Every day, missile defence systems safeguard hundreds of millions of people across Europe, identifying and responding to the unprecedented security challenges coming from multiple sides. These advanced, proven, interoperable systems ensure Europe has capabilities that will keep it safe.

Sustaining this level of protection requires smart, strategic investments by the member states of NATO and the European Union. Many of these countries are users of Raytheon’s Patriot Air and Missile Defense system and other defensive systems, which offer the best technology and the best value to taxpayers. This issue of the Missile Defence Update highlights the recent advancements, investments and strategies that allow European countries to rise to the challenge of stopping these threats.
SMART INVESTMENTS IN MISSILE DEFENCE

PROTECTING EUROPE THROUGH COLLABORATION AND INTEROPERABILITY

Europe is facing an increasingly complex web of security threats. The conflict in Syria, the rise of non-state actors across the Middle East and North Africa and Russia’s increasing military power together create an environment in which European countries should be prepared for a variety of attacks from a number of different directions.

These types of threats could come from a distance, in the form of short- and long-range missiles, and require advanced systems to detect and block them to keep Europe safe. Just over the past few months, for example, missile attacks have been intercepted in the Middle East, reinforcing that an attack targeting Europe is possible, and that advanced, protective systems are of utmost importance to our European safety.

Strong protection depends on having the best technology, with trusted capabilities, and the ability to be deployed immediately. Waiting for systems that currently exist only on paper to become operational is a risk Europe cannot afford.

Raytheon’s Patriot Air and Missile Defense System has a proven track record in Europe and its neighbouring countries, meaning it provides user countries the opportunity to implement a ready- to-go missile defence system that is interoperable and layered, and relied upon by a community of partner nations. Constant testing and improvement within this network offer the 13, soon to be 14, Patriot nations substantial cost benefits and unparalleled, layered protection.

As Europe’s security threats are multifaceted and increasingly difficult to predict, it is not enough to simply have the best defence technology – countries and defence alliances also must work together. Both NATO and the EU are vital to European security now and in the future, which means that various missile defence systems will have to be connected in order to collaborate across alliances and borders.

Collaboration like this will lead to faster, more effective and more accurate responses. It also increases efficiency and eases budgetary pressures, for example through the pooling of resources for maintenance and coordination of joint testing exercises. One clear example of this is the new upgrade programme co-funded by all 13 nations that rely on Patriot for their defence. This is made possible by the unique network of users and the fact that Patriot is designed to be continuously upgraded and improved.

Continued investment in the Patriot also has many economic advantages that contribute to the growth of Europe’s defence industry. As part of Poland’s WISLA missile defence procurement, for example, Raytheon has offered a 50 percent work share to the Polish government, creating jobs, supporting suppliers and building skills in the workforce.

The same applies for Germany, where the long-established German subsidiary Raytheon Anschütz recently became Germany’s new centre for integrated missile defence. Raytheon Anschütz manages of a German supplier base that currently generates more than 500 missile defence-related jobs, including more than $39 million worth of missile defence-related business awarded by Raytheon in 2015 to 22 German suppliers. Raytheon has also signed a new Memorandum of Understanding with German defence group Rheinmetall to cooperate globally on defence technology, forging a new strategic industry partnership to drive innovation globally.

By unifying missile defence through close collaboration and strong interoperability between systems, European countries can take proactive steps towards strengthening strategic autonomy and be confident in their ability to protect their residents. Patriot is the only combat-proven, currently operational air and missile defence system capable of deterring and defending against these rapidly evolving threats, and is therefore ideally placed to support EU and NATO in their defence efforts.
**MISSILE DEFENCE UPDATE**

**PATRIOT SAVES LIVES BY DOWNING MORE THAN 100 BALLISTIC MISSILES IN COMBAT**

Since January 1st, 2015, Raytheon’s Patriot integrated air and missile defense system has shot down more than 100 tactical ballistic missiles in combat operations around the world. More than 90 of those intercepts involved the low-cost Raytheon-made Guidance Enhanced Missile family of interceptors.

