AI-Driven Autonomous Network Operation for Mobile Network

AI-Driven 5G Core Network Deployment

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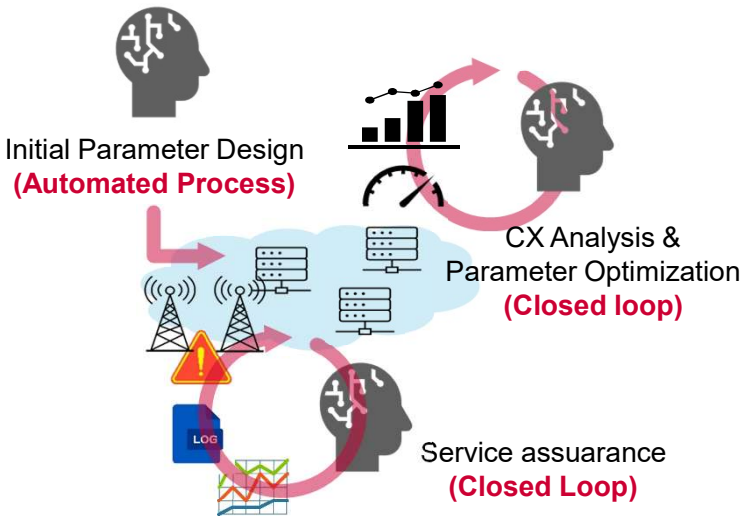
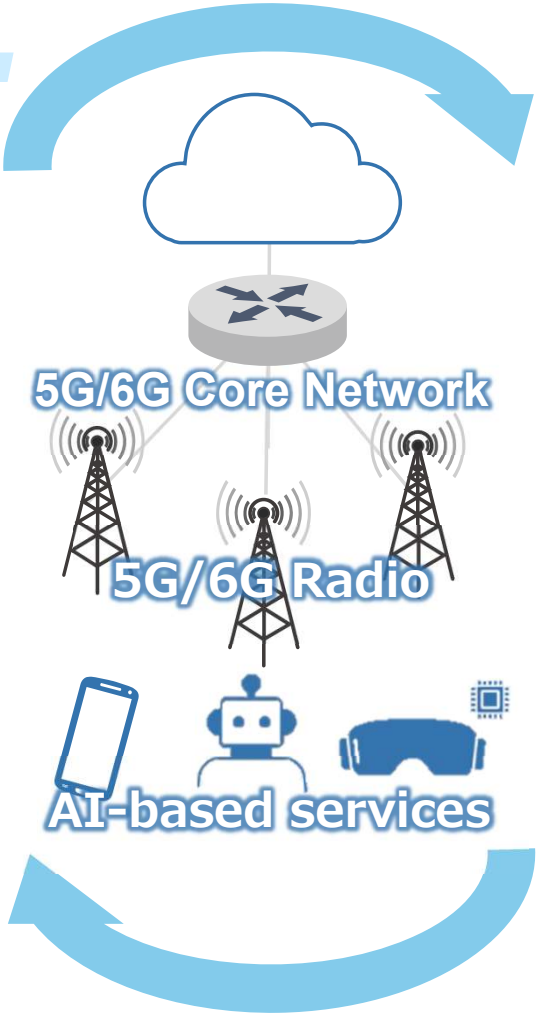
DOCOMO's AI-Centric Network Initiatives

AI for Network

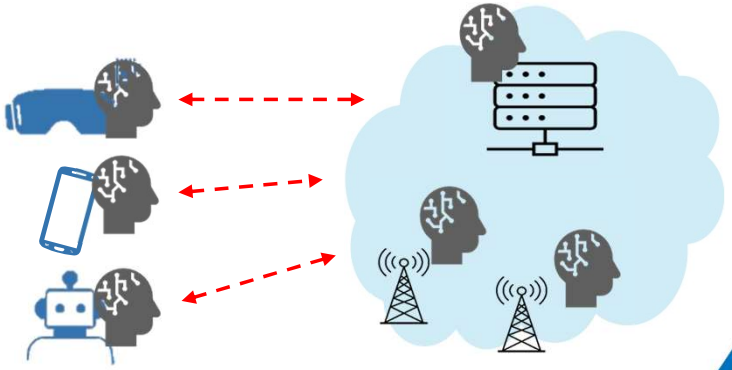
- Autonomous Networks
  - AI-driven network deployment
  - Agentic AI service assurance
  - CX-based network optimization
- Self-aware Networks



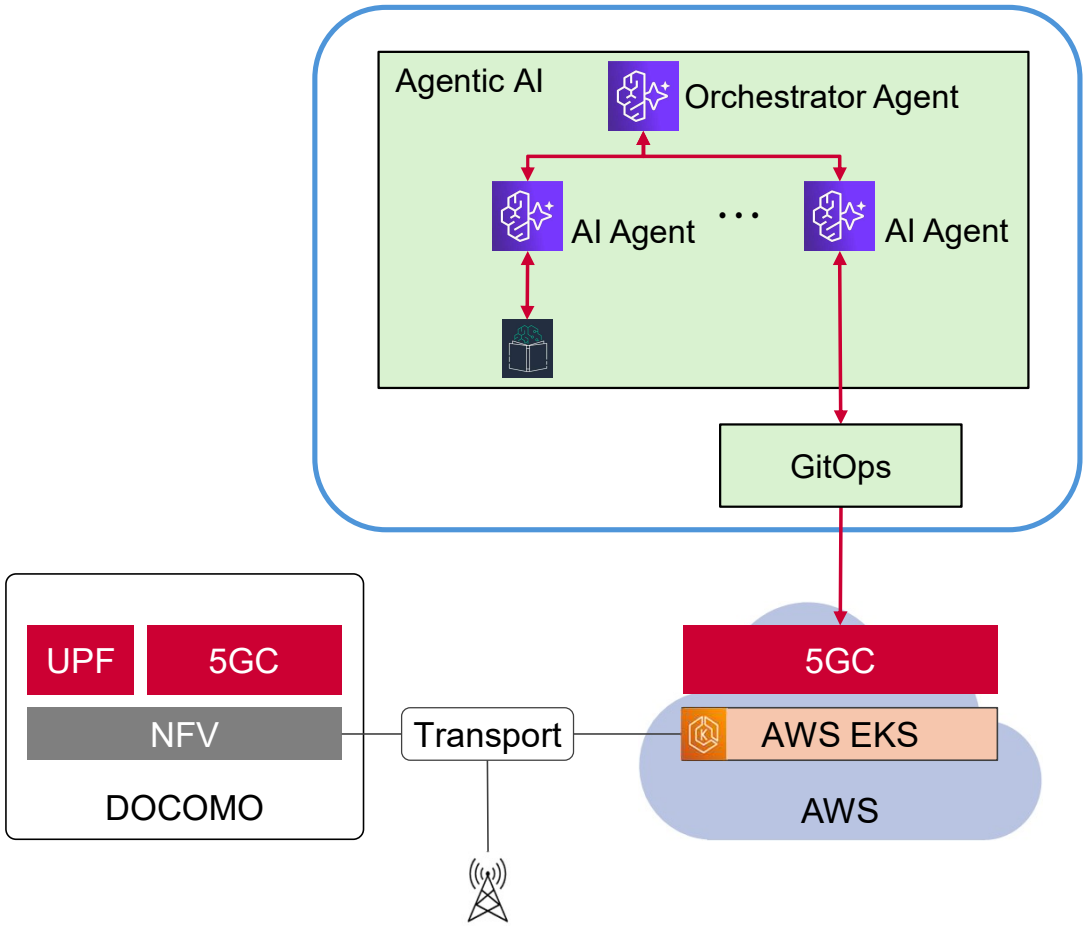


Network for AI

- In-Network Computing
- New AI services on mobile
  (e.g. robots, smart glasses)
- Handling increased AI traffic



AI-Driven 5G Core Network Deployment



- DOCOMO has launched **Japan's first** commercial 5G Core (5GC) on AWS.
- DOCOMO's 5GC on AWS was deployed with automation and is **the world's first** to integrate **AI and GitOps** from the design phase through deployment.
- We introduced **AI-driven** 5G Core Network Deployment.

