

ENTERPRISE MANUFACTURING WIRELESS MODERNIZATION FROM CISCO 5520 TO CATALYST 9800 FOR TMNA PLANTS**Srinivas Marka**

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ABSTRACT

Modern manufacturing facilities increasingly depend on enterprise wireless infrastructure to support production operations, mobile workforce connectivity, industrial applications, scanners, tablets, engineering devices, and other connected systems. Maintaining reliable wireless service in these environments requires scalable controller architecture, effective radio-frequency management, secure network segmentation, and seamless mobility across large production facilities.

This project focused on the modernization of Toyota Motor North America (TMNA) plant wireless infrastructure, transitioning legacy Cisco 5520 Wireless LAN Controllers operating AireOS to Cisco Catalyst 9800 Wireless Controllers based on IOS-XE. The program also modernized the wireless access layer by transitioning legacy Cisco 2800-series access points to Cisco 3800 and Catalyst 9100-series access points.

As a Network Consultant with Tata Consultancy Services, Srinivas Marka contributed to wireless architecture assessment, target controller design, configuration migration, SSID and VLAN mapping, authentication integration, mobility design, access-point staging and migration, RF validation, troubleshooting, and production cutovers.

The working program scope encompassed approximately 10+ manufacturing facilities, 2,000+ wireless access points, 25+ enterprise SSIDs/WLAN configurations, 15,000+ wireless clients and connected devices, and 8+ Catalyst 9800 controller instances. More than 2,500 technical and operational validation checks were performed throughout phased migrations.

The resulting architecture transitioned TMNA from the legacy AireOS controller platform toward an IOS-XE-based wireless infrastructure with improved automation, centralized management, RF capabilities, policy-driven segmentation, higher client capacity, and support for modern manufacturing connectivity requirements.

Keywords: Cisco Catalyst 9800, Cisco 5520, AireOS, IOS-XE, Cisco 2800, Cisco 3800, Catalyst 9100, Enterprise Wireless, Manufacturing Networks, RF Optimization, Wireless Migration, TMNA

1. INTRODUCTION

Wireless connectivity has evolved from a convenience service into critical operational infrastructure for modern manufacturing environments.

Production plants increasingly rely on wireless networks to support mobile workstations, handheld devices, scanners, tablets, engineering systems, operational applications, maintenance platforms, collaboration services, and other connected technologies.

Toyota Motor North America's manufacturing environment therefore required wireless infrastructure capable of delivering reliable connectivity across complex plant environments while supporting growing client density and evolving technology requirements.

The existing wireless infrastructure relied on **Cisco 5520 Wireless LAN Controllers operating AireOS**, together with an installed base that included **Cisco 2800-series access points**.

TMNA initiated a multi-year modernization program to transition this environment toward **Cisco Catalyst 9800 Wireless Controllers operating IOS-XE**, while replacing or upgrading portions of the access-point infrastructure with **Cisco 3800 and Catalyst 9100-series APs**.

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The controller transition represented an architectural migration rather than a simple hardware replacement. Existing SSIDs, VLAN mappings, authentication methods, mobility relationships, RF configurations, and operational policies needed to be analyzed and reconstructed using the Catalyst 9800 configuration model.

Access points also needed to be staged, converted, replaced, registered, and validated before production users and manufacturing devices could depend on the new environment.

Srinivas Marka served as a **Network Consultant with Tata Consultancy Services from October 2020 through December 2022**, contributing to the design, implementation, migration, troubleshooting, and validation of this large-scale wireless modernization.

2. PROBLEM STATEMENT

TMNA's existing Cisco 5520/AireOS wireless infrastructure supported production and enterprise connectivity across multiple manufacturing facilities.

Modernization introduced several significant engineering challenges.

First, the migration from **AireOS to IOS-XE** changed the wireless-controller configuration model. Existing WLANs and policies therefore had to be analyzed and rebuilt using Catalyst 9800 constructs rather than simply copied from the legacy controllers.

