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BALLISTIC AND CRUISE MISSILE THREAT

national air and space intelligence center
wright-patterson air force base

Cover: top left: Iranian 2-Stage Solid-Propellant MRBM Launch
Cover: background: Iranian 2-Stage Solid-Propellant MRBM
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Background: North Korean Taepo Dong 2 ICBM/SLV

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Top right: Pakistani Ghauri Launch
Background: SS-25 Road-mobile Launcher in Red Square

KEY FINDINGS

Many countries view ballistic and cruise missile systems as cost-effective weapons and symbols of national power. In addition, they present an asymmetric threat to US airpower.

Many ballistic and cruise missiles are armed with weapons of mass destruction.

North Korea is continuing to develop the TD-2 that could reach the United States with a nuclear payload if developed as an ICBM. An intermediate-range ballistic missile (IRBM) and a new short-range, solid-propellant ballistic missile are also being developed.

Iran has modified its Shahab 3 medium-range ballistic missile (MRBM) to extend its range and effectiveness and is developing technologies and capabilities applicable to longer-range missiles. In 2008, it conducted a test launch of a two-stage solid-propellant MRBM. In late 2008 and early 2009, Iran launched multi-stage space launch vehicles (SLV) that can serve as a testbed for long-range ballistic missile technologies. With sufficient foreign assistance, Iran could develop and test an ICBM capable of reaching the United States by 2015.

China has the most active and diverse ballistic missile development program in the world. It is developing and testing offensive missiles, forming additional missile units, qualitatively upgrading certain missile systems, and developing methods to counter ballistic missile defenses. China's ballistic missile force is expanding in both size and types of missiles. New theater missiles continue to be deployed in the vicinity of Taiwan, while the ICBM force is adding the CSS-10 Mod 1 (DF-31) and CSS-10 Mod 2 (DF-31A) ICBMs. The new JL-2 submarine-launched ballistic missile (SLBM) is also under development. Future ICBMs probably will include some with multiple independently-targetable reentry vehicles, and the number of ICBM nuclear warheads capable of reaching the United States could expand to well over 100 within the next 15 years.

India and Pakistan continue to develop new short- and long-range ballistic missiles. Pakistan has tested its solid-propellant Shaheen 2 MRBM six times since 2004 and India has tested its new solid-propellant Agni III IRBM three times since 2006. India has stated that the solid-propellant Agni II MRBM is ready for deployment.

Russia still has over two thousand nuclear warheads deployed on ballistic missiles capable of reaching the United States. Although the size of the Russian strategic missile force is shrinking due to arms control limitations and resource constraints, development of new ICBM and SLBM systems is proceeding, and Russia is expected to retain the largest force of strategic ballistic missiles outside the United States.

Land-attack cruise missiles (LACMs) are highly effective weapon systems that can present a major threat to military operations.

At least nine foreign countries will be involved in LACM production during the next decade, and many missiles will be available for export.

Missile Launches in Iranian Noble Prophet III Exercise

Top left: German V-2 Ballistic Missile
Background: V-1 Cruise Missile

THREAT HISTORY

Ballistic and cruise missiles present a significant threat to US and Allied forces overseas, as well as to the United States and its territories. Missiles are attractive to many nations because they can be used effectively against an adversary with a formidable air defense system, where an attack with manned aircraft would be impractical or too costly. In addition, missiles can be used as a deterrent or an instrument of coercion. Missiles also have the advantage of fewer maintenance, training, and logistic requirements than manned aircraft. Even limited use of these weapons could be devastating, because missiles can be armed with chemical, biological, or nuclear warheads.

The ballistic and cruise missile threat continues to increase with the proliferation of missile technology. Over 20 countries have ballistic missile systems, and missiles likely will be a threat in future conflicts involving US forces. Ballistic missiles have been used in several conflicts over the last 25 years, including the Iran-Iraq war, the Afghan civil war, the war in Yemen, the 1991 and 2003 Persian Gulf conflicts, and the Russian military action in Chechnya and Georgia. Although LACMs have not yet been widely proliferated, as many as 20 countries could possess cruise missiles in the next decade.

The US Air Force, in cooperation with the other services, is responsible for countering the ballistic and cruise missile threat through deterrence and, if necessary, active suppression. Threat suppression may include attacks on missile systems, both before launch and in flight, as well as attacks on their supporting infrastructure. This document includes information on some of the major current and projected foreign ballistic and cruise missile systems.

V-2 Ballistic Missile

Guided cruise and ballistic missiles were first used when Germany attacked targets in England and Northern Europe with V-1 cruise missiles and V-2 ballistic missiles during World War II. Although these missiles were inaccurate, their use resulted in tens of thousands of Allied casualties.