Patriot employs multiple interceptor missiles to destroy ballistic and cruise missiles, aircraft and drones. Guidance Enhanced Missiles work by flying at extremely fast speeds to close with the threat and detonating a blast-fragmentation warhead at precisely the right moment.

“No single interceptor is a silver bullet,” said Tom Laliberty, Raytheon vice president of Integrated Air and Missile Defense. “Using a mix of defensive missiles increases cost-effectiveness and gives commanders operational flexibility to choose the right interceptor at the right time.”

Patriot missile defence systems are a cornerstone of national defence capabilities around the world, not just in Europe. In an environment of conflict and uncertainty, Patriot systems and other Raytheon technology have proven vitally important at neutralising threats and protecting people, with multiple activations over the past two years.
HOW DOES LAYERED MISSILE DEFENCE WORK?

INTELLIGENCE REPORTS FROM NATO ALLIES AND EU MEMBER STATES HAVE SHOWN THAT THE THREATS PRESENTED BY BALLISTIC MISSILES HAVE INCREASED IN COMPLEXITY AND INTENSITY IN RECENT YEARS

With more frequent and more diverse security challenges, Europe needs state-of-the-art layered missile defence systems to ensure a consistently high level of security.

Defending Europe requires a robust system of integrated land, sea and space ballistic missile defence assets.

Raytheon’s proven interoperable ballistic missile defence systems provide effective and overlapping capabilities that are as diverse as the threats they neutralise, from advanced sensors and 360-degree radar systems to interceptors that respond immediately.

Layered defence capabilities provide protection against threats travelling at a variety of altitudes, both in and out of the atmosphere, and over distances long and short.

In May 2016, the Aegis Ashore land-based missile defence system was opened in Romania, with ground broken on a second installation in Poland shortly after. Both sites will deploy Raytheon’s SM-3 interceptor, ideal for defending against short- to intermediate-range ballistic missiles.

NATO partners across the continent are building additional layers and adding capabilities. Joining the Patriot user community is one way to accelerate efforts to modernise integrated air and missile defences to defeat ‘lower-tier’ threats closer to cities, military bases, and critical infrastructure. Benefits of joining the growing Patriot user community include significant cost savings through shared maintenance, joint testing and equipment swaps.
Patriot System Successfully Integrates 360-Degree Capability

The world’s newest, lower-tier air and missile defence radar recently completed a critical milestone, moving it one step closer to testing in an operational environment.

Raytheon’s engineers successfully integrated a new digital radar exciter and waveform generator for the company’s new Gallium Nitride-powered (GaN) Active Electronically Scanned Array (ASEA) upgrade to the Patriot Air and Missile Defense radar successfully tracked and analysed fighter jets as they maneuvered, engaging tactical targets in real time. Beyond the GaN-based AESA radar, Raytheon has also installed and successfully integrated the new digital exciter and waveform generator in the currently fielded Patriot radar.

When implemented, this technology will enable Patriot’s radar to function with a full 360-degree capability, “Our GaN technology means Raytheon’s new AESA radar scans in 360 degrees, with better reliability and capability, yet at 50 percent of the operating cost,” said Tom Laliberty, vice president of Integrated Air and Missile Defense at Raytheon’s Integrated Defense Systems business.

These latest tests further prove that the upgrade is ready for engineering, manufacturing and development, and represent a game-changing step in protecting Europe from incoming threats. In addition, Raytheon’s proposed new digital exciter and waveform generator replace more than 15 individual components in the current Patriot radar, which significantly reduces lifecycle costs and increases Patriot’s already-high reliability. It also uses a slotted-card design, which will enable soldiers in the field to replace circuit cards in a matter of minutes.

“The threats militaries will face in 10 or 20 years will be very different than the ones they are facing today,” said Mr Laliberty. “The new technology will enable engineers to rapidly upgrade and adapt the GaN-based AESA radar as well as the current Patriot radar to defeat new and emerging threats such as ballistic and cruise missiles, aircraft and drones.”

Raytheon’s proposed GaN-based AESA Patriot radar will work with the Integrated Air and Missile Defense Battle Command System and other open architecture. It will retain backwards compatibility with the current Patriot Engagement Control Station and will provide European countries with a ready-to-go, fully interoperable missile defence system.