Second, approximately **2,000+ access points** needed to be assessed, migrated, upgraded, replaced, or validated without causing widespread disruption to plant operations.

Third, legacy **2800-series APs** were being replaced by newer **3800 and Catalyst 9100-series platforms**, requiring appropriate staging, configuration, software compatibility, placement, and RF validation.

Fourth, approximately **25+ WLAN/SSID configurations** and their associated VLAN mappings, authentication mechanisms, and security requirements needed to remain functionally consistent after migration.

Fifth, manufacturing environments present complex RF conditions due to large physical spaces, metal structures, machinery, moving equipment, interference sources, and varying client density.

Finally, wireless roaming and application connectivity had to remain stable for mobile devices moving through production environments.

The central engineering challenge was therefore to modernize a large production wireless environment from AireOS-based Cisco 5520 controllers to IOS-XE-based Catalyst 9800 architecture while simultaneously upgrading access points and preserving secure, reliable wireless connectivity for approximately 15,000+ clients and devices.

3. METHODOLOGY

The modernization followed a structured methodology consisting of environment discovery, wireless dependency analysis, target architecture design, configuration translation, controller deployment, AP staging, phased migration, RF validation, application testing, and post-migration monitoring.

3.1 Existing Wireless Environment Assessment

The first phase involved assessing the Cisco 5520/AireOS environment across approximately 10+ manufacturing facilities.

The assessment included:

- Wireless LAN Controllers
- SSIDs/WLANs
- VLAN mappings

- Authentication methods
- AAA/RADIUS dependencies
- Mobility groups
- Access-point inventories
- AP models
- RF profiles
- Channel configuration
- Transmit-power settings
- DHCP dependencies
- DNS requirements
- Network routing
- Wireless security policies
- Client types
- Monitoring dependencies

Approximately **2,000+ access points and 25+ WLAN/SSID configurations** were incorporated into the working modernization scope.

3.2 Target Catalyst 9800 Architecture

The target architecture transitioned wireless control to **Cisco Catalyst 9800 Wireless Controllers running IOS-XE**.

The working design incorporated approximately **8+ controller instances** distributed according to plant capacity, resiliency, and operational requirements.

Critical wireless environments were designed with controller redundancy to reduce dependence on individual controller instances.

The Catalyst 9800 architecture provided a standardized foundation for policy-based wireless configuration and integration with centralized Cisco management capabilities.

3.3 AireOS-to-IOS-XE Configuration Transformation

Existing Cisco 5520 configurations were analyzed and mapped into the Catalyst 9800 configuration model.

The migration included transformation of:

AireOS WLANs → Catalyst 9800 WLAN Profiles

Legacy interface/VLAN mappings → Policy Profiles and VLAN assignments

AP Groups → Policy Tags

RF settings → RF Profiles/RF Tags

Site-specific AP behavior → Site Tags

Authentication configuration → IOS-XE AAA and WLAN security configuration

Mobility configuration → Catalyst 9800 mobility relationships

This required preserving the operational intent of the existing environment while adopting the architectural model of the new controller platform.

3.4 Access-Point Modernization

Approximately **2,000+ APs** were assessed across the modernization program.

Existing **2800-series APs** were progressively retired or replaced, while **3800 and Catalyst 9100-series access points** were staged for deployment.

AP staging included:

- Inventory validation
- Hardware/model verification
- Software compatibility
- Controller discovery
- AP registration
- Site assignment
- Policy-tag assignment
- RF-tag assignment
- WLAN availability
- Client connectivity validation

The newer AP platforms provided the foundation for higher wireless client density and continued evolution of the plant wireless environment.

3.5 Authentication and Segmentation Validation

Existing authentication and network segmentation requirements were reconstructed on the Catalyst 9800 architecture.

Approximately **25+ WLAN/SSID configurations** were mapped to appropriate policies and VLANs.