V-2 Ballistic Missiles

Top right: SS-18 Mod 4 ICBM
Full page: Iranian Shahab 3

WARHEADS AND TARGETS

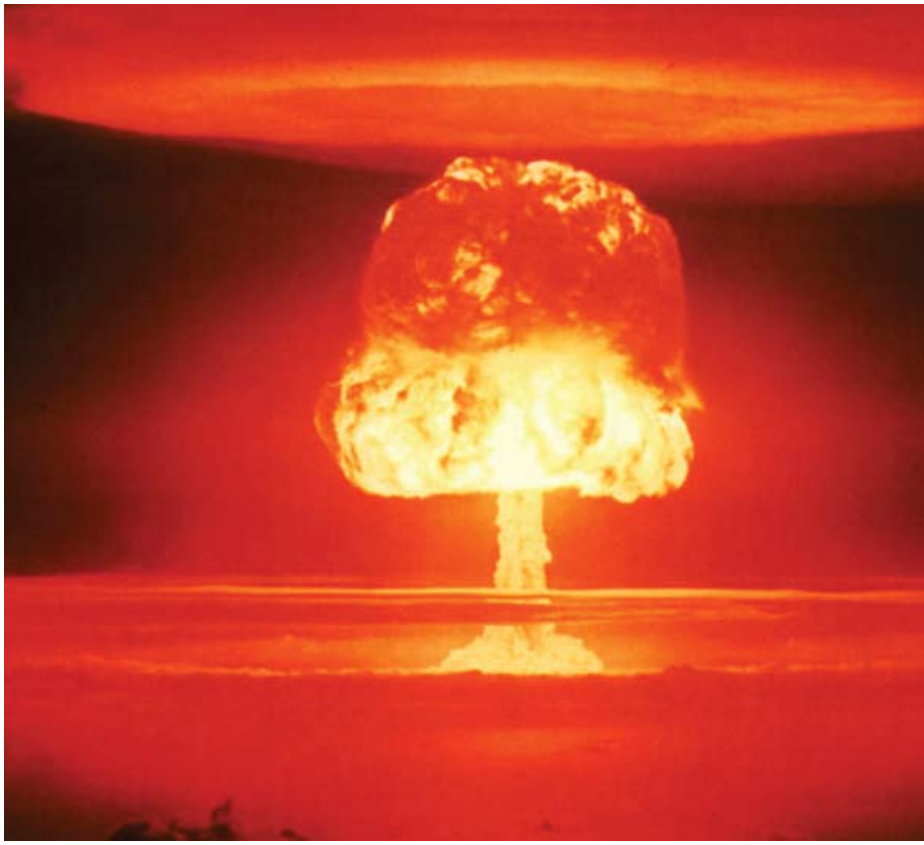
Ballistic and cruise missiles can be armed with conventional or nonconventional warheads. Conventional warheads are filled with a chemical explosive, such as TNT, and rely on the detonation of the explosive and the resulting metal casing fragmentation as kill mechanisms. Nonconventional warheads include weapons of mass destruction (nuclear, biological, and chemical weapons), as well as nonlethal warheads, a relatively new class of warhead designed to disable equipment rather than harm personnel. Conventional, biological, and chemical weapons can be packaged in unitary (single) warheads and in submunitions (multiple small bomblets that are released at altitude to disperse over a wide area).

Conventional warheads can be optimized for specific types of targets. For example, submunitions can be used to create craters in an airfield runway or destroy armored vehicles. A penetrator warhead, which uses a relatively small amount of explosive surrounded by a heavy metal casing, can pass through a hardened structure, such as a bunker, to destroy its contents.

Many longer range ballistic missiles, and several types of LACMs, carry nuclear warheads. Most of these warheads have an explosive force that is tens to hundreds of times more powerful than the atomic bombs used in World War II.

Chemical and biological weapons are attractive to many Third World countries because they are much easier to produce than nuclear weapons. Many countries with chemical and biological warfare programs also are equipped with ballistic and/or cruise missiles. Accuracy is not very important for these weapons when used against urban areas or large concentrations of military forces. Chemical and biological weapons are capable of producing massive casualties, inducing panic and chaos in civilian populations, and severely degrading military operations.

Chemical and biological weapons can be packaged in submunitions to be dispersed over a wide area



Many ballistic and cruise missiles are armed with nuclear warheads

BALLISTIC MISSILES

Operational ballistic missiles are deployed in silos, on submarines, and on land-mobile launchers. Mobile missiles are favored by many nations because they can be hidden, greatly increasing their survivability.

In many short-range ballistic missiles, the entire missile remains intact until the warhead detonates. In longer range ballistic missiles, warheads are contained in separating reentry vehicles. Some long-range ballistic missiles carry multiple independently-targetable reentry vehicles (MIRVs), with up to 10 reentry vehicles (RVs) per missile. RVs reenter the Earth's atmosphere at very high velocities, on the order of 4-5 miles per second at ICBM ranges.

Ballistic missiles can use solid- or liquid-propellant rocket propulsion systems. The trend in modern missile systems has been toward the use of solid propellants because of their reduced logistical requirements and simplicity of operation. However, some Third World nations have greater access to liquid-propellant technology and, therefore, continue to develop new liquid-propellant missiles.

Top left: Pakistani Ghaznavi SRBM
Background: Chinese CSS-2 IRBM

Russian Bulava SLBM launch from a Typhoon class submarine

Iran's Safir space launch vehicle (SLV) can serve as a testbed for ballistic missile technology.

