



**S. RAJARATNAM SCHOOL
OF INTERNATIONAL STUDIES**

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China's Ballistic Missile Modernization

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Summary

1) China's ballistic missile R&D and production shows a gradual, phased, albeit progressive qualitative trajectory:

1st Gen. Copier and reproducer of Soviet ballistic missile technologies
(late 1950s to early 1980s)

2nd Gen. Adapter and modifier of smaller, mobile, solid-propellant ballistic missile systems and their follow-on systems (mid to late 1980s)

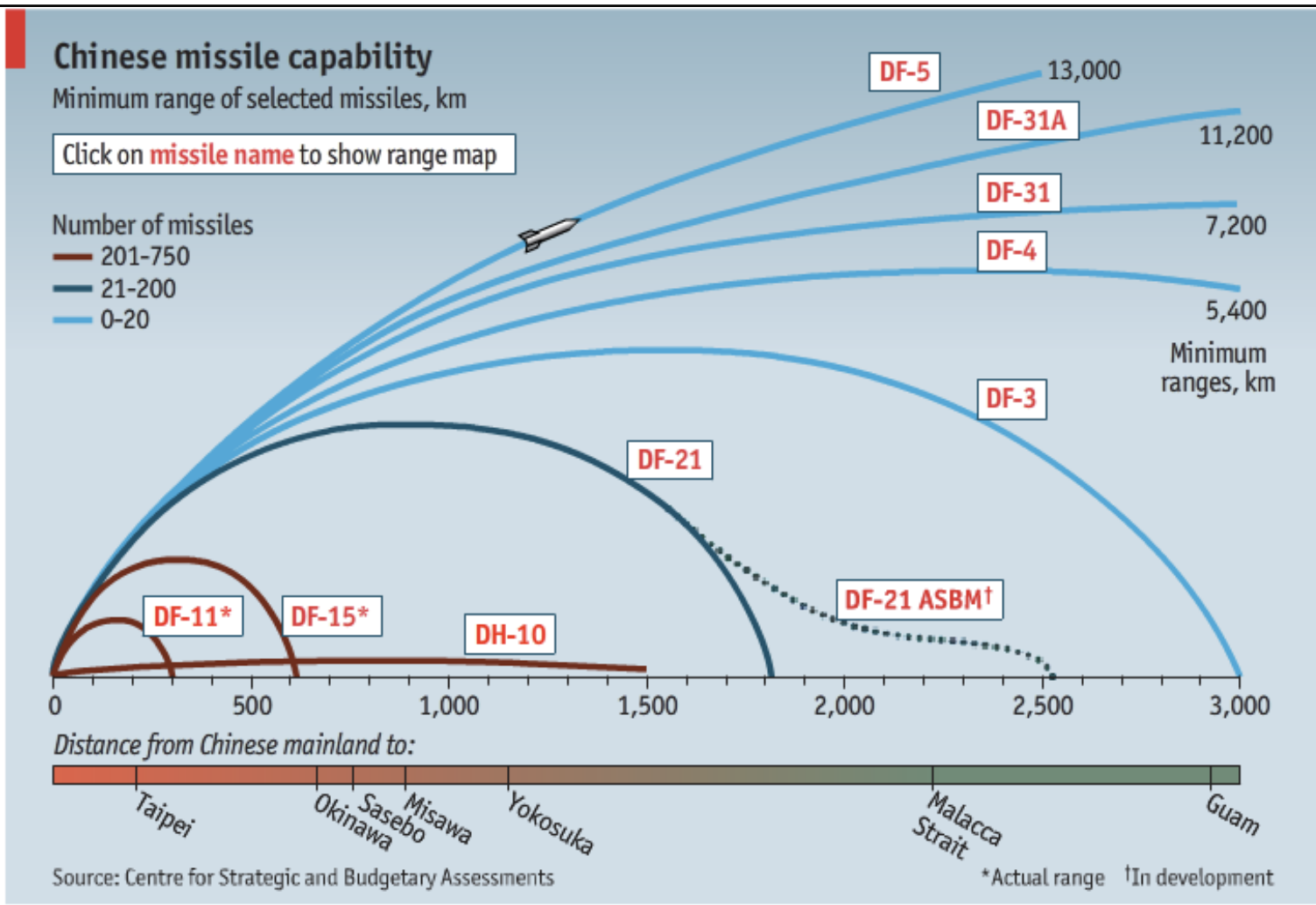
3rd Gen. Independent producer and innovator of selected missile systems and related aerospace technologies (2000s onwards)

2) Since the late 1990s, China's defense aerospace industry has accelerated its military space system R&D driven by:

China's shifting geostrategic interests,
Operational requirements of the PLA
Comprehensive reforms in China's defense industries;

China's Emerging Missile Capabilities

China is diversifying its inventory of missiles in terms of strike-capabilities and mobility;



Ever expanding family of weapons designed for land, sea, and air launch, capable of dispatching every conceivable type of target;

1. China's Emerging Missile & Space Capabilities

2. Strategic Drivers

- Shifts in China's Strategy & Doctrine
- Comprehensive Defense Reforms
- PLA Operational Requirements

3. Evolution of PLA's Ballistic Missile Force

- First, Second, Third Generation

4. Strategic and Policy Implications

Strategic Drivers

China's policymakers view aerospace capabilities as vital to China's rise, power projection, and global influence → “international geostrategic high ground”

China's space industry is intended to “promote...national security...to protect China's national rights and interests...”

