

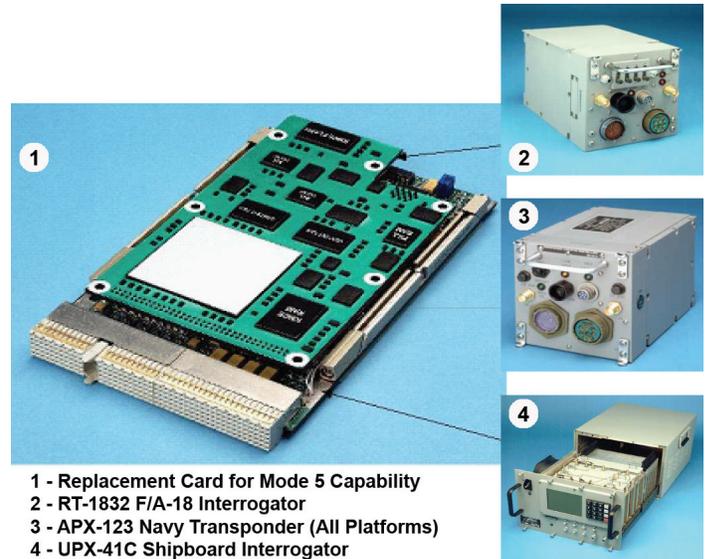
Mark XIIA Mode 5 Identification Friend or Foe (IFF)

Executive Summary

- Independent Mark XIIA Mode 5 Identification Friend or Foe (IFF) (referred to as “Mode 5”) development efforts exist in each U.S. Military Service as well as some NATO countries. Since Mode 5 is not a joint program, the Services are separately developing IFF equipment for use on various land, sea, and air platforms.
 - Of these separate Service efforts, only the Navy has an established Acquisition Category II program.
 - The Army and Marine Corps are procuring Mode 5 transponders developed in the Navy program.
 - Separately, the Army developed and is fielding its own Mode 5 Air Defense Interrogator.
 - The Air Force is developing its own Mode 5 transponders and interrogators.
- The Services are designing and building Mode 5 systems to comply with NATO and DOD IFF standards. DOT&E, in coordination with the Joint Staff and USD(AT&L), initiated oversight in 2006 because of the concern that the multiple programs and vendors required oversight to reduce risks in achieving joint IFF interoperability.
- DOT&E published the Mark XXIIA Mode 5 Joint Operational Test Approach (JOTA) 2 Interoperability Assessment in July 2014 based on the June 2013 major joint operational test off the U.S. East Coast that focused on Mode 5 interoperability and identification in a system-of-systems (SoS) context. This two week event included extensive participation by joint Service and allied systems equipped with a wide variety of Mode 5 equipment produced by different U.S. and European manufacturers.
 - Test results showed that the following Mode 5 transponders and interrogators were interoperable in a joint SoS environment:
 - Army: Sentinel; Air Traffic Navigational, Integration, and Coordination System; A/MH-6; C-12R; CH-47F; UH-60M
 - Air Force: F-15C/D/E, F-16 Block 40/50
 - Marine Corps: US-1Y
 - Navy: E-2C, MH-60R, P-3C
 - DOT&E observed some deficiencies during interrogation with the Patriot and Aegis systems, which were documented in the classified assessment.
 - Patriot and Aegis will be required to participate in additional joint interoperability tests.
 - Similar future events will evaluate Mode 5 interoperability and identification as other IFF systems in development are integrated into various Service platforms.

System

- The Mark XIIA Mode 5 IFF is a cooperative identification system that uses interrogators and transponders on host



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

- 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 Mode 4 and allows National Security Agency-certified secure encryption of interrogations and replies. Primary Mode 5 system features include:
 - A Lethal Interrogation format, which is used by a weapons-capable platform 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 the possibility of 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 a new waveform.
- Mode 5 serves as a component of the combat identification process used on ground-based systems such as the Army’s Patriot and Sentinel missile systems, sea-based systems such as Aegis-equipped warships, and military aircraft to include the E-3 Sentry Airborne Warning and Control System (AWACS) and E-2 Hawkeye command and control platforms.
- Independent Mode 5 development efforts exist in each U.S. Military Service as well as some NATO countries. Although not a joint program, the Services are developing

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equipment capable of employment on multiple Service platforms.