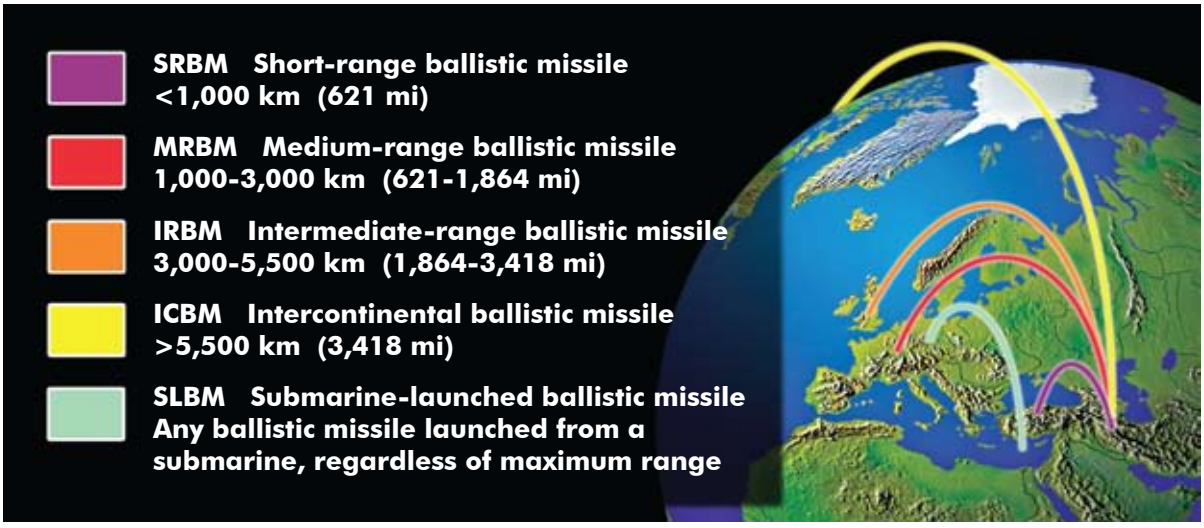
Multiple-stage missiles, with each stage having its own independent propulsion system, are more efficient for longer range missions. ICBMs typically have two or three stages, with powerful liquid-propellant engines or solid-propellant motors to propel the payload toward its target, and a postboost vehicle with a much smaller propulsion system. A postboost vehicle can be used to improve the RV deployment accuracy for a single-RV missile. For a missile with a MIRV payload, the postboost vehicle is used to release RVs so that they follow different trajectories, allowing them to hit separate targets. Some MIRV missiles can hit targets separated by over 1,000 miles with a single missile.

A ballistic missile with a high-quality inertial guidance system is capable of delivering an RV within a few hundred feet of the target after a flight of over 6,000 miles. For many missiles, accuracy can be greatly improved by utilizing satellite-aided navigation. Missiles also can use maneuvering reentry vehicles (MaRVs) with terminal sensors to attain very high accuracy.

As more modern guidance technology is proliferated, countries will be able to improve the accuracy and lethality of their missile forces. However, even a missile with a guidance system only accurate enough to hit a large city is capable of inflicting massive casualties when armed with a weapon of mass destruction.

Many ballistic missiles carry penetration aids to improve the chances of an RV penetrating a ballistic missile defense system. Penetration aids are devices intended to deceive or jam sensors used to detect and track missiles and RVs. Penetration aids are of increasing importance to countries developing and operating ballistic missiles

Chinese Mobile Missile Test Sequence



SHORT-RANGE BALLISTIC MISSILES

Several countries are now producing and/or developing SRBM systems, while many other countries have purchased missiles or missile technologies from one or more of the missile producers. New SRBM systems are in development in several countries. China has deployed a very large force of modern solid-propellant SRBMs in the vicinity of Taiwan.

The Russian SS-1c Mod 1, also called the SCUD B, has been exported to more countries than any other type of guided ballistic missile and has proven to be a versatile and adaptable weapon. For example, the Iraqi SCUD missiles used during the 1991 Persian Gulf War had been modified to double their range. North Korea has produced its own version of the SCUD B, as well as the SCUD C, an extended-range version of the SCUD B.

Top left: Indian Prithvi SRBM
Background: SCUD B on Road-Mobile Launcher

North Korean Solid Propellant SRBM (Toksa)

Although the SCUD was originally designed as a tactical battlefield support weapon, many countries view it and other SRBM systems as strategic weapons to be used against urban areas. Iraq used extended-range SCUD missiles as strategic weapons during both the Iran-Iraq war and the 1991 Persian Gulf War. Other countries could modify SCUD missiles to significantly improve their accuracy and use them against high-value military targets and cities.

Recent conflicts have highlighted missile defense capabilities and provided the incentive for continued missile defense development, in turn, motivating ballistic missile developers to pursue missile defense countermeasures. Some SRBM developers have already begun to develop countermeasures such as maneuvering reentry vehicles and are expected to continue countermeasure development.