Validation included:

- Enterprise authentication
- RADIUS/AAA communication
- Client addressing
- VLAN assignment
- DHCP
- DNS
- Network access
- Security-policy behavior
- Application connectivity

Special attention was given to manufacturing and operational devices whose connectivity requirements could differ from standard enterprise clients.

3.6 Phased Plant Migration

The modernization was executed in controlled plant-by-plant and area-by-area migration waves.

Each migration followed a repeatable sequence:

Pre-migration assessment → Catalyst 9800 readiness → AP staging → WLAN/policy validation → AP migration → Client association → Authentication validation → Application testing → RF validation → Monitoring → Operational acceptance.

This phased approach reduced the risk of simultaneous disruption across manufacturing facilities.

3.7 RF and Roaming Validation

Wireless migration success required more than verifying that access points joined the new controller.

RF behavior and client mobility were validated after migration.

Testing included:

- Channel utilization
- Signal coverage
- Transmit power
- Interference
- Client association
- Authentication
- Roaming
- Client density
- Application connectivity
- AP availability

RF parameters were adjusted where necessary to improve service within complex plant environments.

3.8 Centralized Management Integration

The new architecture was aligned with **Catalyst Center-based centralized management and visibility** where applicable to the environment.

This provided a foundation for centralized inventory, operational visibility, assurance, configuration consistency, and future automation.

3.9 Post-Migration Validation

More than **2,500 cumulative technical and operational validation checks** were performed throughout the program.

Validation covered controller status, AP registration, WLAN availability, authentication, VLAN assignment, client connectivity, RF behavior, roaming, redundancy, application reachability, and centralized monitoring.

4. TECHNICAL ARCHITECTURE AND IMPLEMENTATION

The target wireless architecture replaced the legacy **Cisco 5520/AireOS controller environment with Cisco Catalyst 9800 controllers operating IOS-XE.**

The working deployment supported approximately **10+ manufacturing facilities, 2,000+ wireless access points, 25+ WLAN/SSID configurations, and 15,000+ wireless clients and connected devices.**

Approximately **8+ Catalyst 9800 controller instances** were incorporated into the target environment, with redundancy used for critical wireless services.

The architecture used Catalyst 9800 policy constructs to separate configuration into reusable WLAN, policy, RF, and site-specific components.

This allowed configuration to be standardized while still supporting differences between manufacturing locations.

Legacy 2800-series APs were progressively replaced by **Cisco 3800 and Catalyst 9100-series access points**, providing increased capacity and a newer technology foundation for manufacturing wireless services.

The architecture was designed around a **99.99% availability objective for critical wireless-controller services**, with redundant controllers and resilient network connectivity reducing single points of failure.

5. CHALLENGES AND SOLUTIONS IN WIRELESS MODERNIZATION

Migrating from AireOS to IOS-XE

The architectural differences between Cisco 5520/AireOS and Catalyst 9800/IOS-XE made direct configuration replication inappropriate.

Existing WLAN intent was mapped into the new **WLAN Profile, Policy Profile, Policy Tag, Site Tag, and RF Tag** architecture.

Maintaining Manufacturing Connectivity

Wireless connectivity in manufacturing facilities can directly affect operational workflows.

Migration activities were therefore divided into controlled areas and windows, with client and application testing performed immediately after AP transition.

Migrating a Large AP Estate

Approximately **2,000+ access points** created substantial staging and operational complexity.

Standardized AP staging, naming, tagging, controller-registration, and validation procedures allowed migrations to be performed consistently.

Supporting Mixed AP Generations

The modernization involved Cisco 2800, 3800, and Catalyst 9100-series APs.

Hardware compatibility and software requirements were incorporated into migration planning, with legacy units progressively retired as newer APs were deployed.

Managing Complex Plant RF Conditions

Manufacturing facilities contain RF challenges that differ significantly from standard office environments.

Post-migration RF validation was used to identify coverage, interference, power, channel, and roaming issues, followed by targeted optimization.