Key Challenges in 5G Core Network Deployment

Multiple Environments & Units

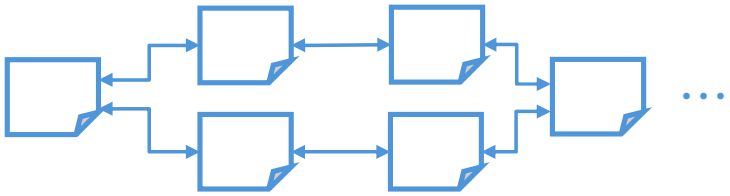
Deployment across various units in diverse environments

Intensive Documentation Analysis

Analyzing 100+ documents along with past configurations

Complex Parameter Dependencies

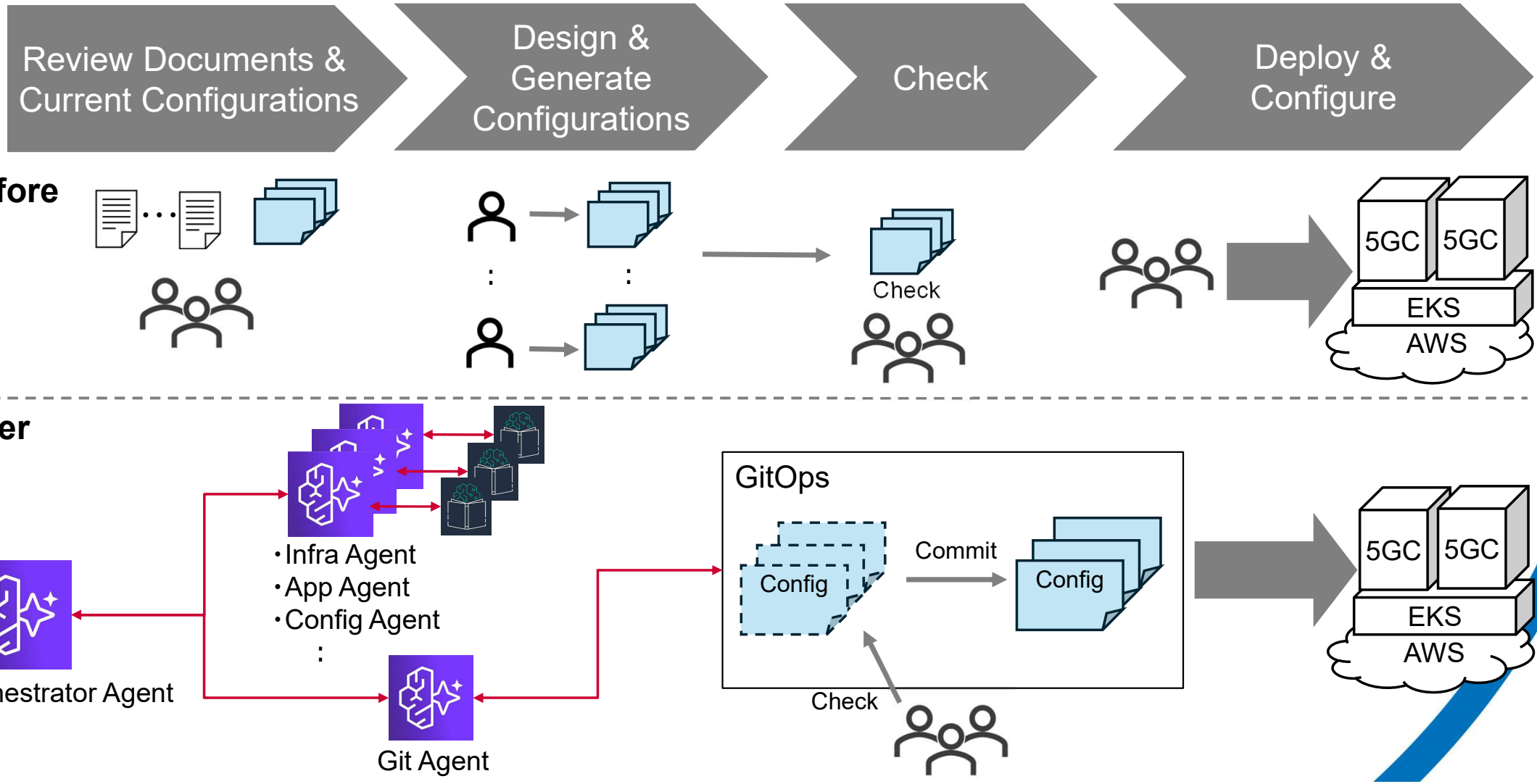
Ensuring consistency between interrelated configuration values



Long Lead Time Due to Manual Deployment

Manual deployment requires several months to complete

5G Core Network Deployment Workflow



3-Layer 5GC Design on Public Cloud with Agentic-AI

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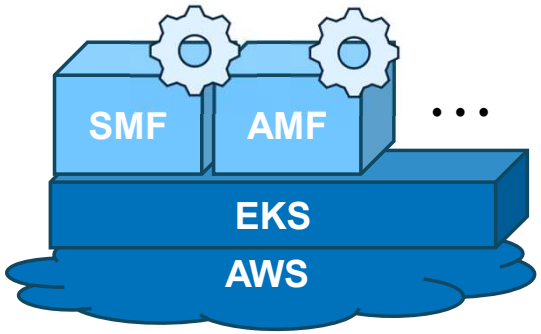
3-Layer 5GC Design Architecture

- Three Distinct Domains: The 5GC design comprises **infra**, **app**, and **app config**.
- Interconnected Expertise: Each layer requires specialized knowledge, yet all remain tightly interconnected.