Shahab 1 Launch during Noble Prophet II Exercise

The Chinese CSS-8 has been exported to Iran

SRBM comparison chart

Iranian Fateh-110 at Holy Defense Week Parade

Indian Agni I

Chinese CSS-6 SRBM on Road-Mobile Launcher

Chinese CSS-6 Mod 2

Pakistani Ghaznavi Road-Mobile SRBM Launch

characteristics

MISSILE	PROPELLANT	DEPLOYMENT MODE	MAXIMUM RANGE (MILES)
RUSSIA			
SCUD B (SS-1c Mod 1)	Liquid	Road-mobile	185
SS-1c Mod 2	Liquid	Road-mobile	150+
SS-21 Mod 2	Solid	Road-mobile	43
SS-21 Mod 3	Solid	Road-mobile	75
SS-26	Solid	Road-mobile	185+
Iskander-E	Solid	Road-mobile	170+
CHINA			
CSS-6 Mod 1	Solid	Road-mobile	370
CSS-6 Mod 2	Solid	Road-mobile	550+
CSS-6 Mod 3	Solid	Road-mobile	450+
CSS-7 Mod 1	Solid	Road-mobile	185
CSS-7 Mod 2	Solid	Road-mobile	370
CSS-8	1st stage: solid 2nd stage: liquid	Road-mobile	93
B611	Solid	Road-mobile	93
NORTH KOREA			
SCUD B	Liquid	Road-mobile	185
SCUD C	Liquid	Road-mobile	310
Toksa	Solid	Road-mobile	75
ER SCUD	Liquid	Road-mobile	435-625
INDIA			
Prithvi I	Liquid	Road-mobile	93
Prithvi II	Liquid	Road-mobile	155
Dhanush	Liquid	Ship-based	250
Agni I	Solid	Road-mobile	435
PAKISTAN			
Hatf-1	Solid	Road-mobile	50
Shaheen I	Solid	Road-mobile	280+
Ghaznavi	Solid	Road-mobile	250
IRAN			
Fateh-110	Solid	Road-mobile	120+
Shahab I	Liquid	Road-mobile	185
Shahab II	Liquid	Road-mobile	310
CSS-8	Solid/Liquid	Road-mobile	93
SYRIA			
SCUD D	Liquid	Road-mobile	435

Note: All ranges are approximate.

Chinese CSS-6 on Road-Mobile Launcher

Chinese CSS-6 Mod 1 SRBM

Indian Dhanush SRBM Launch

Chinese CSS-7 Mod 1 on Road-Mobile Launcher

SRBM launcher order of battle

COUNTRY MISSILE SYSTEM	NUMBER OF LAUNCHERS*
Belarus	
SS-21s/SCUDs	Fewer than 100
Kazakhstan	
SS-21s/SCUDs	Fewer than 50
Syria	
SS-21s/SCUDS	Fewer than 100
China	
CSS-6/CCS-7	More than 200
Libya	
SCUDs	Fewer than 100
Turkmenistan	
SCUDs	Fewer than 25
Egypt	
SCUDs/SS-1	Fewer than 25
North Korea	
Toksa/SCUDs	Fewer than 100
Ukraine	
SS-21s/SCUDs	Fewer than 200
India	
Prithvi-I/II	Fewer than 50
Agni I	Fewer than 25
Pakistan	
Ghaznavi/Shaheen-1	Fewer than 50
Vietnam	
SCUD-Bs	Fewer than 25
Iran	
CSS-8/Fateh-110/SCUDs	Fewer than 100
Russia	
SCUDs/SS-21/SS-26)	Fewer than 200
Yemen	
SRBMs(SCUD/SS-21s)	Fewer than 25

* The missile inventory may be much larger than the number of launchers, because launchers can be reused to fire additional missiles.

Russian SS-26 Iskander SRBM on Road-Mobile Launcher

Indian Prithvi SRBM

Russian SS-21 Damage in Georgia Conflict

MEDIUM-RANGE & INTERMEDIATE-RANGE BALLISTIC MISSILES

New MRBM and/or IRBM systems are in development in China, North Korea, Iran, India, and Pakistan. These are strategic systems, and most will be armed with nonconventional warheads. All of these countries except Iran have tested nuclear weapons. Neither Russia nor the United States produce or retain any MRBM or IRBM systems, because they are banned by the Intermediate-Range Nuclear Forces (INF) Treaty, which entered into force in 1988. China has been very active in its development of MRBMs.

China's long-term, comprehensive transformation of its military forces is improving its capacity for force projection and Chinese ballistic missiles play a key role in China's effort to deny foreign military forces access to the region in any future conflict involving Taiwan. China currently deploys the nuclear-armed CSS-2, CSS-5 Mod 1, and CSS-5 Mod 2 for regional nuclear deterrence. China is also acquiring new conventionally-armed MRBMs to conduct precision strikes at longer ranges. These systems are likely intended to hold at risk, or strike, logistics nodes and regional military bases including airfields and ports. Notably, China is developing an anti-ship ballistic missile (ASBM) based on a variant of the CSS-5.

Top left: Indian Agni III in Flight
Background: Chinese CSS-2 IRBM

Iranian Shahab 3 MRBM

MRBM IRBM

North Korea has an ambitious ballistic missile development program and has exported missile technology to other countries, including Iran and Pakistan. North Korea has also admitted its possession of nuclear weapons. The North Korean Taepo Dong 1 was used in an attempt to orbit a satellite in August 1998. Although a small third stage failed to place the satellite in orbit, the two-stage booster apparently performed successfully. The Taepo Dong 1 demonstrated technologies necessary for longer-range missile development. North Korea has an IRBM in development; this system could be exported to other countries.

Iran has an extensive missile development program and has received support from entities in Russia, China, and North Korea. The Iranian Shahab 3 MRBM is based on the North Korean No Dong missile. Iran has modified the Shahab 3 to extend its range and effectiveness. Iran claimed it tested an improved version of the Shahab 3 in 2004. Subsequent statements by Iranian officials suggest the range is up to 1,250 miles for improved Shahab 3s and that Iran has the capability to mass-produce Shahab 3 missiles. In 2008, Iran conducted test launches of two 2,000- km-range two-stage solid-propellant MRBMs. In late 2008 and early 2009 it launched the Safir, a multi-stage space launch vehicle, that can serve as a testbed for long-range ballistic missile technologies. The 2009 test successfully placed a satellite in orbit. The Safir probably could achieve IRBM range if used as a ballistic missile.

