

NENA 12th Industry Collaboration Event (ICE 12) Summary Report

Overview

This report describes the NENA ICE 12 conclusions, and recommendations drawn from the event. The event was well attended by both virtually and in person by 23 vendors in 9-1-1 at the Illinois Institute of Technology (IIT) in Wheaton, near Chicago Illinois, October 21st through October 25th. A mid-year virtual event was also held from June 10 - 12, 2024, which entailed re-test of scenarios from ICE 11 and provided a platform to do some pre-ICE 12 event testing and validation.

ICE 12 testing scenarios fell into two standards categories: End-to-End Public Safety Answering Point (PSAP) and Security. The Planning Committee solicited various other working groups within NENA and established a working list of items for testing consideration. This working list below, published in the ICE 12 Charter was based on agreement by the Planning Committee participants and approved by the Steering Committee. The test scenarios were developed based on this list.

- Certificate Management
- Encryption between Functional Element (FE) both ingress & egress.
- Callbacks with caller provider asserted identity verification Outbound Call Interface Function (OCIF), Secure Telephone Identity Revisited (STIR) and Signature-based Handling of Asserted Information Using toKENs (SHAKEN), Resource Priority Header (RPH) signing.
- Follow up calls
- Emergency Support Calls – call to another PSAP about a specific incident
- Abandoned Calls, with callback – Call Handling Functional Element (CHFE), Emergency Services Routing Proxy (ESRP) abandon calls notification. Initiate a callback. Test the notifier.
- Processing of Incoming Interactive Emergency calls- standard i3 call
- Emergency Incident Data Object (EIDOs), Incident Data exchange (IDX) and CHFE/IHFE
- EIDOs with Dispatch, initial notification of new Incident, assign resource, close Incident, etc.
- Transfers with Next Generation Core Services (NGCS) Bridge

Ten (10) test scenarios were developed, scheduled and tested over the 5-day event. Not all ICE 12 Functional Element (FE) participants tested in each event and in some instances could successfully complete only partial steps of a specific test scenario. It was widely recognized by participants that the purpose of ICE is to provide participants with experience and feedback of the test scenarios in support of the NENA i3 version 3 specification. It was also recognized that due to complications with certificate server implementation for ICE12, less focus was placed on Certificate Management and encryption.

Planning for ICE 12 was divided into four (4) subcommittees Mid-year, Pre-Event Validation, Test Scenarios and Reporting. All Participants were asked to join at least one subcommittee. All sub-committees had a good participation. For future ICE events, we will encourage more participation on the Reporting Committee. Weekly planning committee meetings were held, and participation was high. Additionally, subcommittee meetings were held weekly throughout the planning process.

Testing Overview

ICE 12 emphasized early configuration and interoperability testing and made progress from previous ICE events where substantial testing startup problems had occurred on the first day. This year's ICE event added a Mid-year Validation Event, that allowed participants to re-test scenarios from ICE 11. We believe this aided in a cleaner start to the first day of in person ICE12. Future ICE events should emphasize this validation and bilateral test scheduling for all FEs to demonstrate end to end connectivity and application-level protocol exchange going forward as needed.

Successful testing for most scenarios was complete for participating FEs although not all participants were able to accomplish each test fully. Each test brought its own challenges and many FEs were able to correct issues and re-test during the week. Each challenge brought with it emphasis on why ICE is crucial to its participants.

The following NENA i3 functional capabilities were successfully demonstrated for the first time in one or more test scenarios during ICE 12:

- STIR/SHAKEN 9-1-1 call setup from Originating Service Provider (OSP) to CHFE .
- STIR/SHAKEN PSAP Call-Back from CHFE through OCIF to OSP.
- Emergency Video Calling.
- EIDO exchange between two CHFE instances.
- Overflow of Emergency Call due to Max Queue state.

- Transfer an emergency call to another agency with EIDO data.
- EIDO support by CAD (Incident Handling), Incident Data Exchange (IDX).

ICE 12 developed ten (10) test scenarios as standalone tests. As the week progressed testing was streamlined to incorporate multiple test scenarios that are built upon each other. This approach was largely viewed as successful in simplifying the organization and execution of test scenarios. ICE 12 built a testing matrix similar to ICE 11, to execute tests and iterate through the vendor participant FEs. The testing matrix was extremely valuable in laying out a testing approach and schedule. This allowed tests to be easily identified that could not be executed based on FE participation, which additionally helped to streamline testing.

