Zebra Wireless Analyzer

White Paper

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Introduction

This White Paper discusses the Wireless Analyzer Application as a tool to address obstacles encountered when using mobile devices in a Wi-Fi environment. Built into the Zebra device, this application identifies problems, determines root causes, drives actions, and provides a detailed and accurate data analysis and mitigation.

The Wireless Analyzer addresses Wi-Fi networking issues that occur in various customer deployment conditions, such as:

- Pre-deployment pilot testing and analysis
- Go-live verifications
- Performance monitoring in end-user operations
- W-Fi networking challenges
- Customer application challenges

Issues faced by network, wireless, and device administrators are:

- Poor Wi-Fi coverage due to high ceiling/roof AP deployment
- High channel load conditions due to dense AP deployment or device concentration
- Roaming challenges due to a high mobility environment
- Legacy-to-latest infrastructures causing interoperability issues between devices and Wi-Fi networks of different generations
- Interoperability across multiple WLAN AP/infrastructure vendors
- High performance expectations requiring superior quality of user experience (QoE)
- Poor Wi-Fi coverage due to high ceiling/roof AP deployment

To address these challenges, traditional Wi-Fi troubleshooting practices require multiple expensive tools and expertise to collect and analyze Wi-Fi data from the device, application, AP infrastructure, and RF network to determine the root cause of the issue and provide a comprehensive assessment of Wi-Fi performance and voice KPIs. This is particularly challenging in a live environment (for example, healthcare) or when attempting to replicate the issue in a lab.

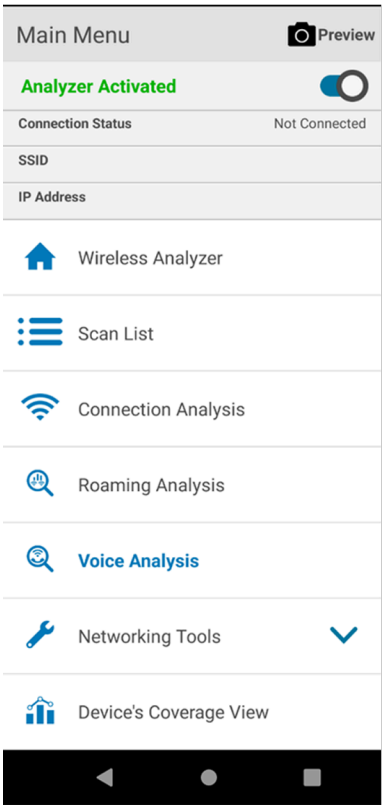
The Wireless Analyzer addresses these challenges in a single tool, saving time and expense, as illustrated in the following examples of enterprise use cases.

Voice Quality Issues

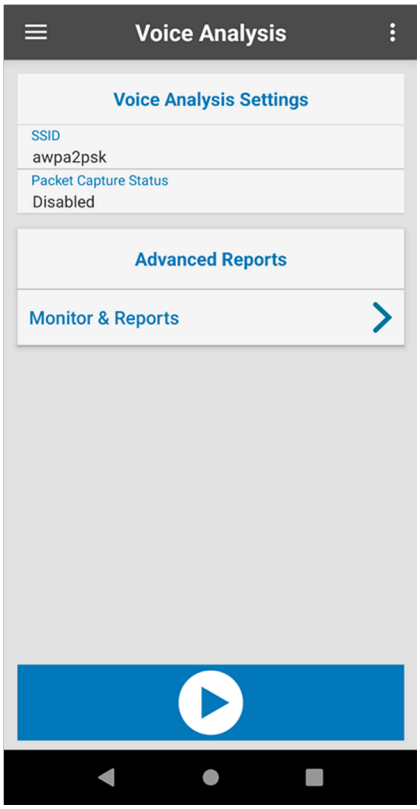
This Wi-Fi network deploys a voice application on Zebra devices. Several device users are experiencing ongoing voice quality issues such as inconsistent audio, choppiness, and missing syllables and words, requiring a re-assessment of the Wi-Fi environment for voice quality readiness.

Performing Voice Analysis

1. On the Wireless Analyzer home screen, select **Voice Analysis**.



2. Select the Play button in the blue field below to start the Voice Passive analysis. Using the deployed voice application, place several long and short calls mimicking operational use cases while roaming through different areas.

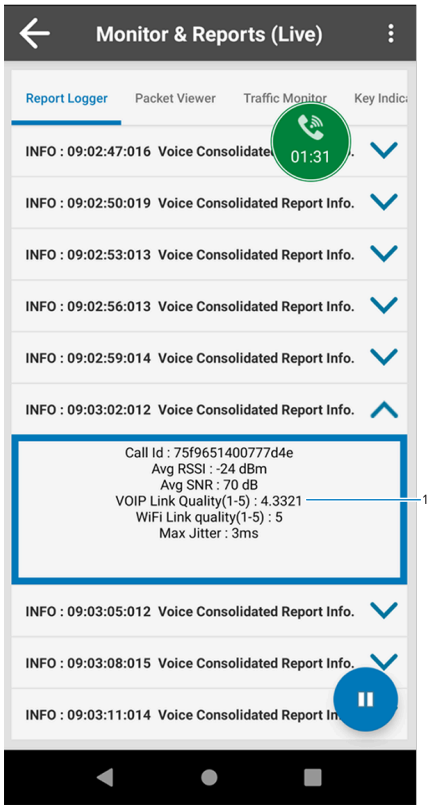


   The Voice Passive analysis feature runs continuously in the background while the voice application makes and receives VoIP calls, and measures key performance parameters such as packet loss, jitter, latency, and MoS to analyze call quality. The feature also analyzes Wi-Fi issues, such as roam failures and disconnections, and measures RF parameters to provide the probable cause of failures.