India continues to develop and improve its ballistic missiles. Indian officials have stated that the solid-propellant Agni II MRBM is ready for deployment. The new solid-propellant Agni III IRBM has been flight-tested three times since 2006. Indian missile developers have also stated that they have the capability to produce an ICBM, with a range of about 3,000-3,700 miles

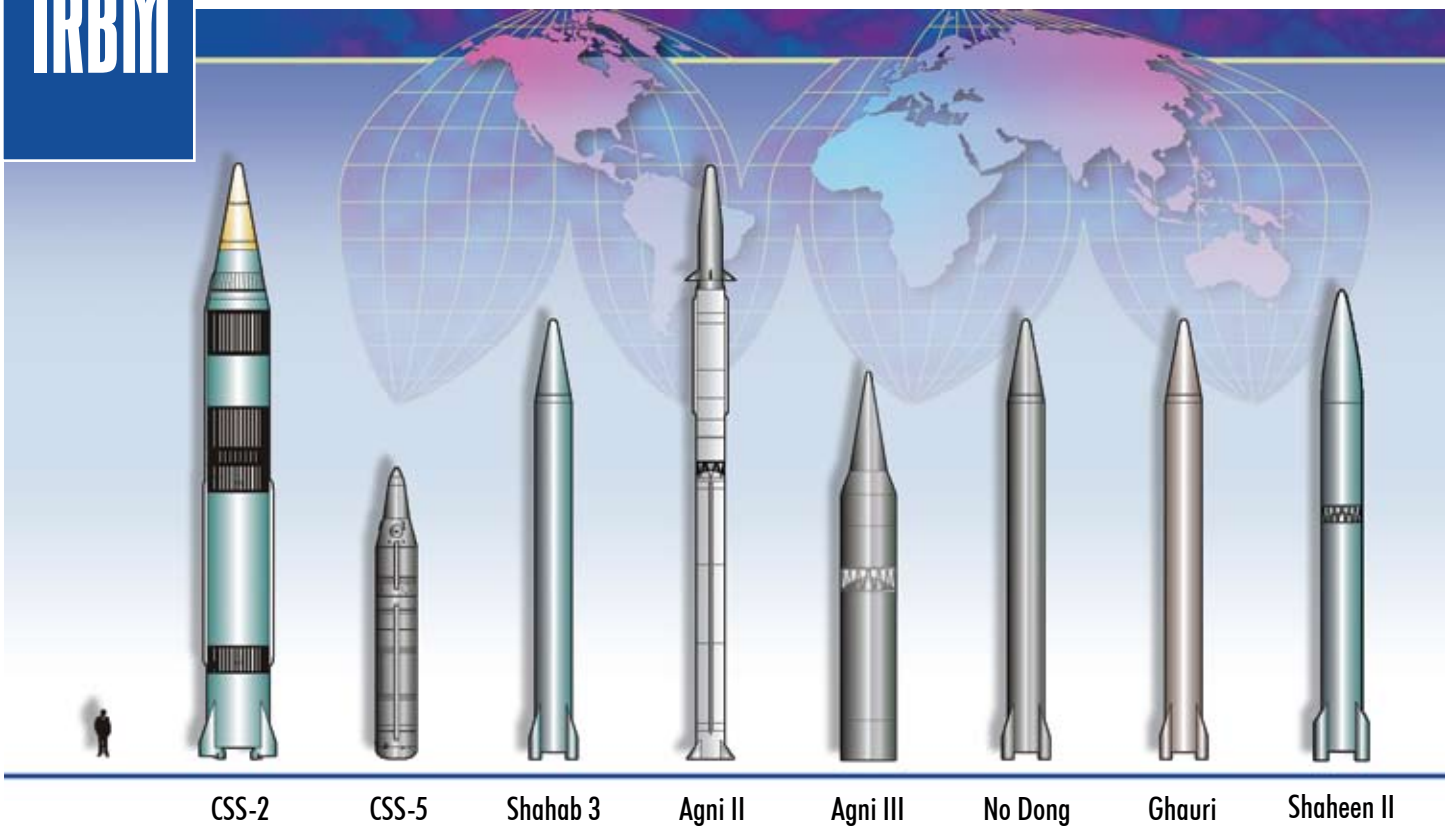
Pakistan continues to improve the readiness and capabilities of its Army Strategic Force Command and individual Strategic Missile Groups through training exercises that include live missile firings. Pakistan has tested its solid-propellant Shaheen 2 MRBM six times since 2004, and this missile system probably will soon be deployed.