A number of current and expected future Patriot Air and Missile Defense System partner nations in Europe and Asia have already expressed interest in acquiring GaN-based AESA.
From cutting-edge radar systems and interface technology to the engineering and build of missile interceptors, Raytheon continues to improve and modernise their defence capabilities to respond to evolving ballistic missile threats. Following successful intercept tests in February 2017, the Standard Missile 3 interceptor joins Raytheon's SM-6 as the latest proven systems to receive groundbreaking upgrades.

The SM-3 Block IIA program continues to reflect Raytheon’s commitment to maturing national and regional ballistic missile defense capabilities. “Recent test successes keep the program on track for deployment at sea and ashore in the 2018 timeframe, building on Raytheon’s unequalled fifteen-year history of exo-atmospheric intercepts,” said Dr. Taylor W. Lawrence, Raytheon Missile Systems president.

The interceptor’s kinetic warhead has been enhanced to best address advanced and emerging threats, with improvements to the search, discrimination, acquisition and tracking functions. The kinetic warhead, along with larger rocket motors, allows SM-3 Block IIA to engage more sophisticated threats and protect larger regions from short- to intermediate-range ballistic missile threats, providing greater operational flexibility.

Future flight tests will continue to evaluate system performance, en-route to a 2018 deployment in support of the European Phased Adaptive Approach Phase 3. The SM-3 IB variant most recently destroyed a ballistic missile target as part of a large multinational exercise off the coast of Scotland, illustrating the essential role that SM-3 plays in defense for our allies across Europe.

Complementing the improved SM-3, the SM-6 provides extended-range protection against fixed- and rotary-wing aircraft, unmanned aerial vehicles, cruise missiles and ballistic missiles in the terminal phase of flight. “International navies are seeking the level of sophisticated protection that SM-6 provides,” said Mike Campisi, Standard Missile-6 senior program director. “The flexibility of this multi-mission effector drives significant savings for our partners and allies; it’s the exact opposite of a boutique missile.”

SM-6 continues to go further and faster. It recently shattered the record for the longest range surface-to-air intercept – a milestone it set, and broke, twice before.

Raytheon’s Stinger air defence missile provides premier short-range defence via man portable air defense systems, helicopter, and ground vehicle launch version, in service with the U.S. and 19 other member nations. Raytheon recently successfully tested proximity fuse equipped Stingers capable of intercepting small unmanned aerial systems, demonstrating that Stinger protects deployed ground forces against the latest threats.
There’s nothing like a concept car, a glittering show vehicle that displays the technology dreams of automakers. Glittering, and futuristic, they look great under spotlights on a rotating platform. But you don’t want to drive one down the highway until it’s been through rigorous testing.

The same goes for the sophisticated Patriot Integrated Air and Missile Defense System. Lives depend on it, and Raytheon is constantly upgrading and testing the system to make sure it uses the very latest technology.

“We’ve conducted more than 3,000 ground tests and 1,400 live fires for Patriot to date and I’m happy to say there will be countless more,” said Bill Tierney, director of testing for Patriot at Raytheon Integrated Defense Systems. “Each and every time we test or live-fire a Patriot, we uncover new ways we might improve or perfect Patriot in order to stay ahead of the constantly evolving threats.”

That was the approach Raytheon took with Patriot Post-Deployment Build (PDB) 8. Each post-deployment build is an upgrade to the currently fielded version of Patriot. PDB-7 is successfully engaging threats and saving civilian lives in an ongoing conflict in the Near East, but there’s always room for improvement.

“Staged demonstrations are well and good, but unless you’ve got soldiers rigorously testing, evaluating and using your system in an operationally realistic environment, you’ll never know how it might perform when lives are on the line,” said Joe DeAntona, vice president and business development executive at Raytheon Integrated Defense Systems, and retired Army air defender.

Testing for Patriot won’t end when the PDB-8 tests conclude. “Working closely with the governments of Patriot partner nations, Raytheon will keep testing Patriot, stressing it, and doing everything we can to find and address improvement opportunities with the system,” said Tom Laliberty, Raytheon’s vice president of Integrated Air and Missile Defense.