- Of the four separate Service efforts, only the Navy had an established Acquisition Category II Program of Record, with incorporation of Mode 5 capability through platform-specific Engineering Change Proposals.
- The Army and Marine Corps are leveraging the Navy program, and the Air Force is executing individual Engineering Change Proposals to introduce Mode 5 capabilities into its various platforms.

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 Contractors

- Navy Transponder and Interrogator: BAE Systems – Arlington, Virginia
- Air Force Transponder and Interrogator and Army Air Defense Interrogator: Raytheon Systems – Waltham, Massachusetts
- Air Force E-3 Interrogator: Telephonics Corporation – Farmingdale, New York

Activity

- The Navy conducted a JOTA event in 3QFY13 off the U.S. East Coast during the Joint Staff J-6-led Bold Quest Coalition Capability Demonstration and Assessment event, which involved a mixture of blue and red forces consisting of a variety of joint Service and allied aircraft equipped with interrogators and transponders produced by different U.S. and allied manufacturers.
 - Air warfare scenarios were conducted under Navy Aegis warship, AWACS, or ground controlled intercept control.
 - During the JOTA event, U.S. and allied aircraft flew 272 of 294 planned aircraft sorties. Representative operational flight profiles and tactics were used during the event.
- Future JOTA events are intended to support the planned FY20 Full Operational Capability declaration.
- The next JOTA event is expected in the FY17/18 timeframe and is driven by systems ready to test as well as test venue availability.
- DOT&E published the Mark XIIIA Mode 5 JOTA 2 Interoperability Assessment in July 2014.

Assessment

- The Navy Aegis Weapon System was initially unable to come online at the start of its scheduled participation in the joint interoperability exercise due to the fact that the published procedures for the initialization of the Mode 5 interrogator as installed in the Aegis system were incorrect. Subsequent to the JOTA 2 Interoperability Assessment, the Navy developed and disseminated a procedural change to the Aegis operator manuals to correct this issue.
- The 3QFY13 JOTA test event addressed DOD concerns about joint interoperability and identification in an SoS context for those systems under test.
 - Results revealed no new Mode 5-associated deficiencies and the following Mode 5 transponders

and interrogators were interoperable in a joint SoS environment:

- Army – Sentinel; Air Traffic Navigational, Integration, and Coordination System; A/MH-6; C-12R; CH-47F; UH-60M
- Air Force – F-15C/D/E, F-16 Block 40/50
- Marine Corps – US-1Y
- Navy – E-2C, MH-60R, P-3C
- Both Patriot and Aegis need to improve their ability to fully employ the new Lethal Interrogation capability inherent in the Mode 5 system.
- Identification information from some Mode 5-equipped command and control systems could not be directly passed via Link 16 datalinks due to inconsistent implementation of the latest version of the Military Standard for dissemination of Mode 5 messages over Link 16.
 - Prior to the JOTA 2 interoperability exercise, some systems had implemented Military Standard-6016E with others scheduled to receive it later. For those systems that did not feature 6016E at the time of the JOTA 2 exercise, a complex and time-consuming methodology was developed and utilized post-exercise to allow Mode 5 track data to be reconstructed and used in the interoperability and effectiveness assessment.
- The Services are implementing new software builds to enable Link 16-equipped systems to disseminate Mode 5 identification information. Specifically, Lethal Interrogation capability with Patriot and Aegis is planned to be improved.
 - The installed performance of new software builds, as well as Mode 5 interoperability with both existing and planned IFF systems, is being validated in combined developmental/integration testing. These upgrades will be incorporated into Mode 5-equipped systems over the next several years.

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Recommendations

- Status of Previous Recommendations. The Services have adequately addressed previous recommendations for some platforms; however, response to these FY13 recommendations is ongoing as Mode 5 integration occurs on additional platforms.
- FY14 Recommendations.
 1. In order to ensure interoperability between interrogators, transponders, and combined interrogator-transponders, Service program managers must ensure that developmental and operational testing of Mode 5 capabilities and systems address compatibility with both joint Service and allied IFF systems as well as interoperability with Link 16.
 2. All platforms that did not participate in JOTA 2 and are equipped with Mode 5 capability must participate in a future JOTA equivalent SoS interoperability event.
 3. Patriot and Aegis must return for a subsequent JOTA equivalent SoS event to assess correction of deficiencies during JOTA 2.

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