It is recommended that future ICE events limit the number of iterative FE permutations through a combination of:

1. Pre-analysis of vendor FEs and suitability toward fulfilling a given test scenario.
2. Leverage call origination location data and ECRF GIS data URI mappings such that a given call location value can be used in different test scenarios to route to various CHFES. The means to achieve this flexibility easily in the test environment needs further study and planning. However, the design of call origination test data and ECRF routing boundaries to specific CHFE instances creates a rigid test execution event.

Only one (1) test scenario was not executed during ICE 12. The Forest Guide (ECRF) scenario #11 will be targeted during a future ICE event. Additionally, some FE capabilities were not compatible with some specific test scenarios and caused some test scenarios to not be executable.

Individual Test Scenario Summaries:

1. **Audio and RTT Call** - Verify that voice and RTT calls can be placed to PSAP CHFE and transferred.
 - a. **Test Scenario Overview:** A RTT call is established between a caller and PSAP and subsequently transferred to second PSAP with the RTT conversation preserved. EIDO is created and sent to EIDO Subscribers (CAD). Log events and media are logged per. Then audio call is established between caller and PSAP and upgraded to an RTT conversation. EIDO is created and sent to EIDO Subscribers (CAD). Log events and media are logged. Then audio call is established between caller and PSAP and subsequently transferred to second PSAP. An upgrade to RTT is requested while all three parties are on the

Conference Bridge. EIDO is created and sent to EIDO Subscribers (CAD). Log events and media are logged.

- b. **Test Results:** Successful Voice and RTT Calls originated from OSPs or LNG providers, routed by NGCS core services elements (BCF, ESRP, and ECRF) and delivered to PSAP Call Handling Functional Elements (CHFE). OSPs provided LIS and ADR information services and LNGs supported Location-by-Value (LbyV) or Location-by-Reference (LbyR) call scenarios. Call transfers were demonstrated between CHFEs, primary PSAP answering the initial call and a second PSAP with EIDO conveyance. Several i3 Loggers were capturing call flow scenarios and functional element (FE) interactions. Computer Aided Dispatch (CAD) Incident Handling elements subscribed to CHFE to obtain EIDO output.
- 2. **Video Call** - Verify that voice and video calls can be placed to PSAP CHFE
 - a. **Test Scenario Overview:** Bi-directional or One-Way video call is established between caller and PSAP. EIDO is created and sent to EIDO Subscribers (CAD). Log events and media are logged. Then an Android audio call is established between caller and PSAP then with the Android UE the call is upgraded with Video conversation. EIDO is created and sent to EIDO Subscribers (CAD). Log events and media are logged.
 - b. **Test Results:** Successful video calls were completed where the CHFE had both video outputs on their equipment, but had some challenges in video of the CHFE call taker video back to the UE. Various loggers were able to capture both video streams. More research on Video Calls needs to take place to ensure accurate 2-way RTCP for video calling and at what MTU size.
- 3. **STIR/SHAKEN** - Verify emergency i3 call with caller Provider Asserted Identity verification is working
 - a. **Test Scenario Overview:** A voice call is established between the caller and PSAP, ESRP uses the Identity header and digital signature provided by the OSP in the authentication process. The header contains the caller's phone number, the attestation level assigned to the call and a cryptographic signature to verify the header's integrity. Also, the Resource Priority Header (RPH) was conveyed to the target ESRP and presented to the PSAP.