Chinese CSS-2 IRBM Erected

Agni II MRBM on display at 2004 Indian Republic Day Parade

MRBM IRBM

comparison chart



Pakistani Shaheen II MRBM

Iranian Shahab 3 MRBM Mobile-Erector-Launcher

Indian Agni III IRBM Launch

Pakistani Ghauri MRBM Launch

Launch of New Iranian Solid-Propellant MRBM

MRBM IRBM

characteristics

MISSILE	NUMBER OF STAGES	PROPELLANT	DEPLOYMENT MODE	MAXIMUM RANGE (MILES)	NUMBER OF LAUNCHERS*
China					
CSS-2	1	Liquid	Transportable (Limited Mobility)	1,900	5 to 10
CSS-5 Mod 1	2	Solid	Road-mobile	1,100+	Fewer than 50
CSS-5 Mod 2	2	Solid	Road-mobile	1,100+	Fewer than 50
CSS-5 Conventional	2	Solid	Mobile	1,100	Fewer than 30
CSS-5 ASBM	2	Solid	Mobile	900+	Not Yet Deployed
Saudi Arabia (Chinese-produced)					
CSS-2**	1	Liquid	Transportable (Limited Mobility)	1,750	Fewer than 50
North Korea					
No Dong	1	Liquid	Road-mobile	800	Fewer than 50
IRBM	1	Liquid	Mobile	2,000+	Fewer than 50
India					
Agni II	2	Solid	Rail-mobile	1,250+	Fewer than 10
Agni III	2	Solid	Rail-mobile	2,000+	Not yet deployed
Pakistan					
Ghauri	1	Liquid	Road-mobile	800	Fewer than 50
Shaheen II	2	Solid	Road-mobile	1,250+	Unknown
Iran					
Shahab 3	1	Liquid	Road-mobile	800	Fewer than 50 (All Variants)
Shahab 3 Variant	1	Liquid	Road-mobile	1,200+	
New MRBM	2	Solid	Road-mobile	1,200+	Not yet deployed
IRBM/ICBM	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined

Note: All ranges are approximate.

* There may be several missiles available for each launcher.

** The exported CSS-2 has a conventional warhead.

INTERCONTINENTAL BALLISTIC MISSILES

Russia retains about 2,000 nuclear warheads on ICBMs and most of these missiles are maintained on alert, capable of being launched within minutes of receiving a launch order. Although the size of the Russian ICBM force will continue to decrease because of arms control agreements, aging missiles, and resource constraints, Russia probably will retain the largest ICBM force outside the United States. Efforts to maintain and modernize the force are underway. The Russian SS-27 Mod 1 ICBM, a missile designed with countermeasures to ballistic missile defense systems, is now deployed in silos in five regiments (48 missiles). Russia began deployment of the road-mobile version of the SS-27 Mod 1 in 2006. A MIRVed version of the SS-27, the SS-27 Mod-X-2 (RS-24), is currently in the flight test phase of development. In addition, Russian officials claim a new class of hypersonic vehicle is being developed to allow Russian strategic missiles to penetrate missile defense systems.

The Strategic Arms Reduction Talks (START I) treaty, which entered into force in December 1994, limits the United States and Russia to no more than 6,000 warheads each (including those on ICBMs, SLBMs, and heavy bombers). The 2002 Moscow Treaty on Strategic Offensive Reductions limits Russia and the United States to no more than 1,700-2,200 deployed warheads each by the end of 2012.

Top left: Russian SS-27 Mod 1 Launch
Background: Russian SS-25 in Red Square 2008 Victory Day Parade

Chinese CSS-10 Road-Mobile ICBM on parade

China's ICBM force is intended as a strategic nuclear deterrent. China has a relatively small force of nuclear-armed, liquid-propellant CSS-3 limited-range ICBMs and CSS-4 ICBMs capable of reaching the United States, but China has been developing and deploying advanced new mobile, solid-propellant ICBMs. Both the road-mobile, solid-fueled, CSS-10 Mod 1 and the longer-range CSS-10 Mod 2 have been deployed to units within the Second Artillery Corps. The deployment of road-mobile ICBMs is enhancing the survivability of the Chinese strategic missile force. The CSS-10 Mod 1 is capable of reaching targets throughout Europe and Asia as well as parts of Canada and the northwestern United States. The longer range CSS-10 Mod 2 will allow targeting of most of the continental United States. China could develop MIRV payloads for some of its ICBMs, and the number of warheads on Chinese ICBMs capable of threatening the United States is expected to grow to well over 100 in the next 15 years.

North Korea is developing the Taepo Dong 2 (TD-2) ICBM/SLV, which could reach the United States if developed as an ICBM. Although both launches of the TD-2 ended in failure, the April 2009 flight demonstrated a more complete performance than the July 2006 launch. North Korea's continued progress in developing the TD-2 clearly shows its determination to achieve long-range ballistic missile and space launch capabilities. The Taepo Dong 2 could be exported to other countries in the future.

Iran has an ambitious ballistic missile and space launch development programs and, with sufficient foreign assistance, Iran could develop and test an ICBM capable of reaching the United States by 2015.

North Korean Teapo Dong 2 Launch April 2009

Russian SS-25 Road-Mobile Launcher

ICBM comparison chart

Russian SS-25 Road-Mobile Launcher

Russian SS-27 Mod 1 ICBM Launch

The Russian Dnepr space launch vehicle is based on the SS-18 ICBM.

Chinese CSS-10 Road-Mobile Launcher

Russian SS-27 Road-Mobile Launcher

characteristics

Missile	Number of Stages	Warheads per Missile	Propellant	Deployment Mode	Maximum Range* (miles)	Number of Launchers
Russia						
SS-18 Mod 4	2 + PBV	10	Liquid	Silo	5,500+	104
SS-18 Mod 5	2 + PBV	10	Liquid	Silo	6,000+	(total for Mods 4 & 5)
SS-19 Mod 3	2 + PBV	6	Liquid	Silo	5,500+	122
SS-25	3 + PBV	1	Solid	Road-mobile	7,000	201
SS-27 Mod 1	3 + PBV	1	Solid	Silo & road-mobile	7,000	54
SS-27 Mod-X-2	3 + PBV	Multiple	Solid	Silo & road-mobile	7,000	Not yet deployed
China						
CSS-3	2	1	Liquid	Silo & transportable	3,400+	10 to 15
CSS-4 Mod 2	2	1	Liquid	Silo	8,000+	About 20
CSS-10 Mod 1	3	1	Solid	Road-mobile	4,500+	Fewer than 15
CSS-10 Mod 2	3	1	Solid	Road-mobile	7,000+	Fewer than 15
North Korea						
Taepo Dong 2	2	1	Liquid	Undetermined	3,400+	Not yet deployed

Note: All ranges are approximate.