3. After running the Voice Analysis, select **Monitor & Reports**.

Good VoIP Call Quality

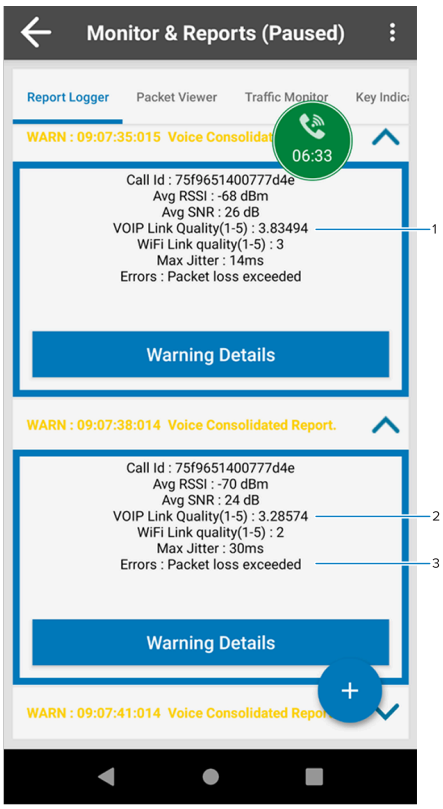
In this example, the **Voice Consolidated Report Info** in the **Report Logger** tab indicates that VoIP call quality is good during a specific period and/or area of the WLAN coverage (VoIP Link Quality >= 4).



Item	Description
1	VoIP Link Quality >= 4 considered good call quality

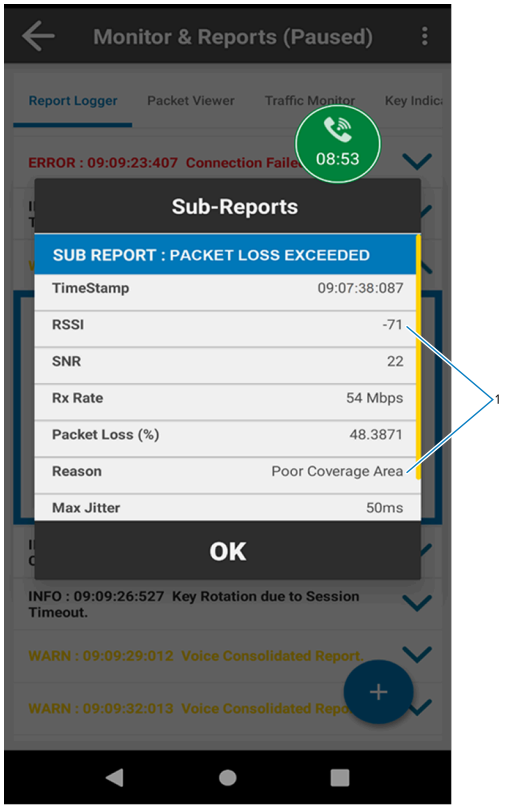
Poor VoIP Call Quality

In this example, a **Voice Consolidated Report** indicates a warning level (yellow) shortly after starting a new call. The Wi-Fi parameters show that RSSI is -70 dbm, indicating a low coverage area, the **VoIP Link Quality** < 4, and the **Errors** parameter displays the reason **Packet loss exceeded**, directly impacting the voice experience.



Item	Description
1	VoIP Link Quality < 4 considered poor VoIP call quality
2	Poor VoIP Link Quality due to packet loss exceeded
3	Packet loss results in poor VoIP performance, e.g., choppiness

Warning Details > **Sub-Reports** shows that an **RSSI** value of -71 dbm, which indicates a **Poor Coverage Area** as shown in the **Reason** field, is the cause of increased packet loss and poor voice quality.



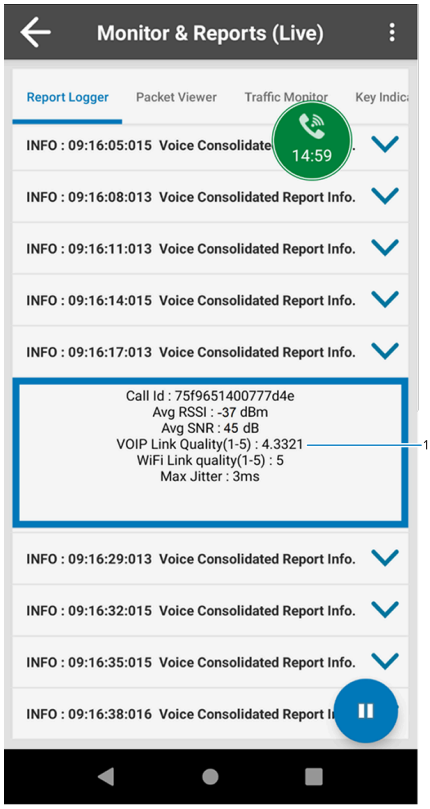
Item	Description
1	RSSI -71 indicates poor coverage, Reason: Poor Coverage Area

Based on this sample screen, the WLAN administrator should consider deploying additional APs in poor coverage areas to address WLAN coverage deficiency, and/or correcting the AP beaconing transmit power to increase RF cell sizes.

After taking corrective action, re-run Voice Analysis while placing new test VoIP calls with the deployed voice application, and ensure the **Voice Consolidated Report Info** reflects the WLAN updates, as shown in the following screen depicting good voice quality.

Expand the **Voice Consolidated Report Info** to view voice quality measures such as VoIP link quality (MoS) and associated parameters such as packet loss, jitter, and latency.