- b. **Test Results:** Successful STIR/SHAKEN calls were tested with the vendors that support it. ESRPs were able to validate an attestation level for the calls that were then displayed on their CHFE with the correct attestation level of “A”. The RPH was successfully conveyed by the OSP and presented to the ESRP who forwarded it to the PSAP.
- 4. **Abandoned call with callback, EIDO, and Follow-up** - Ensure the abandoned call is displayed at the position and CHFE generates EIDO associated with the call. Ensure call taker can perform callback. Ensure call taker can perform a follow-up call.
 - a. **Test Scenario Overview:** A CHFE generates notifications for abandoned calls with EIDOs and sends them to the CAD. Then a voice call is established between a caller and PSAP, EIDO is created and sent to EIDO Subscribers. Two-way audio is established, and the call taker ends the call, when an EIDO is sent to subscribers. The Dispatch FE leaves the Incident open. The CHFE makes a Follow-up call via the OCIF and is reconnected with the caller. An EIDO is sent to subscribers of the new call related to the active Incident. The call taker ends the call, and an EIDO is sent to the subscribers. Dispatch then closes the Incident. Log events and media are logged.
 - b. **Test Results:** Successful i3 PSAP callback calls were completed back to the UE where a call was originated by an OSP to the CHFE, abandoned by the caller, and a callback from the PSAP through the OCIF back to the caller. In some cases, STIR/SHAKEN was received and attested by the OSP. The RPH/SPH were presented to the OSP during the callback. STIR/SHAKEN was also verified as we progressed through other scenarios.
- 5. **Test Scenario 5** – This test scenario was combined with another test scenario and only remains as a reference.
- 6. **Ad Hoc** - Audio Emergency i3 call routed to PSAP CHFE, EIDO Ad Hoc Bridge Method is used, and EIDO link is provided.
 - a. **Test Scenario Overview:** An emergency call is established to a PSAP CHFE, then the emergency call is transferred using the Ad Hoc Bridge Method to a second PSAP ensuring aggregate EIDO by-reference link is provided and can be dereferenced by the second PSAP.
 - b. **Test Results:** Successful i3 Call with Ad Hoc Bridge Method was completed for those FEs capable of participating in this test scenario.

7. **Transfer Emergency Call with Aggregated Incident Data (EIDO)** - Verify that a PSAP that receives a call transfer also receives the aggregated EIDO associated with the call.
 - a. **Test Scenario Overview:** A wireless call is established between a caller and the primary PSAP. The primary PSAP creates an incident and then transfers the call to the second PSAP. The aggregated EIDO with incident information is sent from the primary PSAP to the second PSAP.
 - b. **Test Results:** Successful i3 Call transfer to another CHFE with aggregated Incident Data (EIDO), using the IDX dereference service, was completed for those FEs capable of participating in this test scenario.
8. **Overflow of Emergency Calls Due to Max Agency Capacity** - Verify that emergency 9-1-1 calls are routed to an alternate Agency when the primary Agency has reached Queue capacity.
 - a. **Test Scenario Overview:** A first call should be successfully received by the CHFE at PSAP A and routed to an available position at PSAP A. An ESRP should be updated with the QueueState information. A second call should be successfully diverted to the CHFE at PSAP B and routed to an available position at PSAP B with an indication that the call was diverted with the divert reason.
 - b. **Test Results:** Successful overflow of emergency calls was completed. This occurred with the primary CHFE under test, put their max queue state to 1. A call was made from one OSP/LNG and answered by the primary CHFE, and while the original call is still 'live' with the primary CHFE and 2nd OSP/LNG made a call, which was then diverted to the alternate agency CHFE.
9. **Overflow of Emergency Calls Due to SIP Call Delivery Error** - verify that emergency 911 calls are routed properly to an alternate Agency when the ESRP is unable to deliver calls to the primary agency.
 - a. **Test Scenario Overview:** Re-routed call delivered to CHFE at second PSAP after the ESRP fails to deliver the call to primary PSAP. When the call is received at a position at the second PSAP, the phone client at the position must display an indication that the call was diverted from the primary PSAP with a description for the diversion.
 - b. **Test Results:** Successful overflow of emergency calls was completed. This occurred with the primary CHFE under test which generated a SIP 4XX error. A

call was made, which was then diverted to the alternate agency CHFE which displayed the call redirect reason due to a SIP error.

10. **Forest Guide with CHFE** - verify CHFE-initiated recursive routing during call transfer using the Forest Guide.

- a. **Test Scenario Overview:** A call is delivered to primary PSAP CHFE. The call is transferred to second PSAP CHFE through consulting the Forest Guide and ECRF through recursion. A three-way call is established via the bridge. Primary PSAP CHFE drops off the call and the call has been transferred successfully to second PSAP CHFE.
- b. **Test Results:** Partial success. Configuration issues made testing using the Forest Guide inaccessible during ICE12. An alternative Forest Guide was accessed, although the test could not be fully completed.

11. **Forest Guide with ECRF** - To verify recursive routing during call routing using the Forest Guide.

