

Ticket 8: ABC-2818

Status: Complete
Priority: Medium
Summary: DTMF tone detection accuracy issues causing incorrect menu navigation
Reporter: Patricia Adams (AutoDialer Systems Inc)
Assignee: Michael Chang (Audio Processing)
Created Date: May 8, 2025
Updated Date: May 21, 2025

Description

Customer-Reported Symptoms: AutoDialer Systems Inc reported that callers were experiencing frustrating menu navigation issues where pressed keypad numbers were either not detected or incorrectly interpreted. The problem was particularly severe for users calling from mobile phones and older landline systems. Callers frequently needed to press numbers multiple times or were routed to wrong menu options, leading to abandoned calls.

Error Messages/Logs:

```
[2025-05-08 10:33:14] WARN DTMFDetector: Low confidence tone detected  
[2025-05-08 10:33:15] ERROR AudioProcessor: DTMF decode failed - SNR too low  
[2025-05-08 10:33:16] INFO MenuNavigator: Invalid keypress detected, retrying  
[2025-05-08 10:33:17] WARN SignalProcessor: Background noise interfering with DTMF  
[2025-05-08 10:33:18] ERROR CallFlow: Menu timeout - No valid input received
```

Environmental Details: - Caller Demographics: 65% mobile phones, 35% landlines - Common Mobile Carriers: Verizon, AT&T, T-Mobile (US market) - DTMF Standard: ITU-T Q.23 compliance expected - Audio Codec: G.711 μ -law with 8kHz sampling - Background Noise: Varying from -45dBm to -15dBm - Call Quality: MOS scores ranging 2.8-4.2

Impact on Business Operations: - Menu completion rate dropped from 87% to 61% - Customer satisfaction scores decreased 18 points - Call center overflow increased by 340 calls/day - Revenue impact: \$8,500/week in lost automated transactions - Brand perception issues with "outdated phone system"

Resolution Details: Root Cause Analysis: The DTMF detection algorithm was using static frequency thresholds optimized for high-quality landline connections. Mobile phone audio compression and varying background noise levels caused frequency drift and amplitude variations that exceeded the detector's tolerance. The system was also not accounting for the different DTMF timing characteristics between carrier networks.

Applied Fixes: 1. Adaptive DTMF Detection Algorithm: - Implemented dynamic frequency tolerance based on call quality metrics - Added multiple detection methods: Goertzel algorithm + FFT cross-validation - Increased detection window from 40ms to 80ms for mobile compatibility - Introduced confidence scoring with multiple threshold levels

1. Background Noise Suppression:






2. Deployed spectral subtraction noise reduction pre-processing
3. Added automatic gain control to normalize signal levels
4. Implemented band-pass filtering optimized for DTMF frequency ranges
5. Added echo cancellation improvements for mobile carrier compatibility

6. Carrier-Specific Optimization:

7. Created detection profiles for major US carriers
8. Adjusted timing parameters for GSM vs CDMA network characteristics
9. Implemented adaptive signal processing based on caller's network type
10. Added fallback detection for compressed audio streams

11. User Experience Improvements:

- 12. Extended menu timeout from 10 to 15 seconds
- 13. Added audio confirmation feedback for detected keypresses
- 14. Implemented "press and hold" detection for difficult connections
- 15. Added voice-based menu option as fallback

Verification Steps: - Testing across 15 different mobile carriers and devices:  94% detection accuracy achieved - Landline compatibility testing with various PBX systems:  98% accuracy maintained - Background noise simulation testing (-40dB to -10dB):  Robust performance confirmed - Customer A/B testing with 1,000 callers over 2 weeks:  Menu completion rate: 89% - Production deployment with real-time monitoring:  Detection accuracy stable at 93%