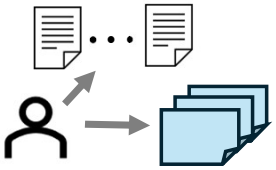
3) App config design

2) App design

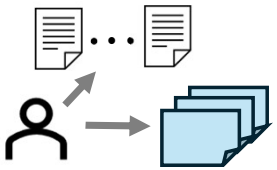
1) Infra design

✓ Manual Design

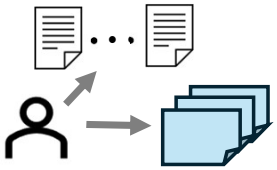
1) Infra design



2) App design

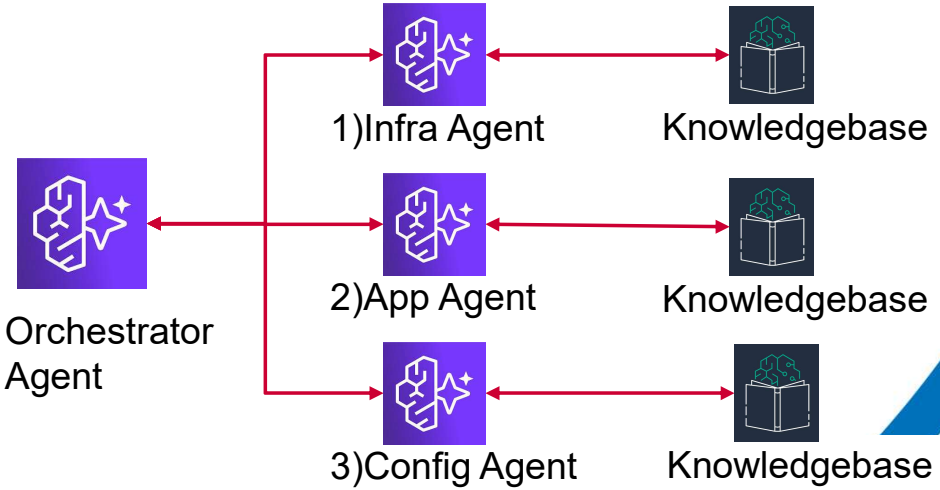


3) App config design

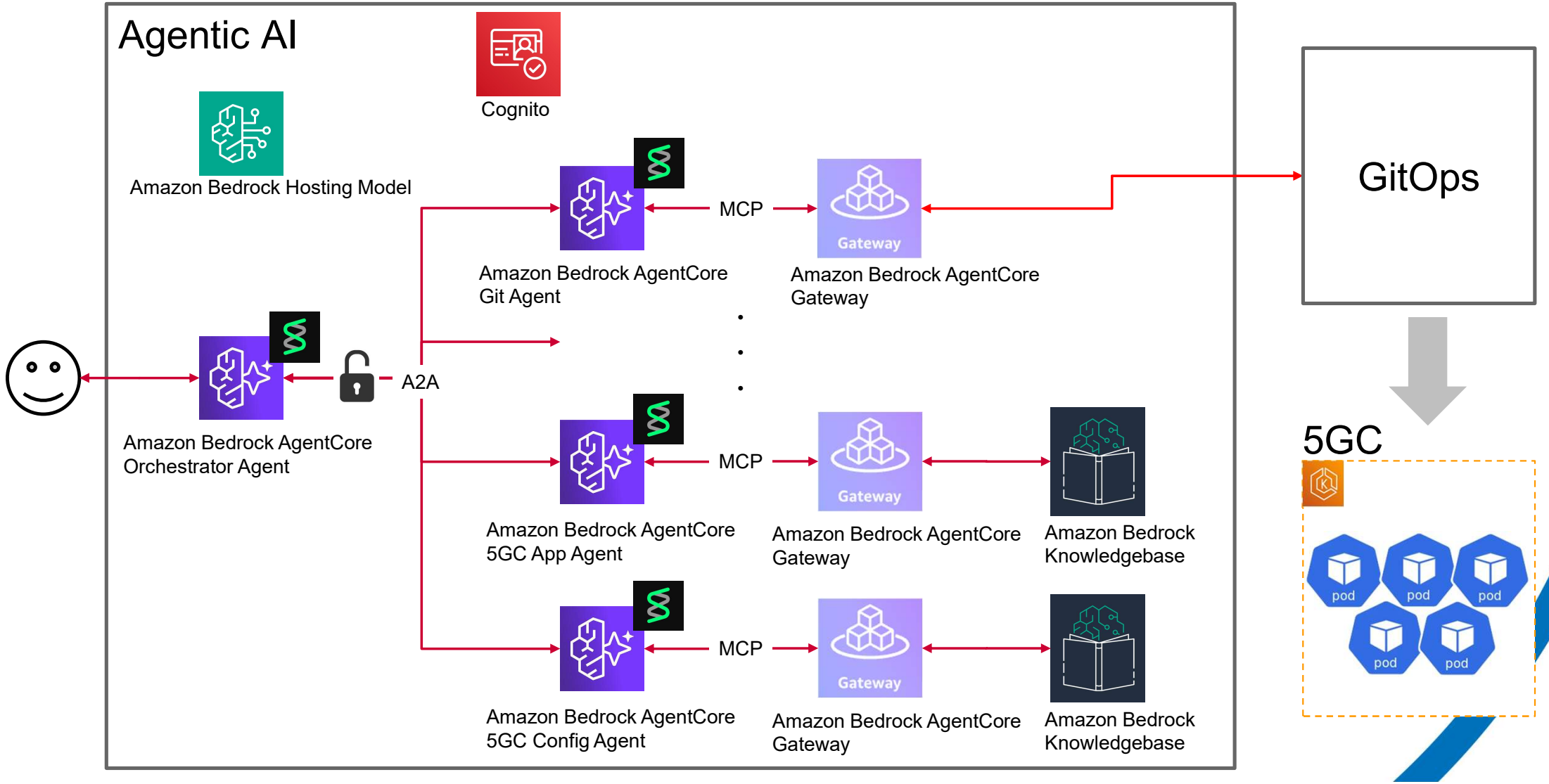


✓ AI Agent-Driven Design

Specialized AI Agents are implemented for each of 3 layers, orchestrated by an Orchestrator Agent.

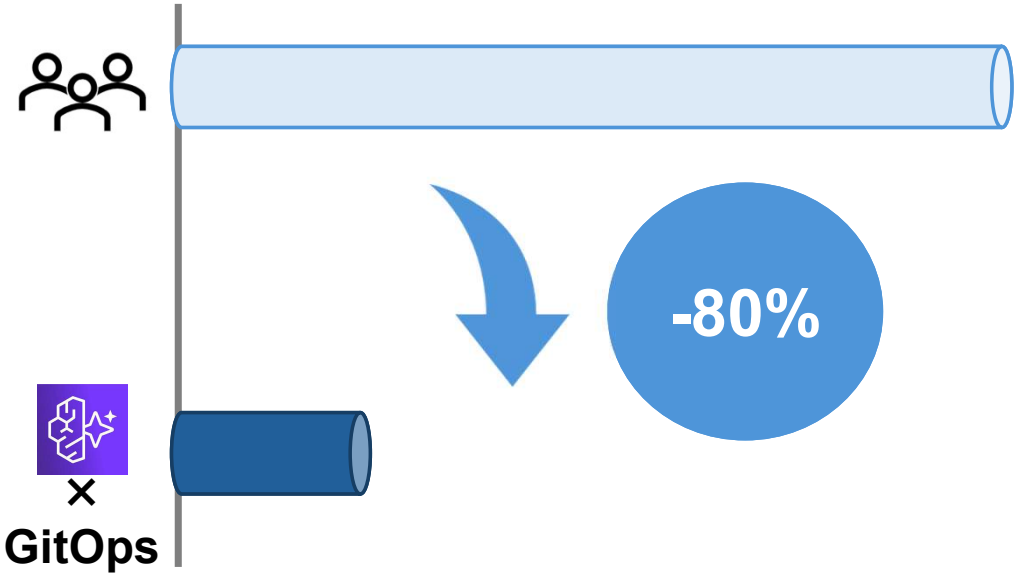


Architecture of Agentic-AI & GitOps



Key Benefits of AI-Driven 5G Core Network Deployment

Accelerated Design-to-Deployment Cycles with Reduced Lead Time

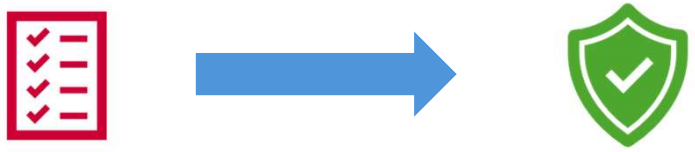


Lower Cost & Effort

- Deployment Cost
- Learning Cost
- Human Effort

:

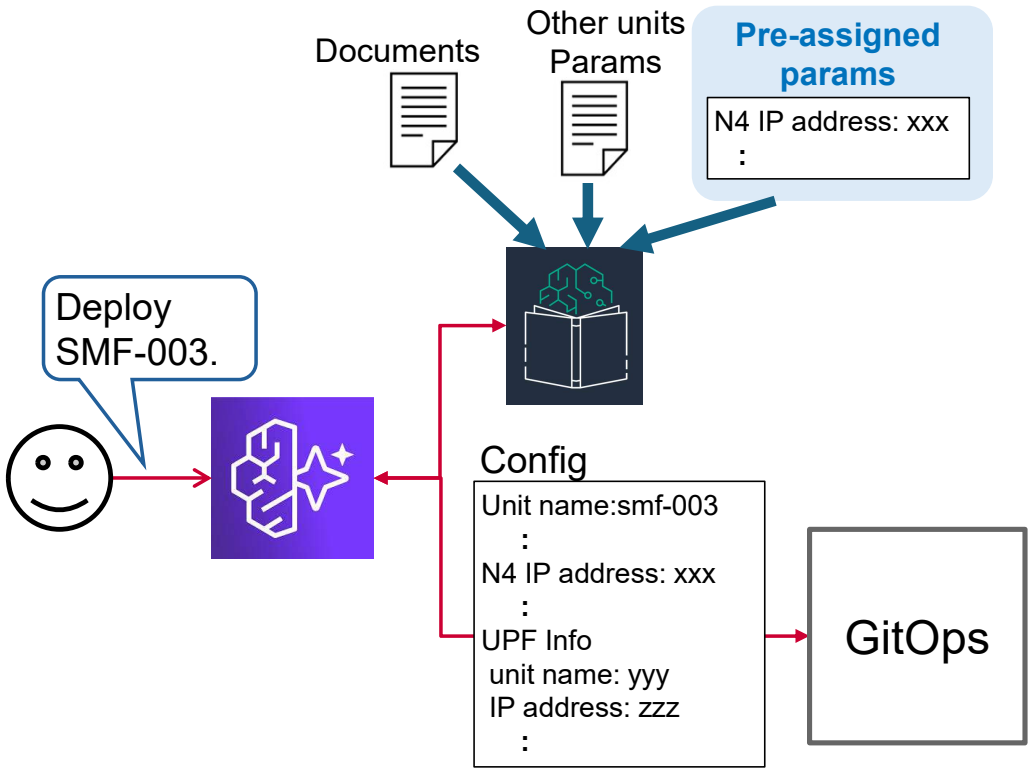
Improved Quality



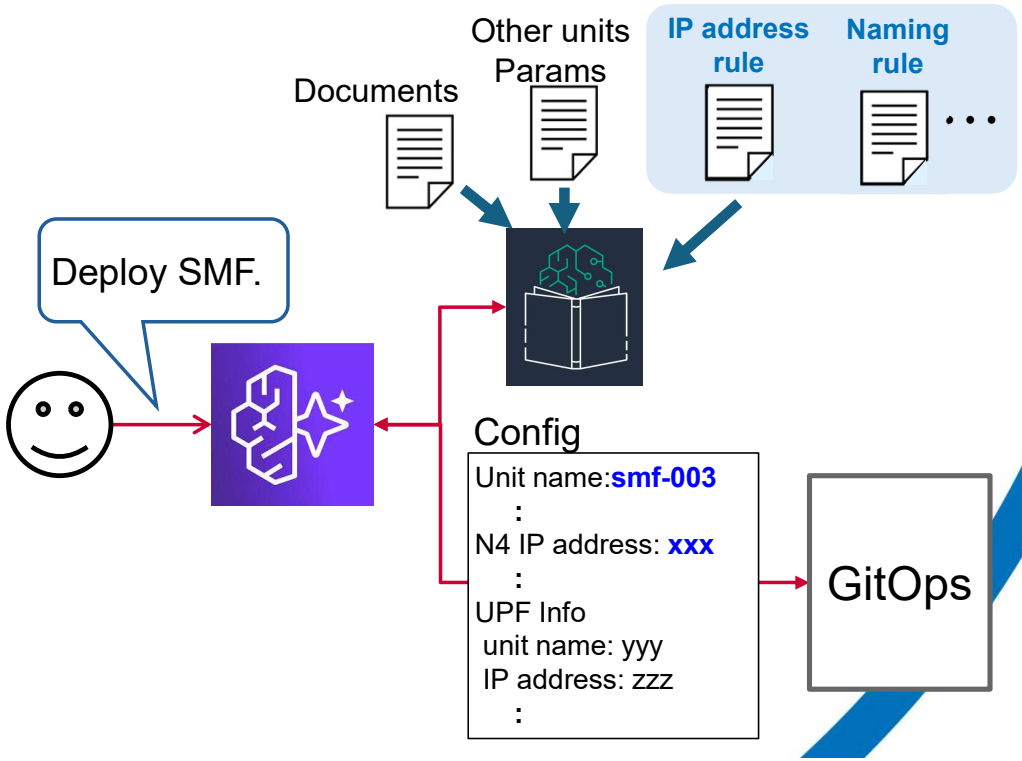
Next Steps (1/2)

1. Toward Fully Autonomous Resource Identification & Generation

Current:
AI agents rely on pre-assigned parameters.
(e.g., IP addresses)



Future:
Automate the derivation and allocation of parameters, based on predefined naming and numbering rules.



Next Steps (2/2)

2. Implementation of Observability and First-Call Test Agents

To achieve perfect deployment automation, we must not only deploy but also monitor in real-time, self-heal, and verify post-deployment.

✓ Observability Agent:

Monitors deployment logs in real-time to detect errors and anomalies, enabling autonomous self-healing or re-execution of design and deployment.

✓ First-Call Test Agent:

Automates end-to-end connectivity verification (First-call) immediately after deployment. (e.g., deploying test simulator with 5GC, executing tests, and deleting it.)

