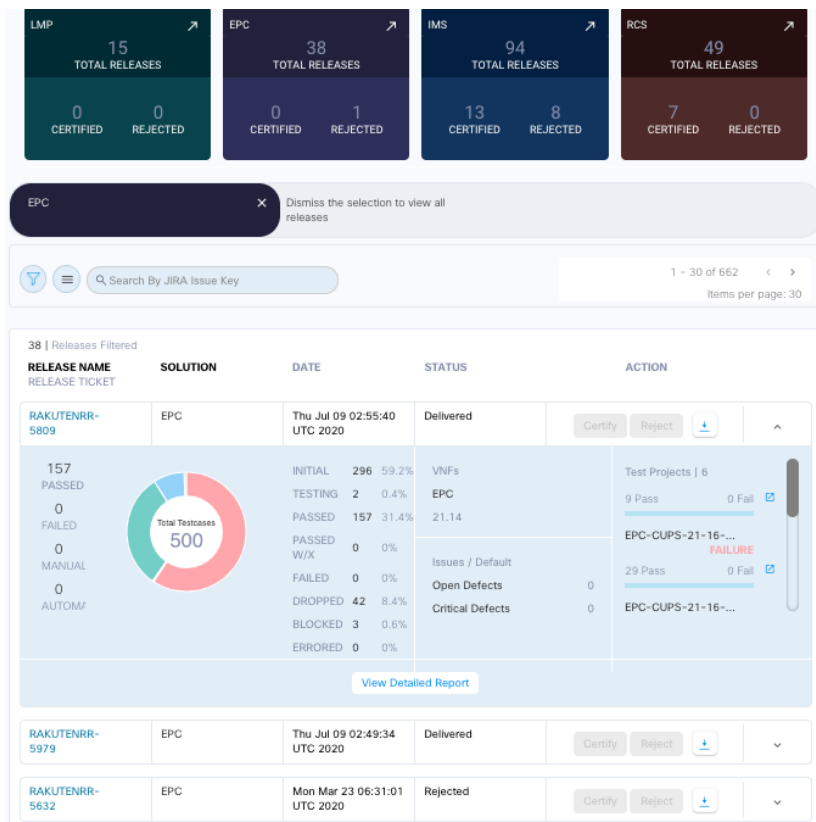
Release
Management

No objective certification of software in timely manner

Challenges : People, Process, Technology

- Hard to track releases from scope to defects per VNF when testing fails
- Customer cannot view each feature and release tested with status
- Complexity in tracking release date, versions per environment
- Too many releases from vendors must be qualified for certification

Release Management



- A single common Release Dashboard
- Consolidated data for release certification
- Negotiate with Operation – Only Certified release can be deployed in production
- Use AI/ML to predict quality of Software for certification

Conclusion

CDAF based CICD Platform in 5G provides an SP following:

- Automate the Vendor Software Release Lifecycle Management by extending to Vendor's CICD environment
- A thin controller platform with specific set of open-source CICD toolset for targeted function
- Offer a unified single user experience (UX) for end-to-end software delivery management

Conclusion

- Augment with the repetitive structured Robotic Process Automation to a more unstructured and human logic AI/ML based
- Optimize management of Cloud Infrastructure Resources required to support high number of Software packages
- Automate Test Management Test Cases selections using AI/ML

Conclusion

- Create a vendor partners echo system, to bring developers closer to the customer pre-production testbed
- Leverage the AI/ML based Release Certification to increase the software velocity without compromising the carrier grade requirement

Thank you



Possibilities

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SPM Sessions – June Release

Session ID	Session Title	Availability
DGTL-BRKSPM-2010	Applying Security in a 5G World	June 18th 2020
DGTL-BRKSPM-2013	Next-Generation Mobile Enterprise: 5G, Private LTE, and Wifi 6	June 18th 2020
DGTL-BRKSPM-2071	5G Technology Updates	June 18th 2020

SPM Sessions – July Release

Session ID	Session Title	Availability
DGTL-BRKSPM-2001	Accelerate Mobility deployment with Cisco Cloud Services Stack	July 15th 2020
DGTL-BRKSPM-2009	Design 5G Ready Distributed Telco DC with Cisco ACI	July 15th 2020
DGTL-BRKSPM-2016	5G network with SD-WAN for Enterprise Customers	July 15th 2020
DGTL-BRKSPM-2020	5G Mobile Edge Computing	July 15th 2020
DGTL-BRKSPM-2129	Deploying 5G and LTE for Enterprise and IoT	July 15th 2020
DGTL-BRKSPM-2950	Rakuten Mobile: All in the Cloud from RAN to Core	July 15th 2020

SPM Sessions – September Release

Session ID	Session Title	Availability
DGTL-BRKSPM-2002	5G CICD with Continues Deployment & Automation Framework	Sep 9th 2020
DGTL-BRKSPM-2015	Telco Cloud: your secret to a faster, smarter 5G network	Sep 9th 2020
DGTL-BRKSPM-2021	5G Enterprise Core Design in Industry Verticals	Sep 9th 2020
DGTL-BRKSPM-2023	Sprint Scalable Cloud with Cisco VIM	Sep 9th 2020
DGTL-BRKSPM-2784	Bridging architectures – Cisco Private Telco Cloud	Sep 9th 2020