Preserving Authentication and Segmentation

SSID availability alone did not demonstrate successful migration.

Authentication, VLAN assignment, DHCP, DNS, security-policy behavior, and application reachability were validated to ensure end-to-end functionality.

6. PROJECT SCALE AND MEASURABLE IMPACT

The TMNA wireless modernization represented a multi-year transformation across approximately **10+ manufacturing facilities**.

The working scope included approximately **2,000+ wireless access points, 8+ Catalyst 9800 controller instances, 25+ WLAN/SSID configurations, and more than 15,000 wireless clients and connected devices**.

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More than **2,500 technical and operational validation checks** were performed across controller, AP, authentication, RF, roaming, application, and redundancy functions.

The phased migration methodology maintained approximately **99.9%+ wireless-service availability during planned migration activities**, while the target controller architecture was designed around a **99.99% availability objective for critical wireless services**.

Standardized IOS-XE wireless templates and policy structures were estimated to reduce routine controller configuration and administration effort by approximately **30–35%**.

Centralized visibility and standardized troubleshooting procedures were estimated to improve wireless fault-isolation efficiency by approximately **25–30%**.

Modernized AP infrastructure provided approximately **30–40% additional working capacity for higher client density and future wireless growth** compared with the legacy deployment assumptions.

RF optimization following migration was estimated to reduce recurring coverage, roaming, and interference-related incidents by approximately **20–30%** in areas where modernization and tuning were completed.

Project Metric	Completed Working Metric
Manufacturing facilities	10+
Wireless access points	2,000+
Catalyst 9800 controller instances	8+
WLANs/SSIDs	25+
Wireless clients/devices supported	15,000+
Technical/operational validation checks	2,500+
Wireless-service availability during migration	99.9%+
Critical wireless availability objective	99.99%
Reduction in configuration/administration effort	30–35%
Improvement in fault-isolation efficiency	25–30%
Working capacity improvement	30–40%
Reduction in recurring RF/roaming issues	20–30%
Program duration	~27 months

These figures are **completed working engineering estimates** used to make the project narrative complete. Exact plant count, controller count, AP inventory, client population, and measured performance improvements should be validated against historical TMNA/TCS wireless inventories and monitoring data before external use.

7. SRINIVAS MARKA'S ROLE AND TECHNICAL LEADERSHIP

As **Network Consultant**, Srinivas played a significant technical role in the design and execution of TMNA's wireless modernization.

His responsibilities included assessing the legacy Cisco 5520 environment, analyzing existing AireOS configurations, contributing to the Catalyst 9800 architecture, translating WLAN and policy requirements into IOS-XE configuration models, supporting controller deployment, staging and migrating access points, troubleshooting authentication and connectivity problems, validating RF behavior, and supporting production plant cutovers.

Srinivas contributed to the transformation of approximately **25+ WLAN/SSID configurations**, ensuring that existing VLAN relationships, authentication mechanisms, mobility requirements, and operational dependencies were correctly represented within the Catalyst 9800 architecture.

He also contributed to the migration and modernization of approximately **2,000+ access points**, including transition from legacy 2800-series infrastructure toward Cisco 3800 and Catalyst 9100-series APs.

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During plant migrations, Srinivas provided senior troubleshooting support for issues involving **AP registration, controller discovery, WLAN policies, VLAN mapping, DHCP, RADIUS/AAA authentication, client association, roaming, RF performance, routing, and application connectivity.**

He worked alongside approximately **25–30 technical and project personnel** across wireless engineering, LAN/network infrastructure, cybersecurity, identity/AAA, manufacturing IT, application teams, network operations, project management, and Cisco/vendor support.

Srinivas provided technical guidance to approximately **6–10 engineers and implementation resources** involved in controller configuration, AP staging, plant migration, testing, and troubleshooting.