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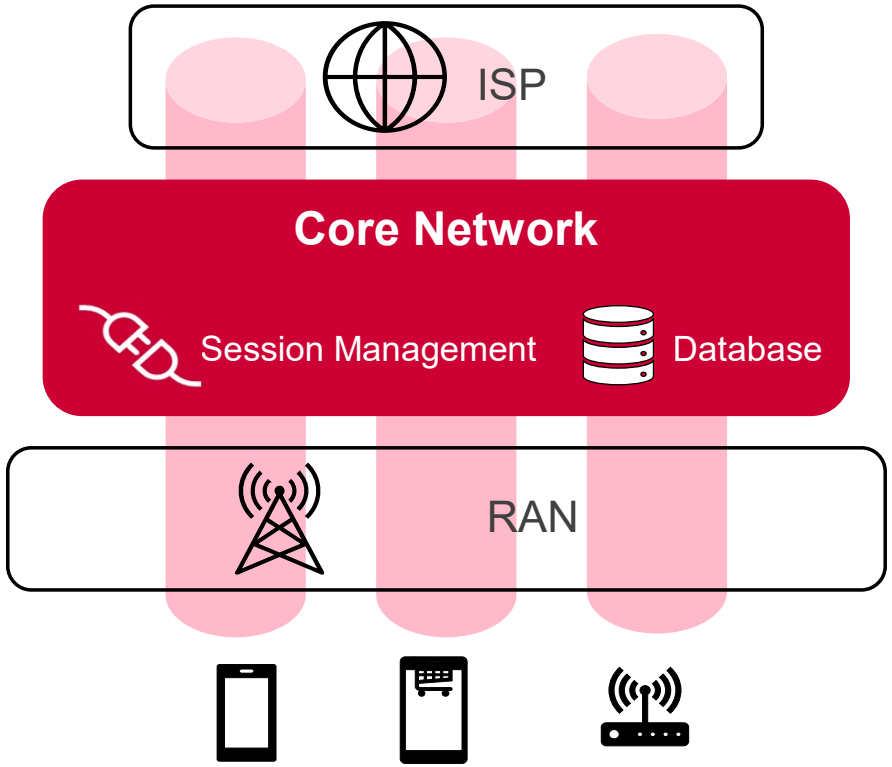
Appendix

デモ静止画を説明用に用意

デモ静止画を説明用に用意

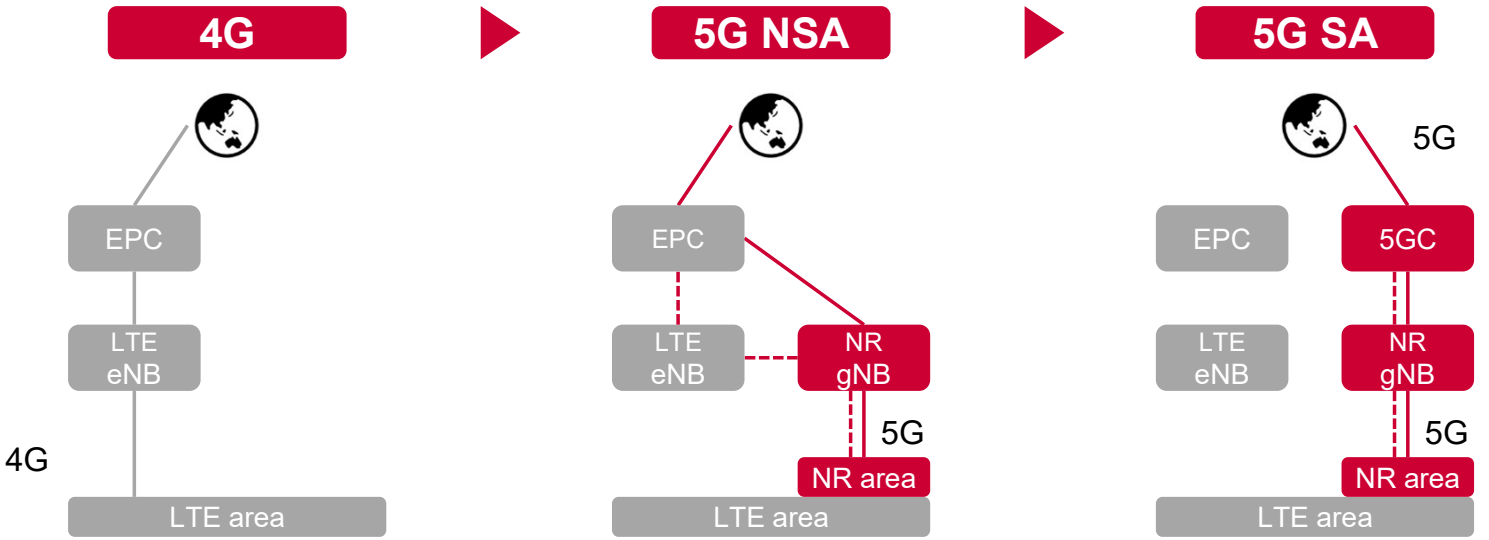
Core Network



The Core Network serves as a gateway between the Radio Access Network (RAN) and the Internet Service Provider (ISP), managing control signals for session management and routing user data.

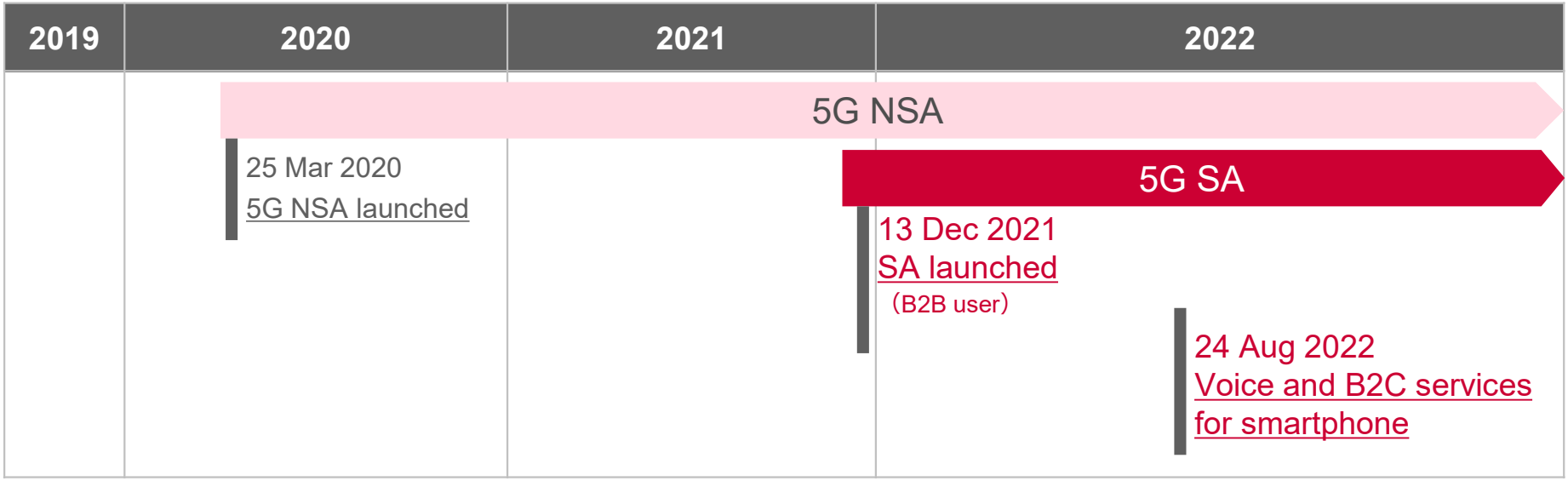
Migration to 5GC

- 5G was first launched as NSA (Non-Standalone) using the existing 4G network infrastructure.
- 5G SA (Standalone) is a 5G network architecture that operates independently of the 4G network.