Good VoIP Call Quality After Corrective Action



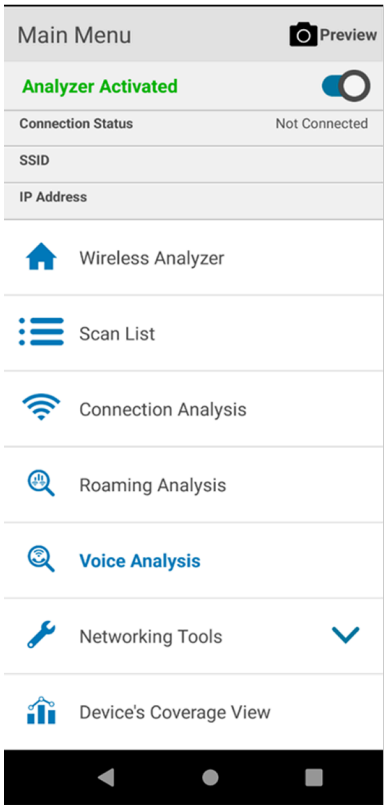
Item	Description
1	VoIP Link Quality >= 4 considered good

Poor Application Performance

In this deployment, users are experiencing sluggishness and disconnections when using an inventory management application in specific locations. The application is sensitive to packet loss and packet delays due to its underlying telnet session.

Device's Coverage View

On the Wireless Analyzer home screen, select **Device's Coverage View**.



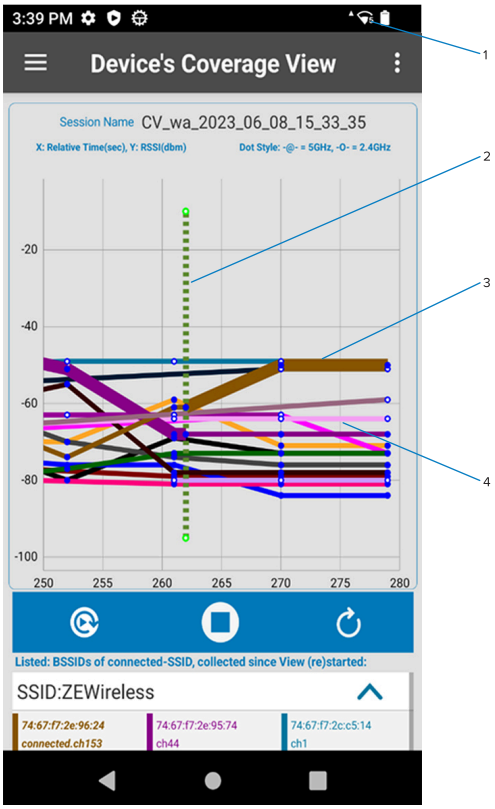
This feature runs continuously in the background and records real-time AP connectivity and roaming events while the application is in use.

Good Wi-Fi Coverage

This screen depicts a specific period when the application experiences good Wi-Fi coverage and successful roaming between APs.

The thick line plots the connected AP at a given time, and the multiple thin lines plot neighboring APs. The vertical green dashed line depicts roaming from one AP to another.

In this instance, good coverage is determined by observing that the roaming event (vertical green dotted line) occurs shortly after the coverage of the connected AP in the time-line axis (purple thick line) gradually (not sharply) decreased, while coverage of a new AP gradually increased. Note that the thin brown line (neighbor AP) before the roaming event becomes a thick brown line afterward.



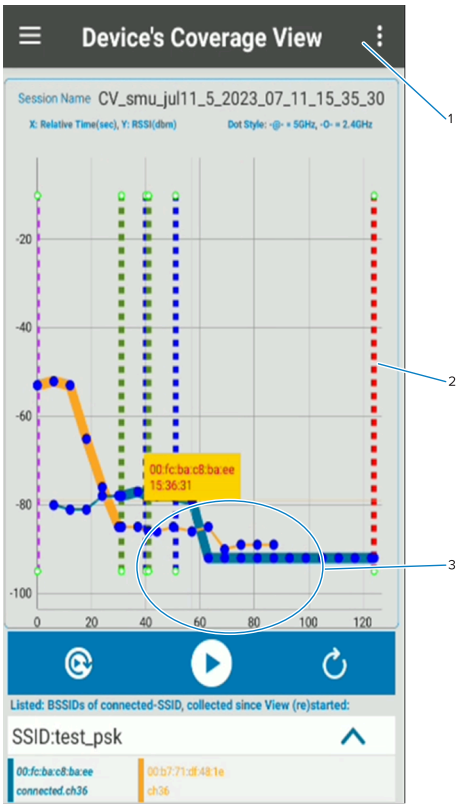
Item	Description
1	Wi-Fi icon indicates good connection
2	Green vertical line depicts successful roam
3	Thick brown line depicts connected AP
4	Thin lines depict neighbor APs

Because certain sections of the store may have better Wi-Fi coverage than others, perform the test in different areas, particularly if it is unknown where the user was when the issue occurred.

Poor Wi-Fi Coverage

This screen shows a different period and area in which the application disconnected (the Wi-Fi icon does not display).

Few neighboring APs (a small number of thin line plots) indicate poor coverage, and the RSSI of the connected AP (thick line) drops to an exceedingly low level (-85 dBm), which leads to Wi-Fi disconnection (vertical red line) coinciding with application failure (disconnection).