High-consequence environments like expressways and battlefields have a way of driving home the importance of the proverbial test track.

This is not a point that is lost on Mr DeAntona, who commanded a Patriot battalion during Operation Iraqi Freedom.

“I wouldn’t be here today if Patriot didn’t work as advertised, and there’s a whole lot of peace-time testing and refinement to thank for that,” said DeAntona. “I’m a living testament to the value of these tests.”
PATRIOT DEFENDS EUROPE

On November 7, the Swedish Government authorised the Swedish Defence Materiel Administration (FMV) to send a Letter of Request to the United States government in order to enter into negotiations for the procurement of Patriot. The announcement brings the country closer to joining the growing group of European nations that rely on the combat-proven Patriot system to defend against ballistic and cruise missiles, advanced aircraft and drones.

As stated in the press release issued by the Swedish government, “The Armed Forces have advocated Patriot as a new air defence system, as it is a proven system with good delivery reliability and anti-ballistic missile capability.” The aim of the negotiations is for delivery to begin in 2020 and for the system to be operational within the next defence framework period, i.e. by 2025 at the latest.

PATRIOT MAKES ITS WAY IN EUROPE

SWEDEN

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PATRIOT MILESTONES IN ROMANIA

April 2017: Announced submission of Patriot LoR
October 2017: Raytheon and Romanian company Aerostar SA sign Memorandum of Understanding
November 2017: Procurement bill for Patriot approved by the Parliament
Thanks to strong strategic partnerships and over five decades of collaboration with the German defence industry, Raytheon is ready to help Germany face the defence challenges of the future. At the heart of this are companies like Raytheon Anschütz and Rheinmetall Defence, both part of the network that helps make Raytheon a driver of local growth and innovation. Raytheon Anschütz, a wholly owned German subsidiary of Raytheon Company, has taken key steps to lead the modernisation of Germany’s air defences. “Raytheon Anschütz has identified a number of German companies as potential Patriot suppliers, and as we modernise the German Patriot assets, they will receive requests for proposals with a total anticipated value exceeding €100 million over the next three years,” said Lueder Hogrefe, CEO of Raytheon Anschütz. “We established a German-based Raytheon Integrated Air and Missile Defence center because the German government asked Raytheon to serve as the TLVS alternative provider. We will meet the German MoD’s essential TLVS requirements on time, within budget and at substantially lower risk than anyone else.” TLVS is Germany’s medium-range air and missile defence modernisation programme.

“Raytheon recognizes that German sovereign capability is as important for TLVS as is technological maturity, cost and proven performance,” said Tom Laliberty, Raytheon vice president of Integrated Air and Missile Defense. “With Raytheon Anschütz working closely with German industry, we can ensure that Patriot meets all of the needs of the German government.”

Following the signing of a Memorandum of Understanding between Raytheon and Rheinmetall in February 2017, the two companies are set to cooperate closely across a range of areas to help keep Europe safe, including not just air defence but cyber defence, simulation, ammunition and training. This new partnership will help deliver comprehensive and powerful solutions that benefit from Raytheon’s combat proven capabilities and global leadership in defence and innovation.

On July 6, 2017 Poland’s government signed a Memorandum of Intent with the United States government which confirmed Poland’s intent to procure Raytheon’s combat-proven Patriot. This confirmation came shortly after Poland submitted a letter of request to the United States government for Patriot.

Raytheon is currently partnering with Poland’s government and industry to finalise offset and industrial participation plans, and has already signed eight contracts and more than 50 letters of intent with Polish industry for a variety of projects.

The letter of intent signed last year between Polska Grupa Zbrojeniowa (PGZ) and Raytheon forms a major pillar of this partnership strategy, which allocates 50 percent of the workshare on the Wisła programme to Polish industry and opens new possibilities in the field of radar and missile technology development.

Such partnerships help reinforce Raytheon’s deep roots in the European defence industry, and open new global opportunities to local partners.