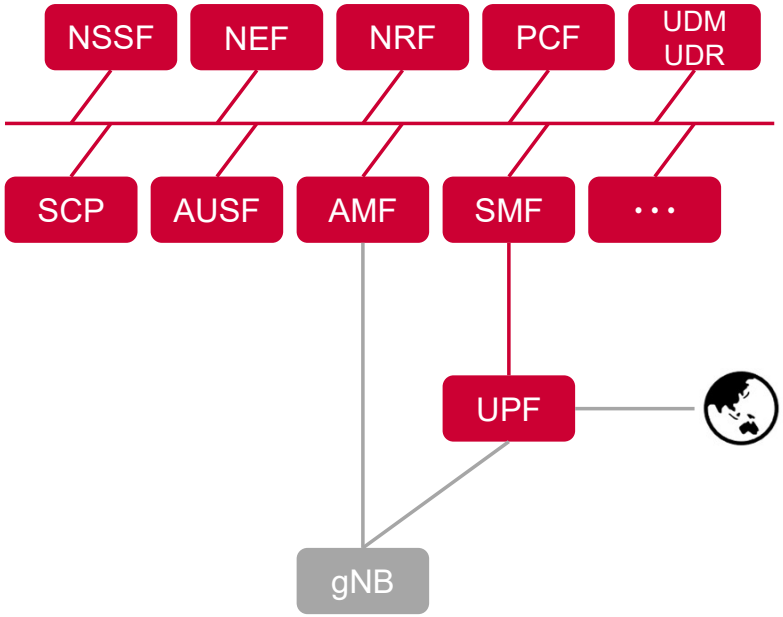


DOCOMO's 5G Services

- DOCOMO introduced 5G-NSA in 2020 and launched 5G-SA service in March 2020.
- The first 5GC deployment focused on delivering SA service to B2B users.
- In 2022, DOCOMO expanded its 5GC to provide voice and B2C services.

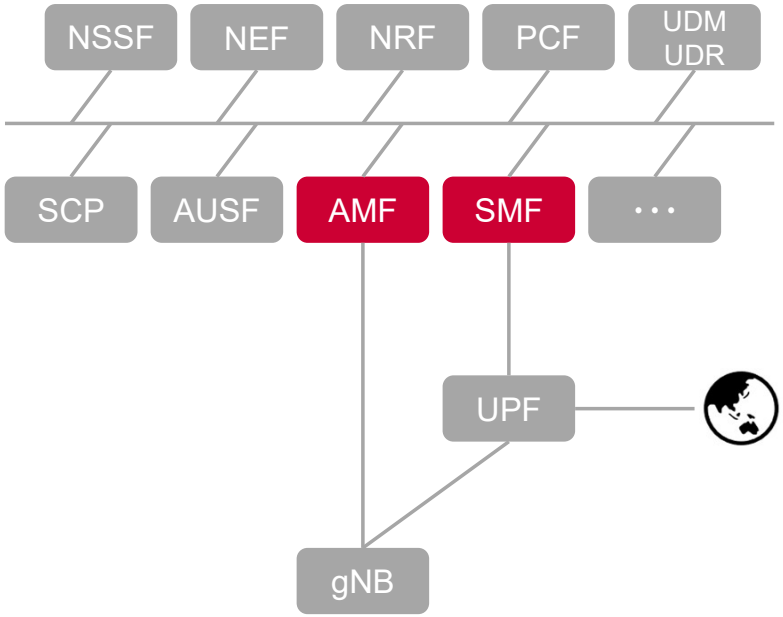


5GC Architecture

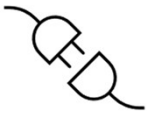


- **The 5G Core is composed of a group of logical functions known as Network Functions (NFs).**
- **NFs communicate with one another to deliver 5G-SA services.**

NF Overview (Control Functions)

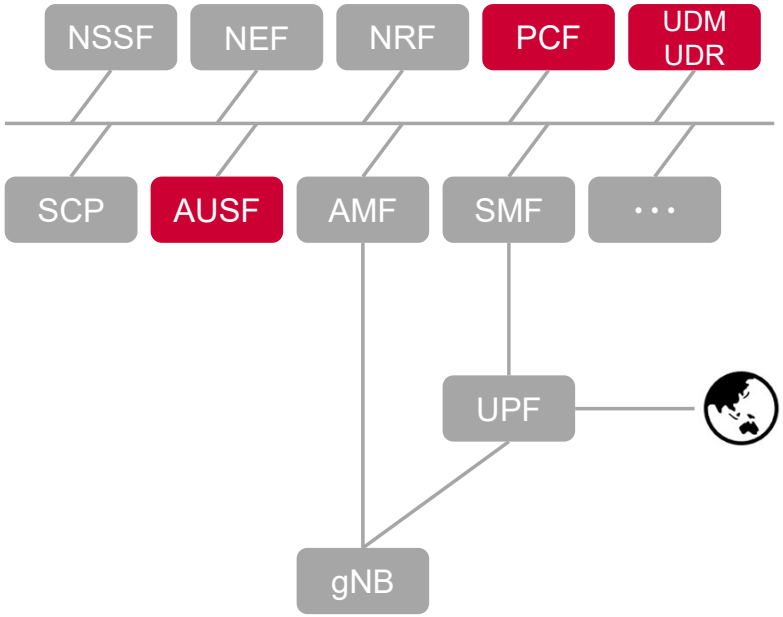


AMF
Access and Mobility Management Function
Manages subscriber location registration, mobility, etc.



SMF
Session Management Function
Manages sessions and controls U-Plane allocation

NF Overview (Database)

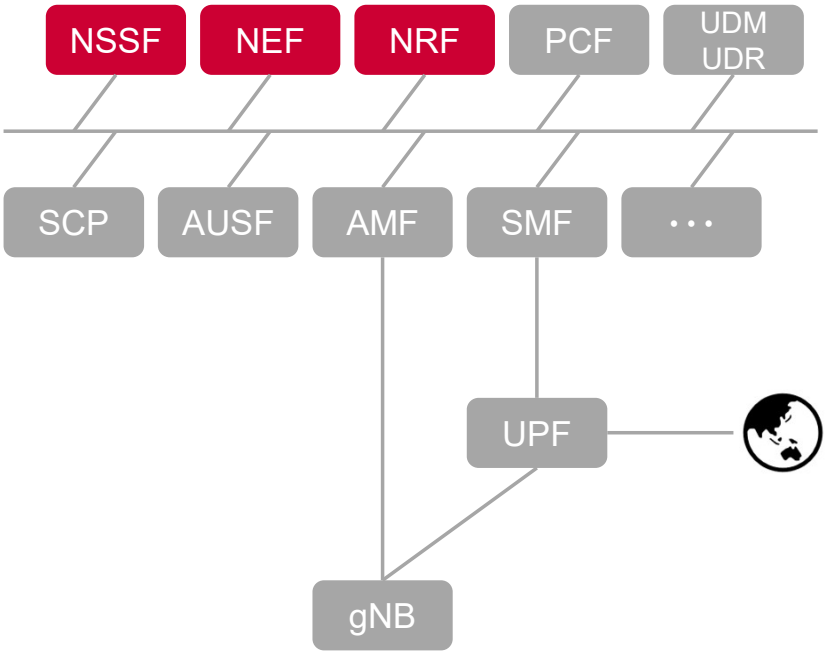


UDM/UDR
Unified Data Management/ User Data Repository
Subscriber information

AUSF
Authentication Server Function
Credentials server

PCF
Policy Control Function
Subscriber policies, QoS, charging controls, etc.

