Network Telemetry and Incident Report

Incident ID: SW-2026-006
Status: MONITORING
Severity: LOW
Report Generated: January 20, 2026 11:00 UTC

Executive Summary

Routine software upgrade applied to Southwest Regional Network (Zone SW-8B) core routers on January 18, 2026 during scheduled maintenance window. Upgrade from Juniper Junos OS 21.4R3 to 22.2R2 completed successfully with zero customer impact. Post-upgrade monitoring (48 hours) confirms all systems operating normally with measurable performance improvements: 8% reduction in CPU utilization, 12% improvement in routing convergence time, and resolution of 3 known software bugs. This report documents successful change management execution and validates upgrade rollout for remaining network zones.

Change Management Overview

Change ID: CHG-2026-0118-001
Change Type: Software upgrade (core router operating system)
Change Window: January 18, 2026, 04:00-07:00 UTC (3-hour maintenance window)
Actual Duration: 2 hours 28 minutes (under estimated window)
Customer Impact: None (zero service interruption)
Change Status: SUCCESSFUL
Post-Change Monitoring: 48 hours (January 18-20) - All systems healthy

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Affected Network Region

Primary Zone: Southwest Regional Network - Zone SW-8B
Geographic Coverage: Phoenix metro area and surrounding regions
Network Tier: Tier-1 Critical Infrastructure
Subscriber Count: ~168,000 active mobile subscribers
Service Types: 5G NR, LTE, Fixed Wireless Access, Enterprise Direct Connect

Upgraded Equipment: - Core Router: SW-8B-CORE-R01 (Juniper MX2020) - Core Router: SW-8B-CORE-R02 (Juniper MX2020)

Software Upgrade Details

Upgrade Specifications

Previous Software Version: Juniper Junos OS 21.4R3
- **Release Date:** November 2023
- **Service Duration:** 15 months (approaching end of standard support window)
- **Known Issues:** 3 bugs affecting performance and stability (detailed below)

New Software Version: Juniper Junos OS 22.2R2
- **Release Date:** July 2025
- **Certification Status:** Recommended by Juniper for production deployment

- **Testing:** Completed in lab environment (December 2025); successful pilot deployment in Zone NE-2A (January 8, 2026)

Upgrade Objectives

1. Bug Fixes - **Bug ID JNX-72841:** BGP session flapping under high CPU load (impacting routing stability) - **Bug ID JNX-68934:** Memory leak in ISIS routing protocol (slow memory growth requiring periodic reboots) - **Bug ID JNX-71203:** MPLS label allocation inefficiency (performance degradation over time)

2. Performance Improvements - Enhanced routing protocol efficiency (BGP, ISIS, OSPF) - Optimized memory management (reduced memory fragmentation) - Improved CPU utilization for packet processing - Faster routing convergence during topology changes

3. Security Enhancements - 8 CVE (Common Vulnerabilities and Exposures) patches - Hardened control plane security - Enhanced authentication mechanisms

4. Feature Additions - Support for newer BGP features (long-lived graceful restart) - Enhanced telemetry and monitoring capabilities - Improved troubleshooting and diagnostic tools

Upgrade Execution Timeline

Pre-Upgrade Preparation (January 10-17, 2026)

January 10-12: Planning and Testing - Reviewed Juniper release notes and known issues for Junos 22.2R2 - Validated software compatibility with existing hardware and configurations - Tested upgrade procedure in lab environment (replicated production configuration) - Reviewed successful pilot deployment in Zone NE-2A (no issues identified)

January 15: Configuration Backup - Complete configuration backup of both routers (R01, R02) - Exported routing tables, interface configurations, security policies - Documented pre-upgrade performance baselines for comparison

January 16: Risk Assessment and Approvals - Assessed upgrade risks: LOW (well-tested software, successful pilot deployment) - Rollback plan documented (revert to previous software version if issues arise) - Change approval obtained from Network Engineering leadership and Change Advisory Board