- a. **Test Scenario Overview:** Call is not delivered to primary PSAP CHFE. The call is routed to second PSAP CHFE through consulting the Forest Guide and ECRF through iteration as redirection, not recursion.
- b. **Test Results:** Because of Forest Guide configuration issues this test was not attempted.

Testing challenges were encountered during various test scenarios that prevented specific FEs or combinations of FE providers to either not attempt the test, or only partially complete the specific test scenario, including:

- 1. Some one way or no audio challenges occurred.
- 2. Challenges with two-way video in some of the test cases were experienced.
- 3. Some test points not CLDXF-US compliant prevented successful responses from ECRF(s).
- 4. Although progress was seen, we could do better in understanding what functional elements can interoperate with each test scenario.
- 5. Multiple Identity Headers during calls with STIR/SHAKEN could not be processed by some vendors who could not ingest two location references both by reference (LbyR)

and by value (LbyV). There was a need to select one and there was no facility for some vendors to decide which reference to select.

6. Vendors had difficulty provisioning to query the Forest Guide.
7. Forest Guide configuration issues parsing XML entries.

Standards Lessons and Learnings

1. STIR/SHAKEN is not universally supported.
2. OCIF is not universally supported.
3. MTU packet size and settings in application-level protocols that cause large data packets (e.g., LoST, HELD, ADR, EIDO, Video) can become problematic.
4. ESRP and Forest Guide reference traversing (LoST query that directs an element to another LoST Server) are not universally implemented.

Better for Next Year

1. Better vetting of participant FE feature support prior to events.
2. Improve mid-year Validation testing:
 - a. Clarify Bilateral and pretesting to include specific test paths and success criteria.
 - b. End to end connection of FEs that will be testing together. Protocol verification in addition to IP path. Need more than 'curl' tests.
3. Pre-event testing activities (to include Bilateral testing) should be scheduled, tracked, and reported including specific test paths and success criteria. Even though significant effort and improvements were made during ICE12 planning, further improvements are necessary.
4. Include Forest Guide testing earlier in the planning and testing process to include Mid-Year event.
5. Improvements to in-room communication and audio-visual setup will help facilitate better cross-room updates and help to focus on some of the communication challenges while running the in-person event.

Standards Gap Identified

1. Calls with STIR/SHAKEN signaling use multiple Identity headers. Unfortunately, the EIDO-JSON standard (NENA-STA-021.1a-2021) only allows 0 or 1 SIP Identity element. This must be an array of 0 or more elements to allow these multiple headers.
 - a. **Recommendation** is to send the gap back to NENA EIDO-JSON WG to be treated as an erratum and simply replace the current element with the array not worrying about backward compatibility.
2. Issue with listServicesByLocation in RFC 5222. Section 11 specifies: "If the <service> element is absent, the LoST service returns all top-level services available for the provided location that it knows about."
 - a. This has been interpreted by at least one ECRF vendor as if there is no mapping defined for a particular top-level service, it will not be returned in the list of services. This is problematic because there will never be a mapping for some top-level services such as urn:emergency:service:responder or urn:emergency:service:sos.
 - b. How is an element expected to discover all the services available at a particular location? Luckily the same ECRF implementation does return all supported top-level services to a listServices query so one could use the result of listServices to ensure service discovery is exhaustive.
 - c. How do we address this gap with listServicesByLocation? Is the interpretation of RFC 5222 the right one? Should an ECRF return top-level services even if there are no mappings for one?
 - i. **Recommendation** is to send the gap back to NENA i3 Arch WG to be reviewed/discussed and a proposed solution documented.

Test Environment

- The IIT test environment proved mostly versatile and reliable.
- During the first three (3) days of the event problems with venue HVAC made temperatures in the facility above 85 degrees.
- During the week there were a couple of isolated power glitches which were quickly resolved. There were some in-room network connectivity losses as well but again they were quickly resolved.

- Connectivity for the Zoom conference worked well, and participants were able to communicate adequately with in-person participants.
- There were some challenges with tracking the test scenarios and with intra-room communication, i.e., one end of the table could not hear or understand what was going on at the other end, we believe this could be resolved with better room set-up.
- Because of some financial constraints, external security TLS key management was brought in-house. IIT hosted an OpenSSL server for encryption key management, which was not available until after the Mid-Year event but can now be used for future events.
- Secure communication was an option for most vendors participating, but not all were using encrypted pathways for communication, and it was easily abandoned as a troubleshooting step.

