**Automation Workflow Design Document**

**Title:** *Automation & CI/CD Pipeline Design for 5G Optimization Logic Deployment*

**A. Objective**

To design an automated, reliable, and secure Continuous Integration / Continuous Deployment (CI/CD) workflow enabling rapid, controlled rollout of machine learning models, optimization algorithms, and network configuration changes.

**B. Workflow Components**

| **Component** | **Function** | **Tools/Technologies** |
| --- | --- | --- |
| **Source Code Repository** | Centralized storage for optimization scripts and configs | GitHub / GitLab / Bitbucket |
| **Build Server** | Automated build & unit testing of code | Jenkins / GitLab CI / CircleCI |
| **Model Training Pipeline** | Automated ML training triggered by new data or code updates | Kubeflow / MLflow / Airflow |
| **Artifact Repository** | Storage for packaged models and binaries | Nexus / Artifactory |
| **Deployment Orchestrator** | Automates staged rollout and rollback | ArgoCD / Spinnaker / Helm Charts |
| **Configuration Management** | Infrastructure-as-Code for network parameter configs | Terraform / Ansible |
| **Monitoring & Alerting** | Monitors deployment success, performance metrics | Prometheus / Grafana / ELK Stack |
| **Security Scanning** | Static & dynamic analysis for vulnerabilities | SonarQube / Aqua Security |

**C. Workflow Steps**

1. **Code Commit & Review:**  
   Developers push code to feature branches → automated linting & unit tests → peer review → merge to main branch.
2. **Automated Build & Test:**  
   CI server builds artifacts, runs integration & regression tests → reports success/failure.
3. **Model Training & Validation:**  
   Triggered on new data or algorithm updates → trains ML models → validates performance against baselines → registers model.
4. **Staged Deployment:**  
   Canary release to test environment → integration with simulated network → performance monitoring → rollout to production clusters.
5. **Rollback & Hotfix:**  
   Automated rollback triggers on failure thresholds → hotfix pipeline enabled for quick patches.
6. **Audit & Compliance Logging:**  
   All pipeline actions logged for audit trails and compliance verification.

**D. Security & Governance**

* Role-based access control to CI/CD tools
* Signed and verified artifacts before deployment
* Secrets management (HashiCorp Vault, AWS KMS)
* Compliance with telco security standards and change management policies