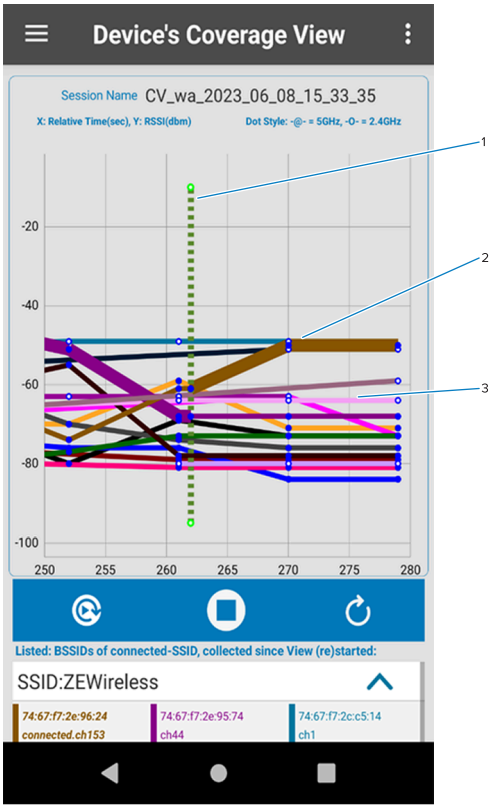
Item	Description
1	Wi-Fi icon not shown (disconnected)
2	Wi-Fi disconnected, coinciding with application disconnection
3	RSSI drops to -85 dBm due to Wi-Fi coverage gap

In this deployment, a large Wi-Fi coverage gap in a specific location causes poor coverage. To address this coverage deficiency, add APs in locations with these gaps, and/or correct the AP beaconing transmit power to increase RF cell sizes.

After taking corrective action, re-run the Device's Coverage View feature while performing the application use cases, and compare outcomes to confirm the updates were successful.

Good Wi-Fi Coverage After Mitigation Efforts

This screen depicts a good outcome after the previous changes, with good coverage and no disconnections.



Item	Description
1	Successful roam
2	Connected AP
3	Many neighboring APs

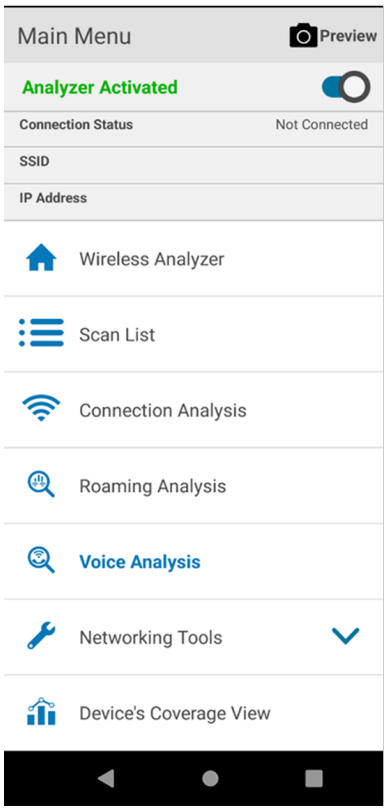
Application Disconnections During Good WLAN Coverage

After verifying WLAN coverage is good, following the previous use case or other previous WLAN coverage validation, the user application experiences "Network not reachable" errors, impacting overall productivity.

Device’s Coverage View

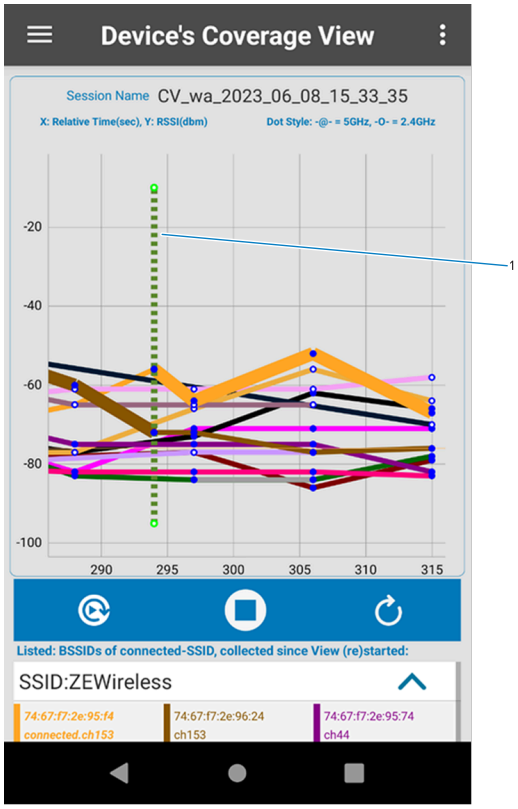
Additional verification that WLAN coverage is good is now necessary within the context of the application issue and in the specific area(s) of the occurrence(s), in case something changed since the last verification.

On the Wireless Analyzer home screen, select **Device’s Coverage View**, which runs continuously in the background and records real-time AP coverage while the application is in use, as indicated in connectivity and roaming events.



Good Wi-Fi Coverage

The following screen indicates good Wi-Fi coverage, as expected from earlier analysis.



Item	Description
1	Successful roam

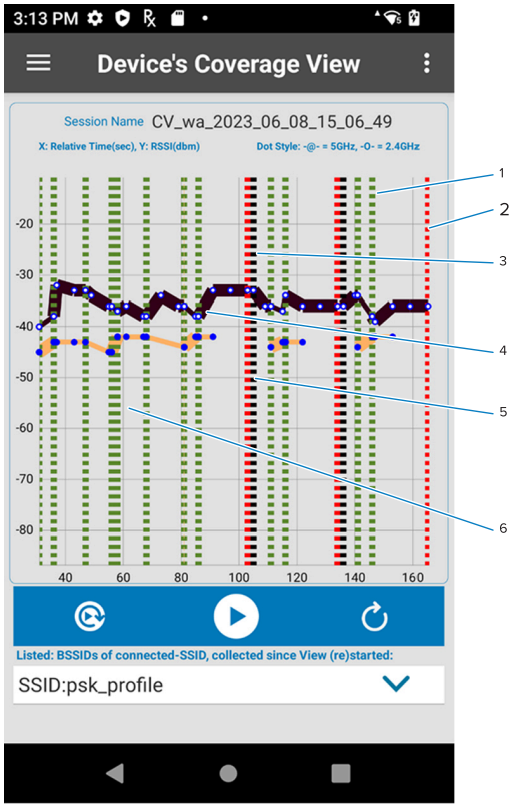
The thick line (the connected AP at a given time) shows a reasonable RSSI, and multiple thin lines (neighboring APs) depict reasonable coverage overlap. The green dashed vertical line depicts roaming from one AP to another.