NF Overview (New Functions)

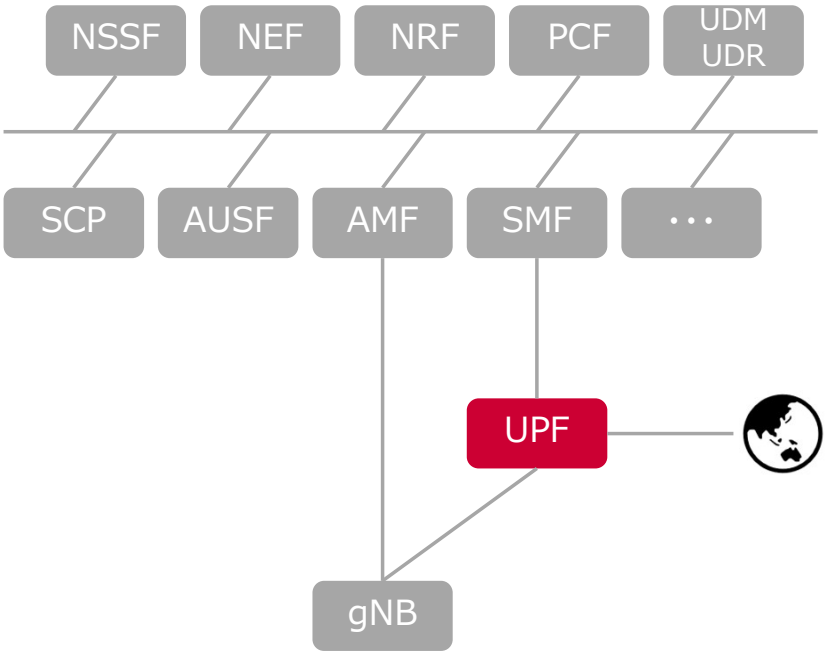


NSSF
Network Slice Selection Function
Selects and assigns the appropriate slices

NRF
Network Repository Function
Repository and discovery broker for all Network Functions (NFs)

NEF
Network Exposure Function
Enables external control of 5GC network functions

NF Overview (U-Plane)

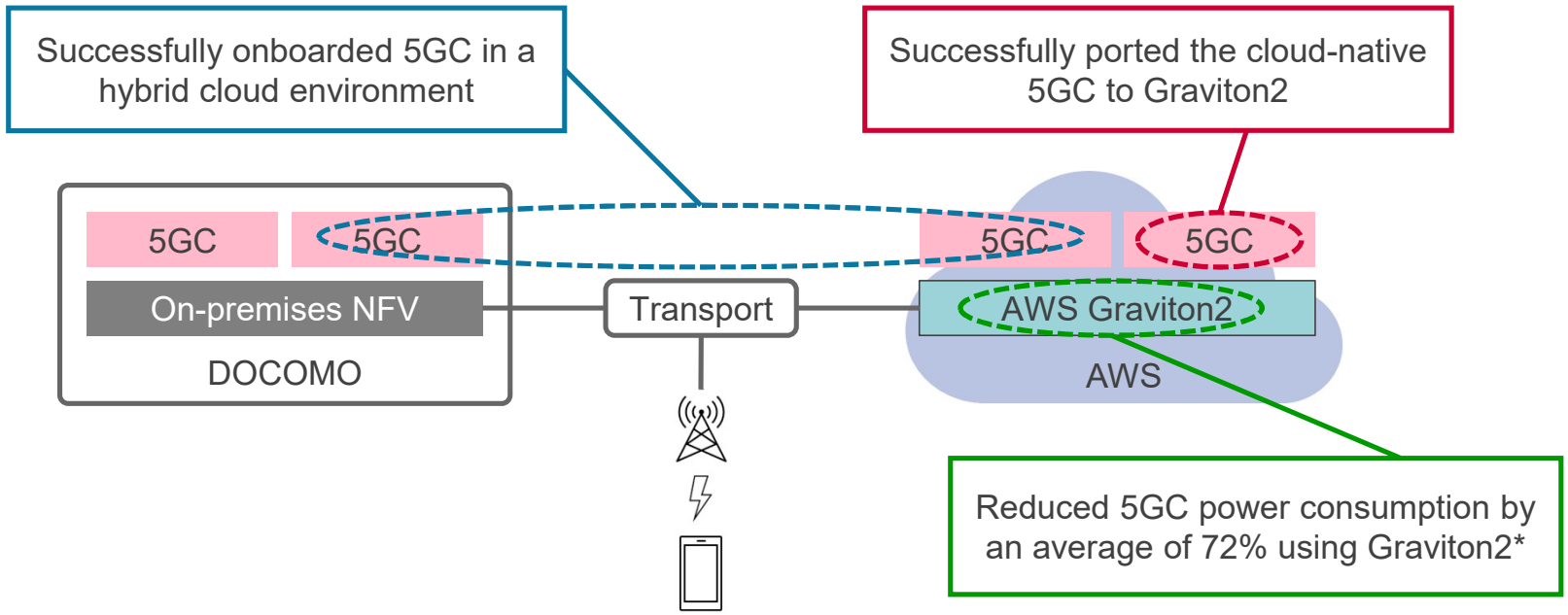


UPF
User Plane Function
Send and receive user data

gNB
gNodeB
5G NR base station

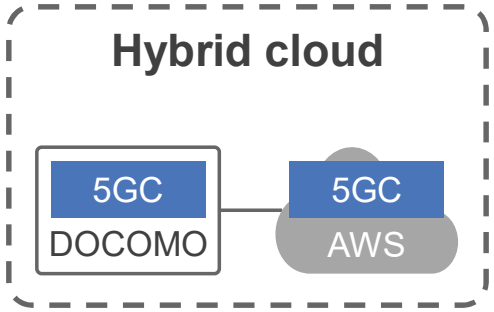
Proof of Concept (PoC): 5GC on AWS

- DOCOMO, NEC, and AWS have initiated a PoC for a 5GC hybrid cloud environment leveraging AWS.



*ARM architecture CPU designed by AWS

PoC Overview



Related Press Releases

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Carrier-Grade Redundancy for 5GC Hybrid Cloud Environment