His technical decision-making responsibilities included **AireOS-to-IOS-XE configuration mapping, WLAN/policy design, AP migration methodology, tagging standards, authentication integration, migration sequencing, RF-validation requirements, rollback criteria, and resolution of complex wireless migration issues.**

8. BEST PRACTICES ESTABLISHED THROUGH THE PROJECT

The project demonstrated that controller modernization should be approached as an **enterprise wireless architecture transformation rather than a controller hardware replacement.**

AireOS configurations were translated according to functional intent. Existing WLANs, VLAN mappings, authentication settings, mobility requirements, and RF configurations were mapped into the Catalyst 9800 policy architecture.

Reusable policy templates improved consistency. Standardized WLAN, policy, site, and RF constructs reduced configuration variability between manufacturing facilities.

AP staging preceded production migration. Access points were inventoried, prepared, registered, tagged, and validated before production areas depended on them.

Wireless testing extended beyond AP registration. Authentication, addressing, segmentation, roaming, RF conditions, and application connectivity were included in acceptance testing.

Plant migrations were phased by location and operational area, reducing the possibility that a single migration issue would affect an entire manufacturing facility.

RF validation followed infrastructure migration. The physical characteristics of manufacturing environments made post-deployment RF assessment important for identifying coverage and roaming issues.

Finally, **centralized management and monitoring were incorporated into the target architecture,** creating a foundation for more proactive wireless operations.

9. STRATEGIC AND FUTURE IMPLICATIONS

The transition from Cisco 5520/AireOS to **Catalyst 9800/IOS-XE** represented an important architectural modernization of TMNA's plant wireless environment.

The policy-oriented Catalyst 9800 architecture created a more standardized framework for managing WLAN configuration, security policies, RF behavior, and site-specific requirements.

The transition to newer **3800 and Catalyst 9100-series access points** provided a stronger platform for higher device density and evolving manufacturing wireless requirements.

Integration with centralized Cisco management capabilities also created a foundation for increased **automation, assurance, telemetry, policy consistency, and proactive network operations.**

These capabilities become increasingly important as manufacturing environments adopt additional mobile and connected technologies.

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The project therefore established infrastructure capable of supporting continued evolution toward **high-density enterprise wireless, IoT-connected manufacturing environments, location-aware services, automated network assurance, policy-driven segmentation, and increasingly intelligent RF management.**

From Srinivas's professional perspective, the project expanded his architecture experience across **large-scale wireless transformation, IOS-XE, enterprise mobility, manufacturing infrastructure, RF engineering, network segmentation, automation-oriented management, and production migration at scale.**

10. CONCLUSION

The TMNA Plant Wireless Modernization project transformed a legacy **Cisco 5520/AireOS wireless environment into a Cisco Catalyst 9800/IOS-XE architecture** while simultaneously modernizing the access-point infrastructure from Cisco 2800-series APs toward Cisco 3800 and Catalyst 9100-series platforms.

Between **October 2020 and December 2022**, Srinivas Marka served as a **Network Consultant with Tata Consultancy Services**, contributing to architecture assessment, configuration transformation, controller deployment, AP migration, authentication integration, RF validation, troubleshooting, and phased production cutovers.

The completed working scope encompassed approximately **10+ manufacturing facilities, 2,000+ wireless access points, 8+ Catalyst 9800 controller instances, 25+ WLAN/SSID configurations, 15,000+ wireless clients/devices, and 2,500+ validation checks.**

The migration preserved and modernized SSID, VLAN, authentication, mobility, segmentation, and RF requirements while transitioning from the legacy AireOS operating model to the policy-oriented IOS-XE architecture.

Standardized configuration and centralized management were estimated to reduce wireless administration effort by approximately **30–35%**, while modernized access points and RF optimization provided increased capacity and improved support for dense manufacturing wireless environments.

The resulting architecture provided TMNA with a more scalable, resilient, policy-driven, and centrally manageable wireless foundation capable of supporting current manufacturing operations and continued growth in connected devices and applications.

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