Run this feature and roam through the WLAN deployment, focusing on areas where users reported that the network was unreachable.

In this use case, coverage is good in all areas including where the application issue is reproduced.

Network Disconnections

In the specific area where the application issue was reproduced, this screen indicates that frequent roams and roam failures are leading to packet loss and Wi-Fi disconnections, and the application cannot reach the network.

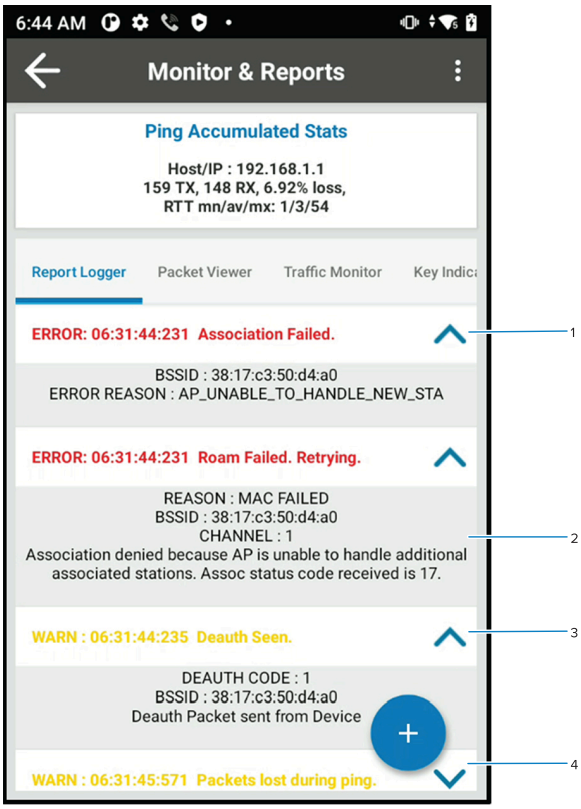


Item	Description
1	Green line – roaming from one AP to another
2	Red line – disconnection from the AP
3	Black line – connection to a new AP
4	Thick black line – connected to an AP for specific duration
5	Disconnection from AP and connect to a new AP
6	Frequent roaming

In this situation, it is imperative to determine the underlying cause for the roam failures and disconnections. To do this, stop the **Device's Coverage View** feature, navigate to the **Roaming Analysis** feature, and use the **Setting** menu to run in **Active** analysis mode.

Run the feature and repeat the roaming sequence in the same area with the same operational use case.

Navigate to **Monitor & Reports** and observe real time reports while roaming and performing the operational tasks of the disconnecting application.

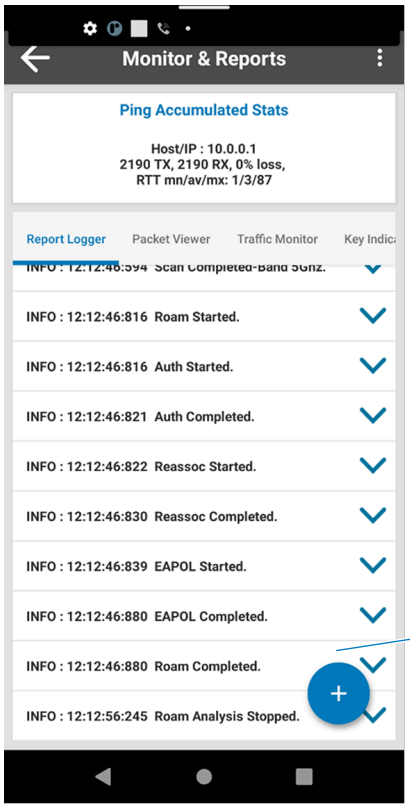


Item	Description
1	Association failure: unable to handle STA/client (wireless infrastructure)
2	Association failure while roaming from one AP to another; max STA limit reached
3	Deauth packet leads to L2 disconnect
4	High packet loss causes application disconnects

The reason code “Association denied because AP is unable to handle additional associated stations” indicates the Max Stations configuration (maximum connected devices per AP at a given time) cannot accommodate respective crowded scenarios, which are dynamic in nature.

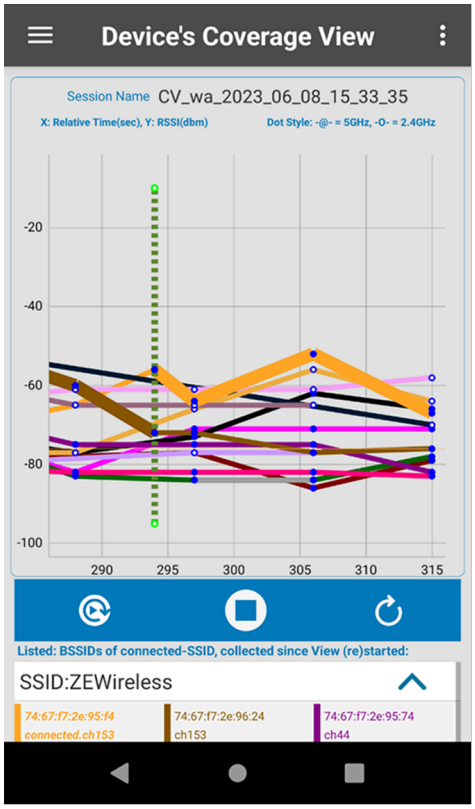
To address this, increase the Max Stations value in the infrastructure (or adjust the configuration per AP/ infrastructure vendor recommendation) to accommodate the use case as per infrastructure guidelines, and then re-run the Roaming Analysis feature in active mode while performing the same use cases to confirm the new data accurately reflects the updates.