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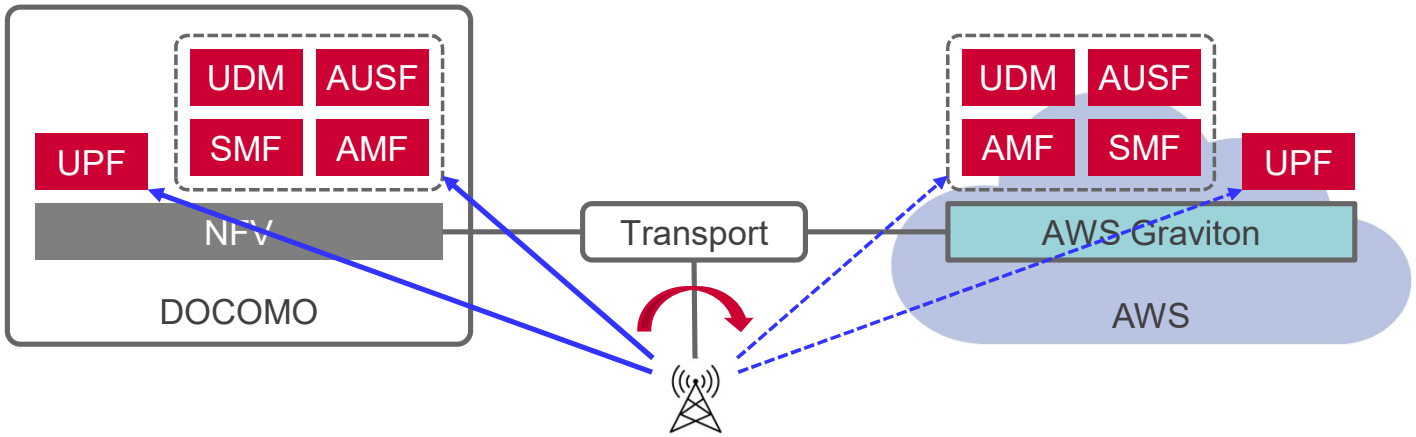
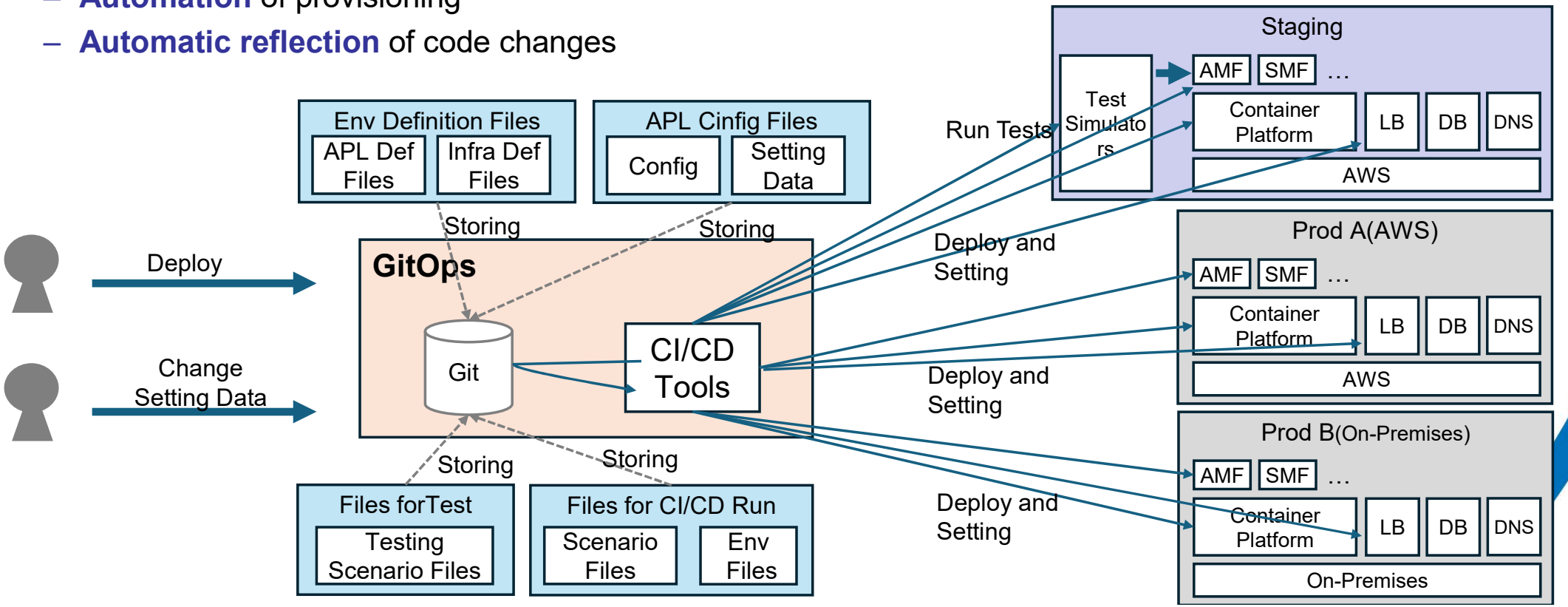
- DOCOMO established a redundant configuration by deploying 5GC on DOCOMO's on-premises virtualization platform and on AWS.
- 5GC on AWS serves as a disaster recovery (DR) site, activated only when the on-premises 5GC fails to reduce cloud costs.



Future Provisioning Architecture of DOCOMO's 5GC

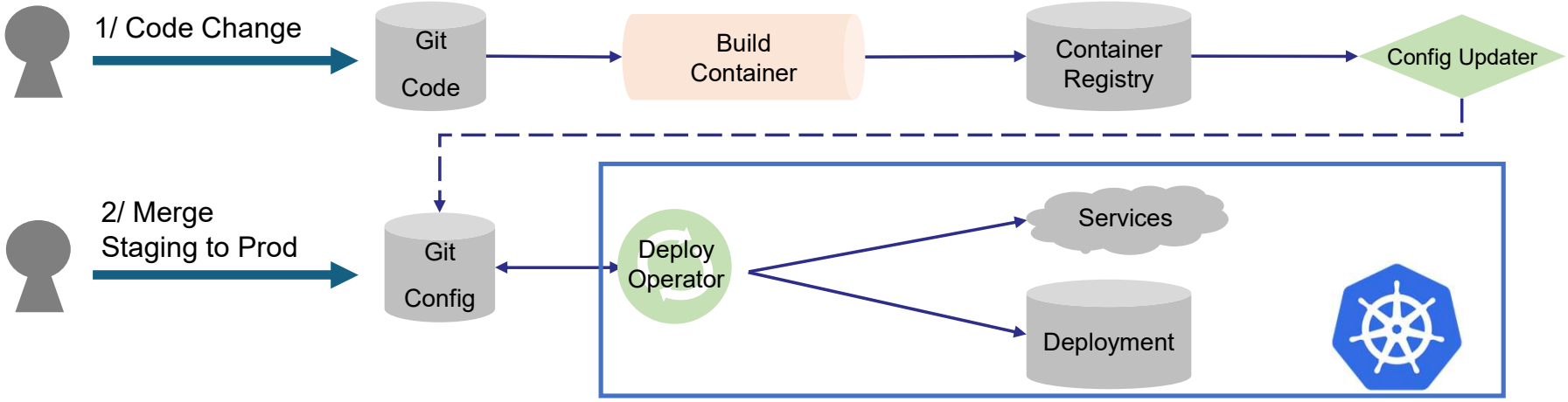
- DOCOMO is currently considering a Future Provisioning Architecture for 5GC with plans to adopt GitOps.
- Our key motivations include:
  - **Same architecture** in both production and staging environments.
  - **Infrastructure as Code** and **the single source of truth**
  - **Automation** of provisioning
  - **Automatic reflection** of code changes



Reference: What is GitOps?

- GitOps is an architecture that uses Git as a **single source of truth** to automate the management and deployment of infrastructure and applications.
- All changes are **managed in Git** and **automatically** applied through CI/CD pipelines.
- GitOps is commonly used for cloud-native applications such as Kubernetes.

Example GitOps Pipeline for Kubernetes



- 5GC features a cloud-native architecture, making GitOps an increasingly popular approach for its management and deployment.