January 17: Customer Notification - Notified enterprise customers of scheduled maintenance window (48-hour advance notice per SLA) - Posted maintenance advisory on customer portal and status page - No customer objections or conflicts identified

Upgrade Execution (January 18, 2026, 04:00-06:28 UTC)

Phase 1: Traffic Migration - Router R01 (04:00-04:20 UTC) - Adjusted BGP local preference to gradually shift traffic from R01 to R02 - Validated traffic successfully migrating to R02 (monitoring traffic flows, latency, packet loss) - Confirmed R01 carrying <5% of production traffic (minimal residual sessions) - **Duration:** 20 minutes

Phase 2: Router R01 Software Upgrade (04:20-05:35 UTC) - Uploaded Junos 22.2R2 software image to R01 (12 minutes) - Initiated software installation and verification (18 minutes) - Router reboot with new software (8 minutes) - Router boot and initialization (12 minutes) - Configuration validation and routing protocol reconvergence (25 minutes) - Performance testing and validation (no errors, all tests passing) - **Duration:** 75 minutes

Phase 3: Traffic Return to R01 (05:35-05:50 UTC) - Restored BGP local preference to normal values - Validated traffic returning to R01 (50/50 split with R02) - Confirmed performance metrics within expected ranges - **Duration:** 15 minutes

Phase 4: Traffic Migration - Router R02 (05:50-06:05 UTC) - Adjusted BGP local preference to shift traffic from R02 to R01 (now running new software) - Validated traffic successfully migrating to R01 - Confirmed R02 carrying <5% of production traffic - **Duration:** 15 minutes

Phase 5: Router R02 Software Upgrade (06:05-07:18 UTC - Extended beyond window) - Uploaded Junos 22.2R2 software image to R02 (10 minutes) - Initiated software installation and verification (16 minutes) - Router reboot with new software (8 minutes) - Router boot and initialization (10 minutes) - Configuration validation and routing protocol reconvergence (19 minutes) - **Note:** Installation took slightly longer than R01 due to additional validation steps triggered automatically - **Duration:** 63 minutes

Phase 6: Traffic Return to Normal Load Balancing (07:18-07:28 UTC) - Restored BGP local preference to normal values (50/50 traffic distribution) - Validated traffic returning to R02 - Confirmed both routers running new software with stable performance - Final validation: All routing protocols converged, no errors, performance optimal - **Duration:** 10 minutes

Change Window Closure: 07:28 UTC (28 minutes beyond scheduled window, but zero customer impact)

Post-Upgrade Validation (January 18-20, 2026)

Immediate Validation (January 18, 07:28-12:00 UTC - First 5 Hours) - Continuous monitoring of router performance (CPU, memory, interface errors) - Routing protocol stability monitoring (BGP, ISIS, OSPF session states) - Traffic flow validation (latency, packet loss, throughput) - No anomalies detected - all systems healthy

24-Hour Monitoring (January 18-19) - Automated performance monitoring every 5 minutes - On-call engineer assigned for immediate response if issues arise - Daily traffic patterns observed (morning, afternoon, evening peaks) - all normal - Memory utilization tracking (validating memory leak bug fix) - No issues identified

48-Hour Monitoring (January 18-20) - Extended monitoring to ensure stability over multiple traffic cycles - Reviewed telemetry data for any subtle performance degradation - Validated bug fixes effective (no BGP flapping, no memory growth, stable MPLS) - **Conclusion:** Upgrade successful, all objectives achieved, no issues

Network Performance Metrics

Pre-Upgrade Baseline (January 17, 2026)

Router SW-8B-CORE-R01 (Pre-Upgrade - Junos 21.4R3): - **CPU Utilization:** 42-58% average (moderate, with occasional spikes to 72% during BGP updates) - **Memory Utilization:** 68% (gradual growth due to memory leak bug - was 62% four months ago) - **Routing Table:** 850,000 routes (full Internet routing table) - **BGP Sessions:** 24 peers, stable with occasional flaps (bug JNX-72841) - **ISIS Sessions:** 12 adjacencies, stable - **Interface Errors:** 8-15 errors per hour (moderate, within acceptable range) - **Routing Convergence Time:** 280ms average during topology changes - **Temperature:** 36°C (normal operating range)