The following screen depicts a good outcome after the WLAN changes, indicated by **Roam Completed**.



Item	Description
1	Roam Completed indicates successful roam (without failure)

After verifying roaming performance, run Coverage View to confirm coverage and connectivity in the same location.


Device's Coverage View
Session Name CV_wa_2023_06_08_15_33_35
X: Relative Time(sec), Y: RSSI(dbm)
Dot Style: -@- = 5GHz, -O- = 2.4GHz
-20
-40
-60
-80
-100
290
295
300
305
310
315
Listed: BSSIDs of connected-SSID, collected since View (re)started:
SSID:ZEWireless
74:67:f7:2e:95:f4
connected.ch153
74:67:f7:2e:96:24
ch153
74:67:f7:2e:95:74
ch44

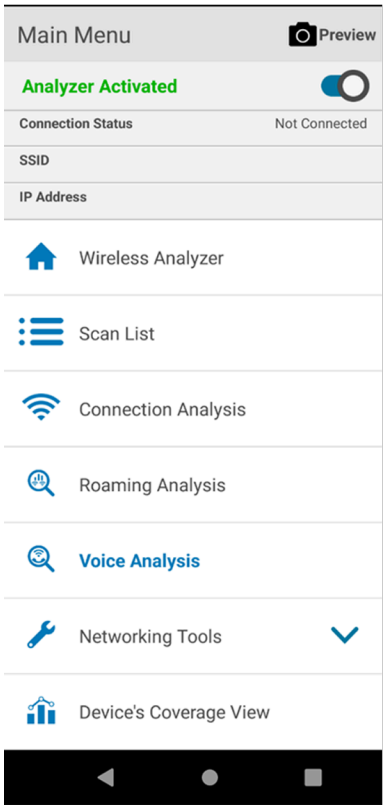
Pre-deployment Voice Readiness Assessment

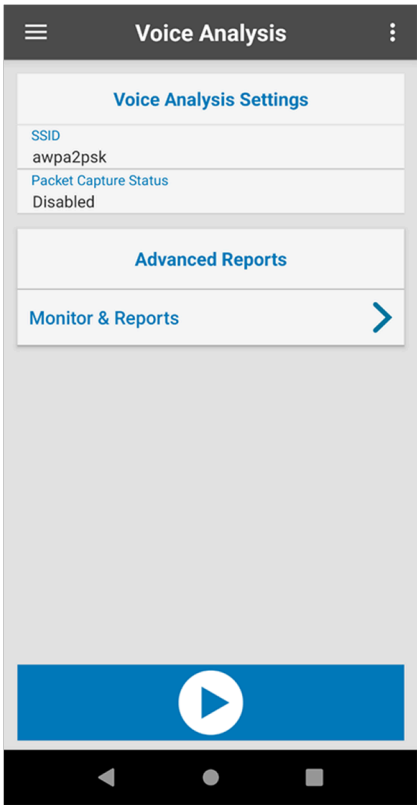
This deployment requires validating network readiness to accommodate good quality of service for Voice, before deploying a VoIP application on Zebra devices.

Voice Analysis

1. On the Wireless Analyzer home screen, select **Voice Analysis,** and use the Setting menu to run in **Active** analysis mode.

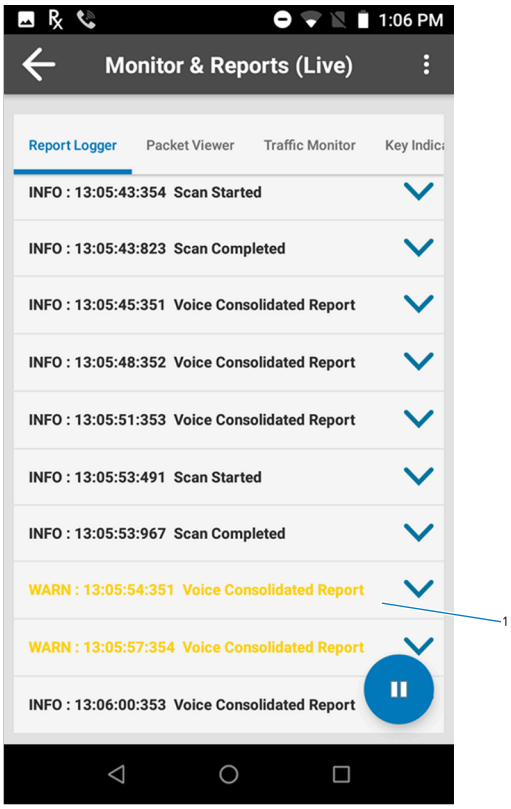
   The detailed analysis of voice simulation in the Active mode assesses feasibility of full voice application deployment.





2. Select **Monitor & Reports** and select the **Report Logger** tab.

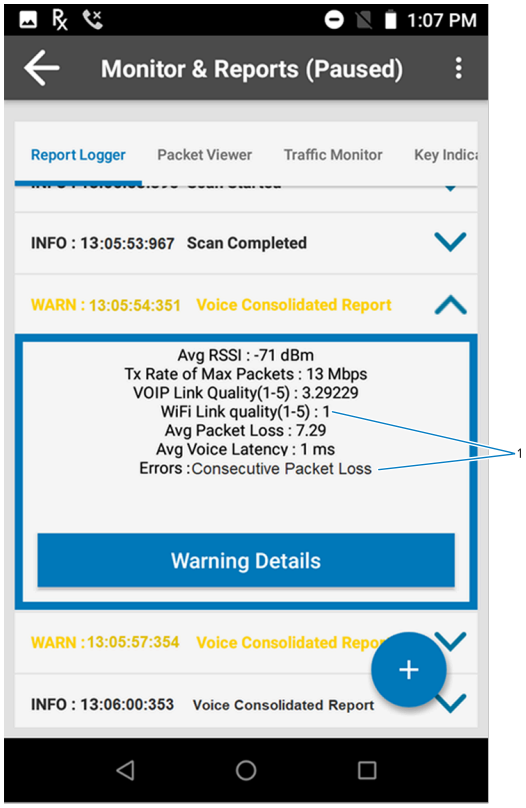
3. Roam through the WLAN coverage areas while observing the Report Logger for anomalies. An operational use case is unnecessary, as the simulated voice traffic is sufficient.



