

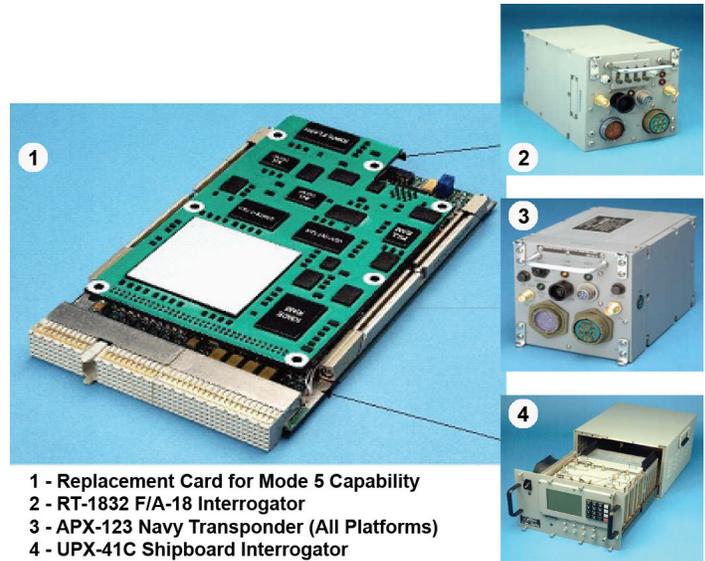
Mark XIIA Identification Friend or Foe (IFF) Mode 5

Executive Summary

- Independent Mark XIIA Mode 5 Identification Friend or Foe (IFF) (referred to as “Mode 5”) programs exist in each U.S. Military Service as well as some NATO countries. Although not a joint program, the Services are developing equipment capable of employment on multiple Service platforms.
 - Of the four separate Service efforts, the Navy has the only established Acquisition Category II program, with incorporation of Service-specific Mode 5 capability through platform-specific Engineering Change Proposals (ECPs).
 - The Army and Marine Corps will leverage the Navy program and the Air Force will execute individual ECPs on their affected hardware.
- Although the Services are designing and building Mode 5 systems to comply with NATO and DoD IFF standards, DOT&E initiated oversight because of the concern that the multiple programs and vendors add risk to achieving joint interoperability.
- The Navy conducted an IOT&E of Mode 5 capability that included significant joint Service participation in FY12. However, the event was severely truncated due to adverse weather. Lack of adequate test data prevented DOT&E from fully assessing system effectiveness and suitability under realistic operational conditions. However, there were sufficient data to assess the performance of the individual components that comprise the Navy Mode 5 system. Those components met their performance thresholds and the Navy Acquisition Executive granted full-rate production authority to the program in July 2012.
- Following IOT&E, the Program Office released new software builds for both its transponder and interrogator systems to address those discrepancies highlighted during the operational test and subsequent reporting. Additional testing is required to assess the performance of these software fixes as well as the Mode 5 interoperating with both existing and planned IFF systems. The next opportunity to conduct that testing is now planned for the 3QFY13. Successful planning and execution of this event should resolve DOT&E concerns about joint interoperability and identification in a system-of-systems context.

System

- The Mark XIIA Mode 5 IFF is a cooperative identification system that uses interrogators and transponders located on host platforms to send, receive, and process friendly identification data.
- Mode 5 is a military-only identification mode, which modifies the existing Mark XII Mode 4 IFF (referred to as “Mode 4”) system and addresses known shortcomings of the legacy Mode 4 identification mode. Mode 5 will eventually replace



1 - Replacement Card for Mode 5 Capability
 2 - RT-1832 F/A-18 Interrogator
 3 - APX-123 Navy Transponder (All Platforms)
 4 - UPX-41C Shipboard Interrogator

Mode 4 and allows National Security Agency-certified secure encryption of interrogations and replies. Primary system features include:

- A lethal interrogation format, which is used by a “shooter” prior to weapons release as a final attempt to get a valid Mode 5 reply from the target, even with the target’s interrogated Mode 5 transponder system in standby; this is intended to reduce fratricide
- A random-reply-delay, which prevents overlapping replies and provides better display discrimination for closely spaced platforms
- Mode 5 offers more modern signal processing, compatibility with legacy Mode 4 systems and civilian air traffic control, and secure and encrypted data exchange through the use of the new waveform.
- Mode 5 serves as a component of the combat identification process used on ground-based systems such as the Army’s Patriot missile system, sea-based systems such as Aegis-equipped ships, and military aircraft to include the E-3 Airborne Warning and Control System and E-2 Hawkeye command and control platforms.
- Independent Mode 5 programs exist in each U.S. Military Service as well as some NATO countries. Although not a joint program, the Services are developing equipment capable of employment on multiple Service platforms.
 - Of the four separate Service efforts, the Navy has the only established Acquisition Category II program, with incorporation of Service-specific Mode 5 capability through platform-specific ECPs.