Router SW-8B-CORE-R02 (Pre-Upgrade - Junos 21.4R3): - **Similar metrics to R01** (redundant pair, load-balanced configuration)

Zone-Wide Network Performance: - **Average Latency:** 16ms intra-zone, 32ms zone-to-core - **Packet Loss:** 0.09% (acceptable) - **Jitter:** 2.1ms - **Throughput:** 34 Gbps average aggregate - **Connection Success Rate:** 99.88%

Post-Upgrade Performance (January 20, 2026 - 48 Hours After Upgrade)

Router SW-8B-CORE-R01 (Post-Upgrade - Junos 22.2R2): - **CPU Utilization:** 38-48% average (8-10% reduction from pre-upgrade) ✓ IMPROVED - **Memory Utilization:** 66% (stabilized, no growth in 48 hours) ✓ IMPROVED (bug fixed) - **Routing Table:** 852,000 routes (normal growth, 0.2% increase) - **BGP Sessions:** 24 peers, all stable with zero flaps in 48 hours ✓ IMPROVED (bug fixed) - **ISIS Sessions:** 12 adjacencies, all stable - **Interface Errors:** 4-8 errors per hour (40-45% reduction) ✓ IMPROVED - **Routing Convergence Time:** 245ms average (12% improvement) ✓ IMPROVED - **Temperature:** 34°C (slightly reduced due to lower CPU utilization)

Router SW-8B-CORE-R02 (Post-Upgrade - Junos 22.2R2): - **Similar metrics to R01** - all improvements replicated

Zone-Wide Network Performance: - **Average Latency:** 15ms intra-zone (6% improvement), 31ms zone-to-core (3% improvement) ✓ IMPROVED - **Packet Loss:** 0.06% (33% reduction) ✓ IMPROVED - **Jitter:** 1.8ms (14% reduction) ✓ IMPROVED - **Throughput:** 35 Gbps average aggregate (no change, as expected) - **Connection Success Rate:** 99.91% (slight improvement) ✓ IMPROVED

Performance Improvement Summary

Router Performance: - CPU Utilization: **8-10% reduction** (more efficient packet processing) - Memory Leak: **Resolved** (memory stable at 66%, not growing) - BGP Stability: **Zero flaps in 48 hours** vs. 4-6 flaps per week previously - Routing Convergence: **12% faster** (245ms vs. 280ms) - Interface Errors: **40-45% reduction**

Network Performance: - Latency: **6% reduction** intra-zone, 3% reduction zone-to-core - Packet Loss: **33% reduction** (0.09% → 0.06%) - Jitter: **14% reduction** (2.1ms → 1.8ms) - Connection Success Rate: **+0.03%** improvement

Assessment: All performance metrics improved or maintained. No degradation in any area. Upgrade objectives fully achieved.

Issue Resolution: Bug Fixes Validated

Bug Fix 1: BGP Session Flapping (JNX-72841) - RESOLVED ✓

Pre-Upgrade Issue: BGP sessions occasionally flapped (went down then back up) when router CPU utilization exceeded 70%, typically during Internet routing table updates or configuration changes. This caused brief (10-30 second) routing disruptions and potential packet loss during reconvergence.

Frequency: 4-6 BGP flaps per week across both routers
Impact: Brief service degradation during each flap (customers may notice brief connectivity hiccups)

Post-Upgrade Validation (48 Hours): - Zero BGP flaps detected in 48-hour monitoring period - Tested by intentionally loading router CPU to 75% (simulated heavy traffic) - BGP sessions remained stable - **Conclusion: Bug resolved** ✓

Bug Fix 2: Memory Leak in ISIS Protocol (JNX-68934) - RESOLVED ✓

Pre-Upgrade Issue: ISIS routing protocol had slow memory leak, causing router memory utilization to gradually increase over months. Memory growth was slow but steady: - Initial deployment (Sept 2025): 62% memory utilization - Jan 2026 (4 months later): 68% memory utilization - Trend: ~1.5% memory growth per month

If left unaddressed, would reach concerning levels (>80%) in 8-10 months, potentially requiring router reboot to clear memory.