Item	Description
1	VoIP Consolidated Report in yellow indicates a warning

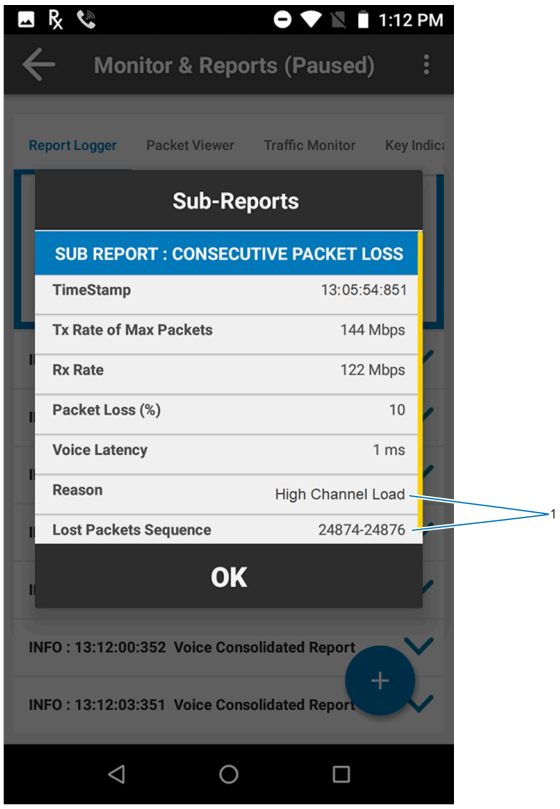
4. Expand the **Voice Consolidated Report** in yellow to view warning details.

   The warning indicates poor VoIP quality (<4) with consecutive packet loss.



Item	Description
1	Bad VoIP Link Quality (<4) with Consecutive Packet Loss

5. Select **Warning Details** to view **Sub-Reports**, which indicates the packet loss is due to high channel load.

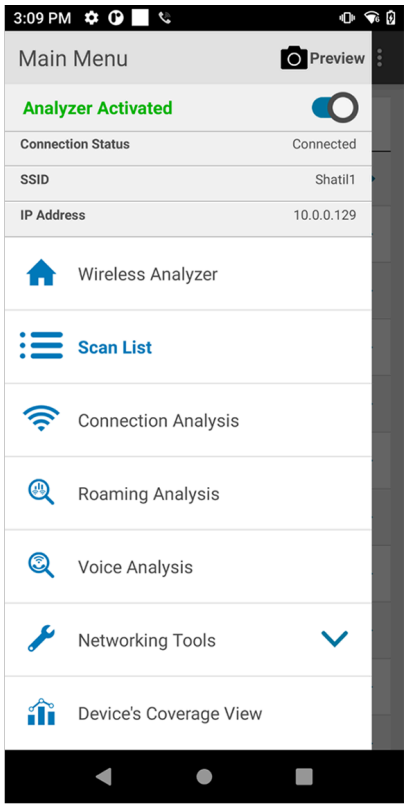


Item	Description
1	Consecutive packet loss due to High Channel Load

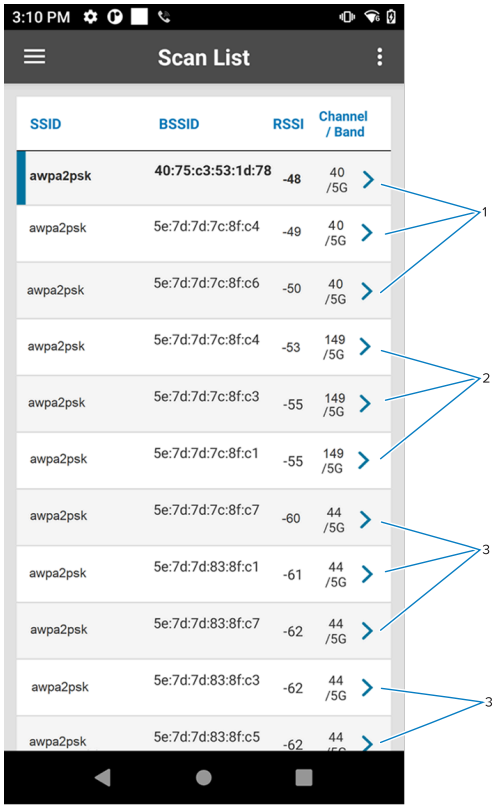
The **High Channel Load** indication necessitates further investigation via the **Scan List** feature.

Scan List

On the Wireless Analyzer home screen, select **Scan List**.