Additional Comments

- Vendor participation and cooperation was viewed as positive.
- Participation in subcommittees increased leading to better planning for both mid-year and in-person events.
- Progress made from previous years on 1st day testing, as everyone was able to start testing sooner. Although improvements could still be enhanced to allow earlier set-up and allow for more effective testing and more effort to establish “readiness”.
- Pre-event testing was more accomplished than prior ICE events. Many recommendations were made to enhance pre-event validation testing. Requests for a more rigid validation testing including specifically scheduled testing, more detailed test plan and documentation provided for those tests made available earlier in the process.
- Failure of test results is a success in learning and feedback.
- All participants viewed the event as a great learning experience.
- There would be value in making sure we have redundancies built into each test to avoid reliance on a single vendor.
- Food such as snacks and lunches being provided was helpful in keeping people together and making progress.
- A proposal was made to run multiple tests in parallel.
- As there were participants globally, appreciation was given for the sensitivity of the time of day in which tests were run.
- A recommendation for a time scheduled for re-testing issues found during the event.
- Potentially more focus on available tests for logging vendors, recommendations were made to enhance this in the future.

Survey

A survey was provided to ICE 12 participants. It was not limited to one per company. The reporting results do not break down responses by company. The following is a summary of the survey results in addition to the notes that were summarized above.

There were 17 responses to the post event survey (truncated percentages).

Question	Yes	No	Other
1. Planning Process – Did the planning process support the needs of the event?	94.12%	5.88%	N/A
2. Were the Planning Committee weekly calls efficient and productive?	100%	0%	N/A
3. Validation Testing – Did the bilateral test procedures and tracking documents provide what was needed to perform pre-event testing?	64.71%	17.65%	17.65%
4. Were you able to complete your Validation testing prior to the event?	47.06%	35.29%	17.65%
5. Were the test scenarios appropriate for the event?	94.12%	0%	5.88%
6. Did the facilities meet the needs of the event?	47.06%	0	Other 52.94%
7. Were the capabilities of the lab (facility, room, projectors, etc.) supportive of a positive testing environment?	52.94%	0%	47.06%
8. Were you able to engage with your remote team members effectively?	64.71%	0%	35.9%
9. Did the remote access meet the needs of the event?	94.12%	0%	5.88%
10. The Mid-Year Event was scheduled to support testing from the previous ICE event that either was not able to be tested or tests that failed. Did you find the Mid-Year Event testing effective?	88.24%	5.88%	5.88%
11. Did you find the test scenarios and the testing schedule effective?	82.35%	5.88%	11.76%
12. Did you feel the opportunity to test at the Mid-Year Event valuable?	82.35%	0%	17.65%

13. The ICE 12 Event was scheduled for five (5) full days of testing. Were five (5) days sufficient time to complete all the planned testing?	88.24%	5.88%	5.88%
14. Did you find the test scenarios and the testing schedule effective?	82.35%	5.88%	11.76%
15. Did you feel you had the opportunity to test all the functionality you were prepared to test?	70.59%	23.53%	5.88%
16. Did you find it easy to report and/or resolve problems experienced that affected testing?	82.35%	5.88%	11.76%
17. Were you able to track the testing activities easily?	88.24%	0%	11.76%

Question	Answer Choices	Responses	
18. On a scale of 1 – 5, with one being the lowest value, how much value did your company find by participating in the ICE 11 event?	(5) Extremely valuable	76.47%	13
	(4) Very valuable	11.76%	2
	(3) Somewhat valuable	5.88%	1
	(2) Not so valuable	5.88%	1
	(1) Not at all valuable	0.00%	0
19. On a scale of 1 – 5, with one being the lowest value, how much value do you think your company received for its investment as a participant in ICE 11?	(5) Extremely valuable	70.59%	12
	(4) Very valuable	11.76%	2
	(3) Somewhat valuable	11.76%	2
	(2) Not so valuable	5.88%	1
	(1) Not at all valuable	0.00%	0
20. On a scale of 1 – 5, with one being the lowest, how likely is it that your company will participate in another ICE event?	(5) Extremely valuable	70.59%	12
	(4) Very valuable	23.53%	4
	(3) Somewhat valuable	0.00%	0
	(2) Not so valuable	0.00%	0
	(1) Not at all valuable	0.00%	0

This is the last line of the NENA ICE 12 Summary Report.