Post-Upgrade Validation (48 Hours): - Memory utilization stabilized at 66% (slight

decrease from 68% pre-upgrade due to more efficient memory management) - No memory growth detected over 48 hours (monitored every 5 minutes) - Extended monitoring planned for 30 days to confirm long-term stability - **Conclusion: Bug appears resolved (continued monitoring required for full validation)** ✓

Bug Fix 3: MPLS Label Allocation Inefficiency (JNX-71203) - RESOLVED ✓

Pre-Upgrade Issue: MPLS (Multiprotocol Label Switching) label allocation algorithm was inefficient, causing gradual performance degradation over days/weeks of operation. Symptoms: - MPLS label database fragmentation - Slower label allocation during network changes - Occasional MPLS forwarding errors (rare, but occurring)

Post-Upgrade Validation (48 Hours): - MPLS label database optimized and defragmented by new software - Label allocation speed improved (measured during testing) - Zero MPLS forwarding errors in 48 hours (previously 2-3 per week) - **Conclusion: Bug resolved** ✓

Risk Assessment: Post-Upgrade

Risk Level: LOW - All Systems Healthy

Risk Score: 1.5 / 10

Risk Factors: - **Software Stability:** Proven stable (successful pilot deployment in Zone NE-2A, 48-hour monitoring in Zone SW-8B) - **Performance:** All metrics improved or stable (no degradation) - **Bug Fixes:** All three known bugs resolved - **Customer Impact:** Zero customer complaints or service issues - **Operational Impact:** Minimal (standard maintenance window, no extended outages)

Residual Risks (Minimal)

1. Long-Term Stability (Low Risk) - While 48-hour monitoring is positive, some software issues only manifest after weeks/months - **Mitigation:** Continue monitoring for 30 days; review monthly performance reports

2. Undiscovered Bugs (Very Low Risk) - New software may have undiscovered bugs not identified in testing - **Mitigation:** Gradual rollout to other zones (one zone at a time); comprehensive monitoring; rollback plan ready

3. Configuration Incompatibility (Very Low Risk) - Some advanced features may behave differently in new software version - **Mitigation:** Extensive pre-upgrade testing validated all configurations; post-upgrade validation confirmed expected behavior

Assessment: Residual risks are minimal and well-managed through monitoring and gradual rollout strategy.

Root Cause Explanation: N/A - Planned Maintenance, Not Incident

This report documents a **successful planned maintenance activity**, not an incident. There was no failure or service impact.

Why This Upgrade Was Necessary:

1. Software Lifecycle Management - Junos 21.4R3 (previous version) approaching end of standard support (18-month lifecycle) - Upgrading to Junos 22.2R2 ensures continued vendor support, security patches, and bug fixes

2. Performance and Stability Improvements - Three known bugs impacting performance and stability (BGP flapping, memory leak, MPLS inefficiency) - New software resolves these issues and improves overall router performance

3. Security Enhancements - Eight CVE security vulnerabilities patched in new software version - Hardened control plane security reduces attack surface

4. Feature Enablement - New software version enables advanced features planned for deployment in 2026: - BGP long-lived graceful restart (improves failover behavior) - Enhanced telemetry (better monitoring and troubleshooting) - Segment Routing (planned for Q3 2026 deployment)

Best Practice: Proactive software upgrades during planned maintenance windows prevent issues and ensure optimal performance. This is routine lifecycle management, not reactive incident response.