* These estimates do not include range extension from the postboost vehicle; some postboost vehicles provide substantial range extension.

SUBMARINE-LAUNCHED BALLISTIC MISSILES

Russia maintains a substantial force of nuclear-powered ballistic missile submarines (SSBNs) with intercontinental-range missiles. Russia is developing new and improved SLBM weapon systems to replace its current inventory of Cold War vintage systems. An upgrade to the SS-N-23, named Sineva, is intended to replace the existing SS-N-23 on DELTA IV Class SSBNs. The SS-NX-32/ Bulava-30 SLBM is a new solid-propellant SLBM that is primarily intended for deployment on new DOLGORUKIY class SSBNs. Russian SLBMs are capable of launch from surfaced and submerged SSBNs from a variety of launch locations.

Top left: Chinese CSS-NX-3 Launch
Background: Russian Typhoon SSBN with Launch Tube Doors Open

Each Russian TYPHOON SSBN can carry 20 SS-N-20 missiles

China currently has a single XIA Class SSBN that is intended to carry 12 CSS-NX-3/JL-1 missiles. In addition, the Chinese will deploy the new CSS-NX-14/JL-2 SLBM on new 12-tube JIN Class SSBNs. This missile will, for the first time, allow Chinese SSBNs to target portions of the United States from operating areas located near the Chinese coast.

India is developing two new naval systems, the Sagarika SLBM (which is expected to become operational after 2010) and the Dhanush ship-launched ballistic missile (a naval version of the Prithvi land-based ballistic missile). The Dhanush is undergoing sea-based flight tests from an Indian naval surface ship.

Each Russian Delta IV SSBN can carry 16 SS-N-23 missiles

Indian Sagarika SLBM Test Launcher

Russian SS-N-23 SLBM

SLBM comparison chart

Chinese CSS-NX-3 SLBM Launch Sequence

Chinese JIN-Class Ballistic Missile Submarine

Russian SS-N-18 SLBM

Russian SS-N-20 SLBM Launch

Russian SS-N-23 SLBM

The Chinese XIA SSBN can carry 12 CSS-NX-3 missiles

characteristics

Missile	Number of Stages	Warheads per Missile	Booster Propellant	Submarine Class	Maximum Range (Miles)	Number of Launch Tubes
RUSSIA						
SS-N-18	2 + PBV	3	Liquid	DELTA III	3,500+	96
SS-N-20	3 + PBV	10	Solid	TYPHOON	5,500+	40
SS-N-23/Sineva	3+PBV	4	Liquid	DELTA IV	5,000+	96
SS-NX-32 (Bulava)	3+PBV	6	Solid	DOLGORUKIY (BOREY)	5,000+	16; Not yet deployed
				TYPHOON		20; Not yet deployed
CHINA						
CSS-NX-3/JL-1	2	1	Solid	XIA	1,000+	12; Not yet deployed
CSS-NX-14/JL-2	3	1	Solid	JIN	4,500+	12; Not yet deployed
INDIA						
Sagarika	Undetermined	Undetermined	Undetermined	Undetermined	180+	Not yet deployed

Note: All ranges are approximate.

LAND-ATTACK CRUISE MISSILES

Unlike ballistic missiles, cruise missiles are usually categorized by intended mission and launch mode (instead of maximum range). The two broadest categories are land-attack cruise missiles (LACMs) and anti-ship cruise missiles (ASCMs). Each type can be launched from an aircraft, ship, submarine, or ground-based launcher. LACMs are addressed in this document.

A LACM is an unmanned, armed aerial vehicle designed to attack a fixed or mobile ground-based target. It spends the majority of its mission in level flight, as it flies a preprogrammed path to a predetermined target. Propulsion is usually provided by a small jet engine.
Because of highly accurate guidance systems that can place the missile within a few feet of the intended target, the most advanced LACMs can be used effectively against very small targets, even when armed with conventional warheads. LACM guidance usually occurs in three phases: launch, midcourse, and terminal. During the launch phase, a missile is guided using only the inertial navigation system (INS). In the midcourse phase, a missile is guided by the INS updated by one or more of the following systems: a radar-based terrain contour matching (TERCOM) system, a radar or optical scene matching system, and/or a satellite navigation system such as the US Global Positioning System (GPS) or the Russian Global Navigation Satellite System (GLONASS). The terminal guidance phase begins when a missile enters the target area and uses either more accurate scene matching or a terminal seeker (usually an optical or radar-based sensor).

Top left: Pakistani Babur Cruise Missile Launch
Background: Rafale with APACHE Cruise Missile

KEPD-350 Cruise Missiles Carried on Tornado Aircraft

Defending against LACMs will stress air defense systems. Cruise missiles can fly at low altitudes to stay below enemy radar and, in some cases, hide behind terrain features. Newer missiles are incorporating stealth features to make them even less visible to radars and infrared detectors. Modern cruise missiles also can be programmed to approach and attack a target in the most efficient manner. For example, multiple missiles can attack a target simultaneously from different directions, overwhelming air defenses at their weakest points. Furthermore, the LACMs may fly circuitous routes to get to the target, thereby avoiding radar and air defense installations. Some developmental systems may incorporate chaff or decoys as an added layer of protection, though concealment will remain a cruise missile's main defense.