With today’s announcement, Poland continues to be a leader in defence and security cooperation in the region and in the NATO Alliance. We look forward to working with Poland to finalise the details of this agreement, which will deliver the world’s best air and missile defence capability to protect the Polish people. This is an important step forward for Poland’s security, the security of NATO, interoperability with U.S. forces, and the U.S.-Poland defence relationship.

Paul Jones
U.S. Ambassador to Poland
THE NETHERLANDS ENHANCES PATRIOT INVESTMENT

The Royal Netherlands Defence Materiel Organisation awarded Raytheon a contract to upgrade its Patriot Integrated Air and Missile Defense system with the Modern Man Station user interface, a move to significantly boost the nation’s missile defence capability.

“The Netherlands will continuously modernize Patriot as they intend to keep it in their inventory until at least 2040”, said Tom Laliberty, Raytheon vice president of Integrated Air and Missile Defense. “The Modern Man Station is an important step in the Royal Netherlands Army’s plan to upgrade their entire Patriot inventory to the most advanced capability currently available.”

“Patriot remains a pillar of NATO missile defense because it is the only fielded, combat-proven air and missile defense system capable of outpacing the evolving threat,” said Joe DeAntona, Raytheon vice president of business development for Integrated Air and Missile Defense.

“This upgrade will make it easier for The Netherlands to operate Patriot, and will provide them enhanced situational awareness.”

The Modern Man Station, or MMS, is the latest operator-machine interface upgrade to Patriot command and control shelters. It provides state-of-the-art, full-colour graphical user interface with LCD displays. It also has touch screens and soft keys for enhanced situational awareness, with best-in-class command and control decision support tools. MMS is used to identify and display airborne objects, track potential threats, and engage hostile targets, including aircraft, unmanned air vehicles, cruise missiles and tactical ballistic missiles.

LITHUANIA PURCHASES THE NASAMS SYSTEM

Following a technical agreement with the Norwegian Ministry of Defence in October 2016, on 26 October 2017 Lithuania’s Ministry of Defence signed a contract with Kongsberg Defence & Aerospace to complete the acquisition of two NASAMS batteries.

The NASAMS system, manufactured by Raytheon and its Norwegian partner Kongsberg, is the most widely-used short- and medium-range air defence system in NATO. Together, Raytheon and Kongsberg have delivered more than 70 fire units of the highly adaptable launcher.

As a part of the acquisition, Lithuania will obtain new additional equipment, training and an integrated logistics support package, as well as refurbishment and integration of government supplied components for a complete NASAMS system.
In May 2016, a new land-based missile defence system was launched in Romania. Dubbed Aegis Ashore, the site is operated under NATO control, providing regional ballistic missile defence protection. Construction has begun on a second installation in Poland that is scheduled to become operational in 2018. Both sites field the Raytheon-made SM-3® interceptor, the only weapon that can defend against short- to intermediate-range ballistic missiles from both sea and shore.

"Countering the threat of ballistic missile attacks... is a collective security challenge that requires collective defence," U.S. Deputy Secretary of Defence Robert Work said in a news release regarding the partnerships with Poland and Romania.

The two land-based SM-3 missile sites join four U.S. Naval destroyers deployed out of Rota, Spain, as the backbone of the U.S. contribution to Europe’s regional missile defence.

"The U.S. and Europe are demonstrating their ability to integrate and collaborate on solutions," said Dr. Mitch Stevison, vice president of Raytheon Air and Missile Defence Systems, during a missile defence briefing at the Royal United Services Institute in London. "But the threat is escalating, and Europe needs continued investment to deepen its defence."

NATO partners across the continent are building other layers of the region’s missile defence, accelerating efforts to modernise their integrated air and missile defence systems to defeat "lower-tier" threats closer to cities, military bases and critical infrastructure.

These threats are best countered by the combat-proven Patriot Air and Missile Defence System, which has been tested more than 2,500 times in real-world conditions.

"Our partners must strike the right balance between making their own investments and working together through NATO and the EU on shared capabilities that enhance regional stability," said Tim Glaeser, vice president of business development for Raytheon’s Integrated Air and Missile Defence Systems business, while attending GLOBSEC, a leading European security conference in April 2016. “Funds are limited, which is why interoperability is critical.”