Remediation Actions: N/A - No Issues to Remediate

Ongoing Actions

1. Extended Monitoring (30 Days) - Continue monitoring Zone SW-8B routers for 30 days to validate long-term stability - Specific focus on memory utilization (confirming memory leak bug fully resolved) - Daily performance reviews for first week, weekly reviews thereafter

2. Rollout Planning for Remaining Zones

Based on successful upgrade in Zone SW-8B, proceed with gradual rollout to remaining network zones:

Phase 1 (Complete): - Zone NE-2A (pilot) - Upgraded January 8, 2026 - SUCCESSFUL - Zone SW-8B - Upgraded January 18, 2026 - SUCCESSFUL

Phase 2 (February 2026): - Zone MW-4C (Chicago) - Scheduled February 2, 2026 - Zone SE-6A (Atlanta) - Scheduled February 9, 2026 - Zone WE-1B (San Francisco) - Scheduled February 16, 2026

Phase 3 (March 2026): - Zone NE-5D (Boston) - Scheduled March 2, 2026 - Zone SW-7A (Dallas) - Scheduled March 9, 2026 - Zone MW-3B (Minneapolis) - Scheduled March 16, 2026

Phase 4 (April 2026): - Remaining zones (8 zones) - Scheduled throughout April

Rollout Strategy: - One zone per week (allows time for monitoring and issue identification) - If any issues identified, pause rollout and investigate before proceeding - All zones targeted for upgrade completion by April 30, 2026

3. Documentation and Knowledge Sharing - Document lessons learned from SW-8B upgrade - Update upgrade procedure documentation based on execution experience - Share best practices with engineering teams - Conduct training session for field engineers on new software version features

Best Practices Demonstrated

Change Management Excellence

1. Comprehensive Testing - Lab testing validated upgrade procedure and configuration compatibility - Pilot deployment in Zone NE-2A (10 days prior) validated production readiness - Risk assessment identified potential issues and mitigation strategies

2. Gradual Rollout - Pilot zone first (NE-2A), then production zones one at a time -

Allows early issue detection before impacting large customer base - Conservative approach prioritizes reliability over speed

3. Zero-Impact Maintenance - Careful traffic migration ensured continuous service during router upgrades - Load-balanced architecture (R01/R02) enabled one-router-at-a-time upgrade approach - Customers experienced zero service interruption

4. Communication and Transparency - 48-hour advance notice to enterprise customers - Public maintenance advisory on status page - Post-upgrade status updates confirming successful completion

5. Comprehensive Monitoring - Pre-upgrade baseline documentation - Real-time monitoring during upgrade execution - Extended post-upgrade monitoring (48 hours, continuing to 30 days) - Performance comparison validates improvement claims

Technical Execution Excellence

1. Rollback Plan - Documented rollback procedure (revert to previous software if issues arise) - Configuration backups ensure quick restoration if needed - Tested rollback in lab environment (validated procedure)

2. Performance Validation - Measured and documented pre-upgrade baseline - Post-upgrade metrics comparison confirms improvements - Objective evidence of success (not just "no complaints")

3. Risk Mitigation - Load-balanced architecture prevents single point of failure - Gradual traffic migration reduces impact of unexpected issues - Extended monitoring catches issues before they become customer-impacting

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Expected Impact: Positive - Improved Performance and Reliability

Near-Term Benefits (Immediate - 3 Months)

1. Performance Improvements - 8-10% reduction in router CPU utilization → more headroom for traffic growth - 12% faster routing convergence → quicker recovery from network events - 33% reduction in packet loss → better customer experience - 6% reduction in latency → improved application performance

2. Stability Improvements - Zero BGP flaps (vs. 4-6 per week) → more stable routing, fewer brief disruptions - Memory leak resolved → no forced reboots for memory management - MPLS efficiency improved → better enterprise service quality

3. Security Enhancements - Eight CVE vulnerabilities patched → reduced attack surface - Hardened control plane → better protection against control plane attacks

Customer Experience Impact: - Slightly faster response times (lower latency) - Fewer brief connectivity hiccups (no BGP flapping) - More consistent service quality (no MPLS errors) - **Net Impact:** Measurable but subtle improvement; customers unlikely to notice dramatic difference, but overall experience improved

Medium-Term Benefits (3-12 Months)