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- The Army and Marine Corps will leverage the Navy program, and the Air Force will execute individual ECPs on its affected hardware.

Mission

The Combatant Commander employs the Mode 5 system to provide positive, secure, line-of-sight identification of friendly platforms equipped with an IFF transponder. In the future, this system's information will be combined with other cooperative

and non-cooperative combat identification techniques in order to provide identification of all platforms – enemy, neutral, and friendly.

Major Contractor

BAE Systems – Arlington, Virginia

Activity

- Although the Services are designing and building Mode 5 systems to comply with NATO and DoD IFF standards, DOT&E initiated oversight because of the concern that the multiple programs and vendors add risk to achieving joint interoperability.
- The Navy executed IOT&E on their Mode 5 system for shipboard interrogators and transponders as well as aircraft transponders from October through November 2011. The Navy executed the test in accordance with the DOT&E-approved Test and Evaluation Master Plan (TEMP) and test plan; however, poor weather and technical test execution deficiencies truncated the amount of test data recorded. There were sufficient data to assess the performance of the Navy Mode 5 system-under-test; however there was insufficient data to provide a full assessment of the Mode 5 system-of-systems interoperability and suitability.
- DOT&E published its IOT&E report in July 2012, assessing the Navy's Mode 5 hardware/software as well as the overarching Mode 5 system-of-systems. The Navy Acquisition Executive approved full-rate production of the Navy Mode 5 system in July 2012 following the Navy Mode 5 IOT&E.
- The Army and Air Force are developing and testing Service-specific Mode 5 capabilities:
 - The Army developed a Mode 5 Air Defense Interrogator for the Patriot and Sentinel systems; it is currently in developmental testing.
 - The Air Force is developing a separate Mode 5 interrogator for the E-3 Airborne Warning and Control System.
 - The Air Force Operational Test and Evaluation Center tested the integration of an Air Force-developed Mode 5 interrogator and transponder on the F-15C/E aircraft in conjunction with the Navy IOT&E in November 2011.
- The Navy submitted, and DOT&E approved, a revised Test and Evaluation Master Plan that will ensure that Mode 5 is assessed in operationally realistic environments that include (in addition to Navy ship and aircraft platforms) a variety of Army, Air Force, and allied systems equipped with Mode 5 capability.
- USD(AT&L) and DOT&E worked with the Services to develop and approve a revised Joint Operational Test Approach (JOTA) (version 2.0) document to guide Mode 5 interoperability testing across the DoD.

- Utilizing the approved JOTA guidance, the Navy is currently leading development of a test concept for the conduct of an operationally realistic test of Mode 5 capability in 2013.
- This event will employ a variety of joint Service and allied aircraft equipped with interrogators and transponders using representative flight profiles. JOTA efforts are critical to informing the DoD-wide FY14 Mode 5 Initial Operational Capability and FY20 Full Operational Capability declarations.

Assessment

- During IOT&E, Mode 5 demonstrated significant improvement over the existing Mode 4. However, weather limited the scope of testing and prevented a complete operational assessment. Lack of adequate test data prevented DOT&E from fully assessing system effectiveness and suitability under operationally realistic conditions. However, there were sufficient data to assess the performance of the individual hardware components that comprise the Navy Mode 5 system. Those components met their individual performance requirements thresholds during the IOT&E.
- Although no hardware or software failures occurred during IOT&E, DOT&E observed substantial suitability deficiencies, including short battery life, easily triggered anti-tamper features, and difficulty loading cryptographic keys.
- The IOT&E highlighted interoperability concerns between Mode 5 and other systems onboard Navy ships. These include:
 - Shipboard integration problems of Navy Mode 5 equipment into the larger shipboard Aegis weapons system, which could cause incorrect engagement decisions with potentially severe consequences.
 - Problems with the accurate and timely flow of Mode 5-derived identification information between components of the Navy Cooperative Engagement Capability system.
- Following IOT&E, the Program Office released new software builds for both its transponder and interrogator systems to address those discrepancies highlighted during the operational test and subsequent reporting. Additional testing is required to assess the performance of these software fixes as well as the Mode 5 interoperating with both existing and planned IFF

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systems. The next opportunity to conduct that testing is now planned for the 3QFY13. Successful planning and execution of this event should resolve DOT&E concerns about joint interoperability and identification in a system-of-systems context.

Recommendations

- Status of Previous Recommendations. The Navy has adequately addressed all previous recommendations.
- FY12 Recommendations.
 1. In order to ensure interoperability between interrogators, transponders, and combined interrogator-transponders, the Service program managers must continue to integrate their test schedules. Additionally, all Services must fully participate in the JOTA evaluation process to ensure that Mode 5 capabilities are tested in a realistic joint Service environment.
 2. The Navy needs to address problems with the Mode 5 shipboard integration on the Aegis weapons system and the information flow between Mode 5 and the Cooperative Engagement Capability command and control infrastructure to ensure that the Mode 5 system capabilities are fully effective.

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