During a POLITICO Playbook Live forum in Brussels in June 2016, NATO Secretary General Jens Stoltenberg reinforced the importance of interoperability to Europe’s collective defence. “We’re facing some new security threats and challenges,” said Stoltenberg. “None of us has all the tools in the toolkit; we have to work together to meet these challenges.”
The U.S. government has authorised Raytheon to integrate SkyCeptor, a variant of the jointly developed Israel/U.S. Stunner interceptor into the Polish Patriot Integrated Air and Missile Defense system.

**THE SKYCEPTOR INTERCEPTOR IS A NEW, HIGHLY ADVANCED, HIT-TO-KILL MISSILE, DEVELOPED TO DEFEAT SHORT-TO-MEDIUM-RANGE BALLISTIC MISSILES, CRUISE MISSILES AND ADVANCED AIR DEFENCE THREATS.**

"Raytheon anticipates SkyCeptor will cost significantly less than current hit-to-kill interceptors used by Patriot," said Tom Laliberty, Raytheon vice president of Integrated Air and Missile Defense.

"SkyCeptor gives the Polish military a fourth Patriot interceptor to engage airborne threats, offering Polish commanders increased operational flexibility and a cost-effective way to engage a wide variety of threats." SkyCeptor will address Poland’s air and missile defence threat requirements, and offers significant work content for Polish industries.

The combat-proven Patriot currently uses PAC-3, PAC-3 MSE and GEM-T missiles. The PAC-3 and PAC-3 MSE are hit-to-kill kinetic interceptors which destroy threats by the force of the collision, while the combat-proven GEM-T interceptor uses a blast fragmentation warhead to destroy tactical and ballistic missiles or manned and unmanned aircraft.

"The SkyCeptor low-cost interceptor brings an affordable missile to Poland’s Patriot," said Mitch Stevison, Raytheon vice president for Air and Missile Defense Systems. "Using this rigorously tested effector with the Polish Patriot will help to meet current and future threat requirements." The current Stunner low-cost interceptor is co-developed by Raytheon and Rafael Advanced Defense Systems, and is co-funded by the U.S. and Israeli governments. Raytheon and Rafael have already started preliminary integration work and are in the process of conducting testing, modelling and simulation. They are also developing plans and identifying potential co-development and co-production partners.
RAYTHEON IN EUROPE
Committed to Europe’s Protection for More Than a Century

EUROPEAN PRESENCE

BY THE NUMBERS

- 100+ YEARS IN EUROPE
- 2,500+ EMPLOYEES
- 24 RAYTHEON LOCATIONS
- 66% OF RAYTHEON’S INTERNATIONAL SUPPLY BASE IS IN EUROPE
- 4 MANUFACTURING CENTRES
- 15+ PARTNERSHIPS
- 500+ SUPPLIERS

PARTNERING FOR PROTECTION

- RAYTHEON OFFERING 50% WORKSHARE
- INDUSTRY PART OF PATRIOT GLOBAL BASE

1,000 JOBS

RAYTHEON MISSILE DEFENCE IN EUROPE

- AN/TPY-2
- EARLY WARNING RADARS
- LAND-BASED SM-3
- NASAMS
- PATRIOT

RAYTHEON SOLUTIONS PROVIDE LAYERED DEFENCE CAPABILITIES ACROSS EUROPE

RAYTHEON’S EUROPEAN PARTNERSHIPS AND VENTURES HAVE GROWN LOCAL CAPABILITIES AND INNOVATION
THE MOST MODERN, AND COMBAT-PROVEN BALLISTIC MISSILE DEFENCE SYSTEM IN THE WORLD

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- **FIELDED FIRE UNITS**

- **MEADS DEVELOPMENT PROJECT**

- **20TH CENTURY**
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  - **1**

- **21ST CENTURY**
  - **0**
  - **3+**
  - **2022**
  - **5**

**SOURCE:** GRIEPHAN REPORT

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Standard Missile-3, shown here in this illustration, is the world’s only ballistic missile killer deployable on land or at sea.