1. Operational Efficiency - Fewer software-related incidents → reduced operational overhead - No memory management reboots → improved uptime - Better telemetry and diagnostics → faster troubleshooting

2. Feature Enablement - New software enables advanced features planned for 2026: - Segment Routing (Q3 2026) - more efficient traffic engineering - Enhanced QoS (Q2 2026) - better service differentiation - Advanced telemetry (Q2 2026) - AI-based network analytics

3. Compliance and Support - Current software version ensures continued vendor support - Security compliance (patches for known vulnerabilities) - Audit readiness (running recommended software versions)

Long-Term Strategic Benefits (12+ Months)

1. Network Modernization Foundation - Current software enables next-generation features and architectures - Positions network for 5G evolution, edge computing, IoT services - Supports strategic initiatives: network automation, AI/ML operations, intent-based networking

2. Competitive Advantage - Reliable, high-performance network differentiates in competitive market - Enables premium service offerings requiring high performance - Supports enterprise customer acquisition (businesses require reliability)

3. Lifecycle Management - Demonstrates proactive software lifecycle management (upgrade before end-of-support) - Establishes operational rhythm for ongoing software maintenance - Reduces technical debt (avoiding legacy software dependencies)

Business Impact: - Improved customer satisfaction through better performance - Reduced operational costs through fewer incidents and better efficiency - Enabled revenue growth through premium service offerings - Competitive differentiation through network reliability

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Lessons Learned

What Worked Exceptionally Well

1. **Gradual Rollout Strategy:** Pilot deployment validated production readiness; identified no issues before rolling out to additional zones
2. **Load-Balanced Architecture:** Redundant routers enabled zero-impact maintenance (customers unaware upgrade occurred)
3. **Comprehensive Testing:** Lab testing and pilot deployment eliminated surprises during production upgrade
4. **Communication:** Proactive customer notification and status updates maintained transparency
5. **Performance Validation:** Objective metrics demonstrated improvement (not just subjective assessment)

What Could Be Improved

1. **Maintenance Window Duration:** Upgrade took 2 hours 28 minutes vs. 3 hours estimated (good), but Phase 5 extended 28 minutes beyond window (minor issue, but shows estimating can improve)
2. **Automated Testing:** Could implement more automated post-upgrade validation tests to reduce manual validation time
3. **Customer Communication Granularity:** Could provide more detailed status updates during maintenance window (some enterprise customers requested real-time updates)

Best Practices for Future Upgrades

1. **Continue Gradual Rollout:** One zone at a time with monitoring between upgrades
2. **Maintain Comprehensive Documentation:** Document baseline, execution steps, results, lessons learned
3. **Invest in Automation:** Develop automated upgrade procedures and validation tests
4. **Cross-Team Coordination:** Include customer success teams in planning for better customer communication
5. **Continuous Improvement:** Apply lessons learned from each upgrade to improve future executions

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Technical Metadata

Report Classification: Internal Operations - Change Management Success Report
Report Type: Post-Change Validation and Performance Review
Change ID: CHG-2026-0118-001
Data Sources: Router telemetry (Juniper Junos monitoring), network performance monitoring (SolarWinds NPM), change management system
Analysis Period: January 17-20, 2026 (pre-upgrade baseline + 48 hours post-upgrade)
Contributors: Network Engineering team, Change Management team, Network Operations Center
Review Status: Reviewed and approved by Director of Network Engineering
Distribution: Network Engineering teams, Change Advisory Board, NOC staff, Executive leadership (summary)

Related Changes: - CHG-2026-0108-001: Zone NE-2A upgrade (pilot) - January 8, 2026 - SUCCESSFUL - Upcoming: CHG-2026-0202-001: Zone MW-4C upgrade - February 2, 2026 (scheduled)

Follow-Up Actions: Continue 30-day monitoring; proceed with Phase 2 rollout (February 2026)
Next Review Date: February 17, 2026 (30-day post-upgrade review for Zone SW-8B; post-Phase 2 rollout review)

End of Report

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