The cruise missile threat to US forces will increase over the next decade. At least nine foreign countries will be involved in LACM production during the next decade, and several of the LACM producers will make their missiles available for export.

The success of US Tomahawk cruise missiles has heightened interest in cruise missile acquisition in many countries. Many cruise missiles available for purchase will have the potential to perform precision-strike missions. Many of these missiles will have similar features: a modular design, allowing them to be manufactured with a choice of navigational suites and conventional warhead options; the incorporation of stealth technology; the ability to be launched from fighter-size aircraft; and the capability to fly high-subsonic, low-altitude, terrain-following flight profiles.

South African MUPSOW Cruise Missile

Russian AS-15 Cruise Missile

Kh-101/Kh-102 Missiles on Test BEAR H Bomber

LACM comparison chart

Pakistani Ra'ad Air Launched Cruise Missile

KEPD-350 in Foreground, Storm Shadow in Background

The Black Shaheen is an export version of the French SCALP-EG cruise missile

Chinese YJ-63 cruise missile is carried by the H6 aircraft

Pakistani Ra'ad Cruise Missile

Brahmos-A Indian/Russian Cruise Missile

characteristics

Maximum System	Launch Mode	Warhead Type	Range (miles)	IOC
CHINA				
YJ-63	Air	Conventional	Undetermined	Undetermined
DH-10	Undetermined	Conventional or nuclear	Undetermined	Undetermined
FRANCE				
APACHE-AP	Air	Submunitions	100+	2002
SCALP-EG	Air and ship	Penetrator	300+	2003
Naval SCALP	Sub and Surface Ship	Penetrator	300+	2010+
UAE				
BLACK SHAHEEN*	Air	Penetrator	250+	2006
GERMANY, SWEDEN, SPAIN				
KEPD-350	Air	Penetrator	220+	2004
INDIA, RUSSIA				
Brahmos-A	Air	Conventional	150+	2010+
ISRAEL				
Popeye Turbo	Air	Conventional	200+	2002
PAKISTAN				
RA'AD	Air	Conventional or Nuclear	200	Undetermined
Babur	Ground	Conventional or Nuclear	200	Undetermined
RUSSIA				
AS-4	Air	Conventional or nuclear	185+	Operational
AS-15	Air	Nuclear	1,500+	Operational
SS-N-21	Submarine	Nuclear	1,500+	Operational
Kh-555	Air	Conventional	Undetermined	Undetermined
New GLCM	Ground	Conventional	less than 300	Undetermined
3M-14E	Ship, Submarine, & Ground	Conventional	185+	Undetermined
SOUTH AFRICA				
MUPSOW	Air and ground	Conventional	125+	2002
Torgos	Air and ground	Conventional	185+	2006+
TAIWAN				
Wan Chien	Air	Conventional	150+	2006
HF-2E	Ground	Conventional	Undetermined	Undetermined
UNITED KINGDOM				
Storm Shadow	Air	Penetrator	300+	2003

Note: All ranges are approximate and represent the range of the missile only. The effective system range may be greatly increased by the range of the launch platform.

*The BLACK SHAHEEN is an export version of the SCALP-EG.

SUMMARY

Ballistic missiles are already in widespread use and will continue to increase in number and variety. The availability of weapons of mass destruction for use on ballistic missiles vastly increases the significance of this threat.

Despite an ongoing reduction in the size of the Russian strategic missile force, Russia probably will retain the largest force of strategic ballistic missiles outside the United States. The development of new ballistic missile systems (i.e., the SS-27 ICBM and the SS-N-23 Sineva and SS-NX-32/Bulava-30 SLBMs) is a high priority for Russia. Russian officials have claimed that a new class of hypersonic vehicle is being developed to allow Russian strategic missiles to penetrate missile defense systems. Russia is also offering the advanced new Iskander-E SRBM for export.

China is producing technologically advanced ballistic missiles and has sold ballistic missile technology to other countries. China has an extensive theater missile program and has deployed a large force of ballistic missiles in the vicinity of Taiwan. China is expanding the reach of this force to attempt to prevent foreign powers from becoming involved in any future regional conflict. China can already target the United States with a relatively small force of ICBMs, and China's ICBM force will grow considerably.

Top left: Chinese CSS-4 ICBM Launch
Full page: Russian SS-18 Launch

Chinese CSS-5 MRBM Road-Mobile Launcher

North Korea is continuing the development of the Taepo Dong 2 ICBM/SLV and has an IRBM in development. North Korea has exported ballistic missile systems and will probably continue to do so.

Proliferation of LACMs will expand in the next decade. At least nine countries will be involved in producing these weapons. The majority of new LACMs will be very accurate, conventionally armed, and available for export. The high accuracy of many LACMs will allow them to inflict serious damage, even when the missiles are armed only with conventional warheads. US defense systems could be severely stressed by low-flying stealthy cruise missiles that can simultaneously attack a target from several directions.

Ballistic and cruise missiles, with their relatively low operating costs, their potential to penetrate defense systems, and their value as a symbol of national power, will continue to be the offensive weapons of choice for many nations. As such, they are threats that must be carefully considered in future military planning and operations.

Iranian Shahab 3 MRBM Launch

Chinese CSS-6 SRBM

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