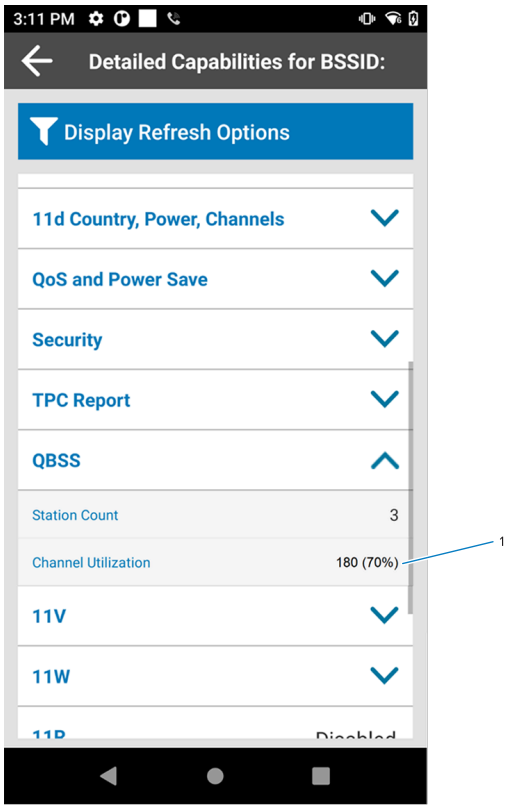
The Scan List feature acquires fresh scanning data and refreshes every few seconds. Roam the High Channel Load area and note that each channel (40, 149, 44) shows multiple separate APs (BSSID) within that same channel group (RSSI values differ by a small number of db), indicating co-channel interference.



Item	Description
1	3 APs with same SSID and different BSSID within the same channel (40), with only a small RSSI difference
2	3 APs with same SSID and different BSSID within the same channel (149), with same or small RSSI difference
3	5 APs with same SSID and different BSSID within the same channel (44), with same or small RSSI difference

Select the arrow next to the connected AP (the top line) to view additional parameters for that AP.

Scroll down in **Detailed Capabilities for BSSID** and expand **QBSS**, the AP's measurements of specific quality metrics for the Basic Service Set. This is review in cases of suspected interference and congestions.

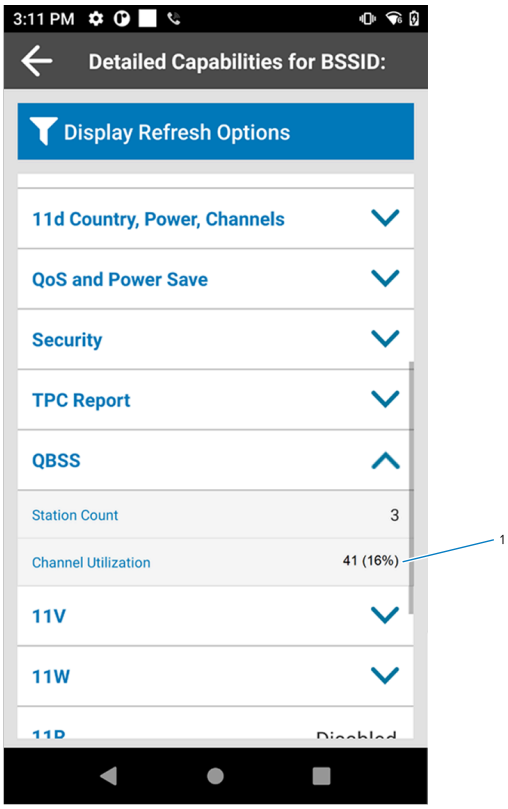


Item	Description
1	High channel load / utilization > 60% leads to packet retries and packet loss

Note that although the **Station Count** is 3 (a low number of connected stations for the AP), the **Channel Utilization** is a high, undesirable value of 70% (> 60%). With multiple APs configured on the same channel with similar power, the utilization (high channel load) is due to many packet retries by network or application protocols and packet loss, which congest the medium with redundant traffic. The voice traffic packet loss directly impacts VoIP application quality in that location.

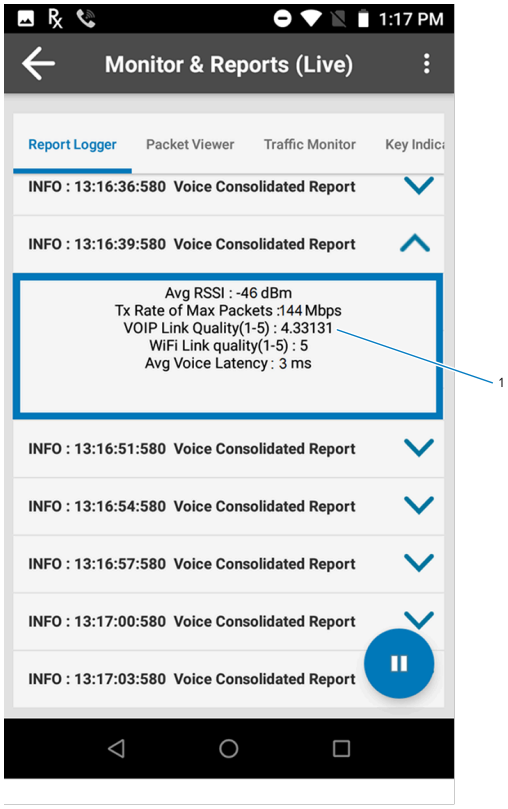
To correct this, adjust the WLAN/AP vendor's configuration related to its Adaptive Radio Resource Management to assign separate channels to nearby APs. Typically, reconfiguring radio management responsiveness to utilization parameters adjusts the adaptation automatically. If this is unsuccessful, manually reconfigure channel separation.

After corrective actions, re-run the **Scan List** feature. The channel utilization of the same AP returns to a normal level.



Item	Description
1	Utilization at 16% considered normal

Re-run the Wireless Analyzer Voice Analysis feature in active mode after infrastructure configuration changes to confirm the new data indicates no warnings or packet loss. This screen shows a good link quality of > 4.



Item	Description
1	VoIP Link Quality > = 4 considered good

This pre-deployment VoIP analysis saves significant cost, effort, and time when deploying the VoIP solution in a production environment.