Military use of space is increasingly dependent and interlinked with civilian and commercial space activities, human capital and expertise, space systems, assets, and infrastructure;

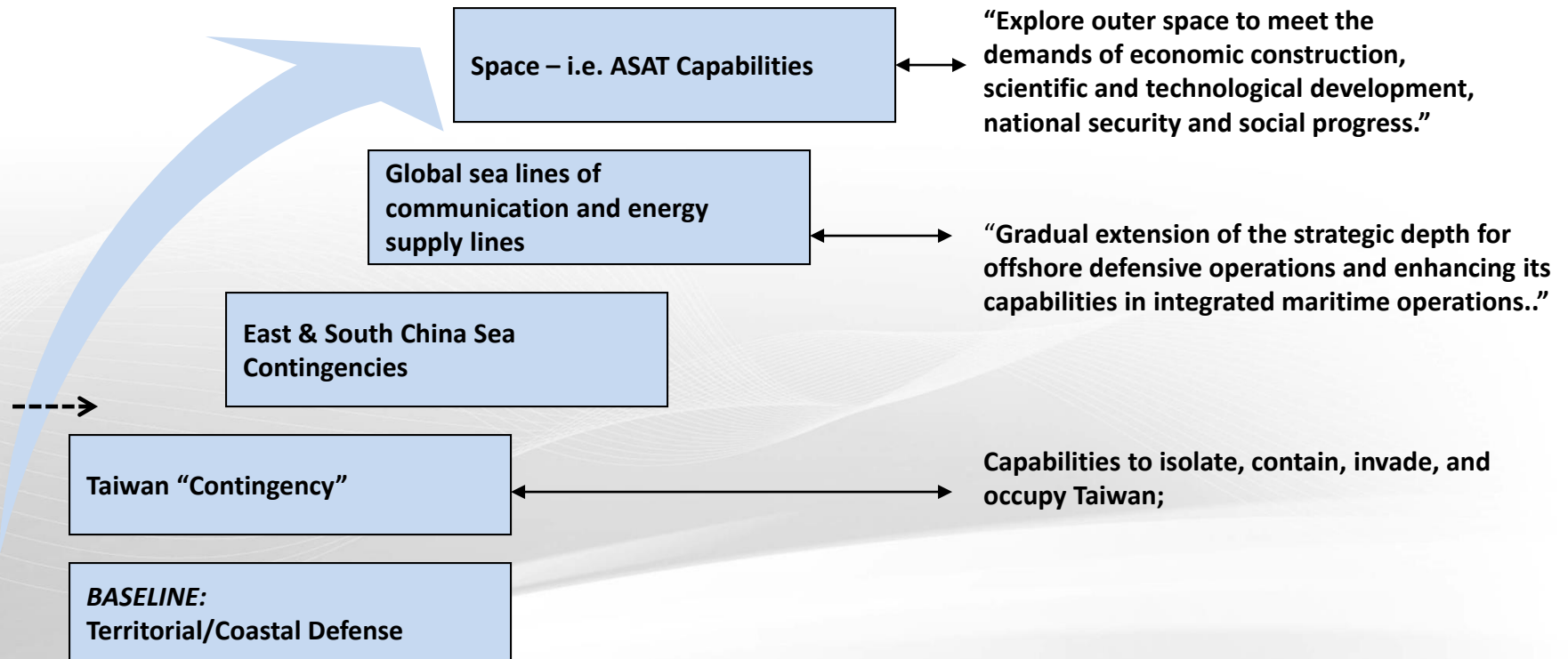
- Political** : Geopolitical Influence & Strategic Interests
- Military** : Operational Requirements & Military Modernization
- Economic** : Comprehensive Reforms in China's R&D Industrial Base

PLA Operational Requirements

“Limited, Local Wars under Informationalized Conditions”

“Multilayered Active Defense”

“Diversified Missions”



Two-track vision of PLA’s military modernization:

- (1) upgrading of existing equipment + selective introduction of new generation systems
- (2) transformation of the PLA

Ongoing Defense Industry Reforms

Civil-Military Integration	Industrial Consolidation	S&T Drive & Investment	International Cooperation
<p>Integration of defense enterprises into commercial economies :</p> <p>“Yujun Yumin” system -locate military potential in civilian capabilities:</p> <ul style="list-style-type: none"> - Integration of civilian economy and S&T sectors; - Access to global commercial markets; - Raising funds through global capital markets; - Encouraging foreign investment in non-strategic defense industries; - Expanding the manufacturing and trade of products for civil use; 	<p>Restructure, optimize, and upgrade defense Industrial base:</p> <ul style="list-style-type: none"> - Reduce duplication and maximize efficiencies; - Gradual defense market reforms and liberalization <p>“Four Mechanisms” – competition, evaluation, supervision, encouragement:</p> <ul style="list-style-type: none"> - Exposing China’s defense industries to modern commercial technologies and management practices; - Expanding financial and technical support; boost innovation; improve competitiveness; 	<p>Increased R&D defense spending:</p> <ul style="list-style-type: none"> - Increased funding for military R&D activities; - Integration into the global R&D chain, gain access to foreign technology and know-how; - “Informationization” 	<p>International exchanges and co-operation with “friendly” foreign countries:</p> <ul style="list-style-type: none"> - Opening up a proportion of the equipment budget to privately owned Chinese companies; - Outsourcing certain non-strategic defense-related activities to the private sector; - Flexible export regulations; - Joint R&D technological cooperation, technology transfer;

Three Generations of Ballistic Missiles

China's nuclear weapon and ballistic missile development - "pockets of excellence"
→ Enjoyed top-priority in the Chinese defense-industrial system;

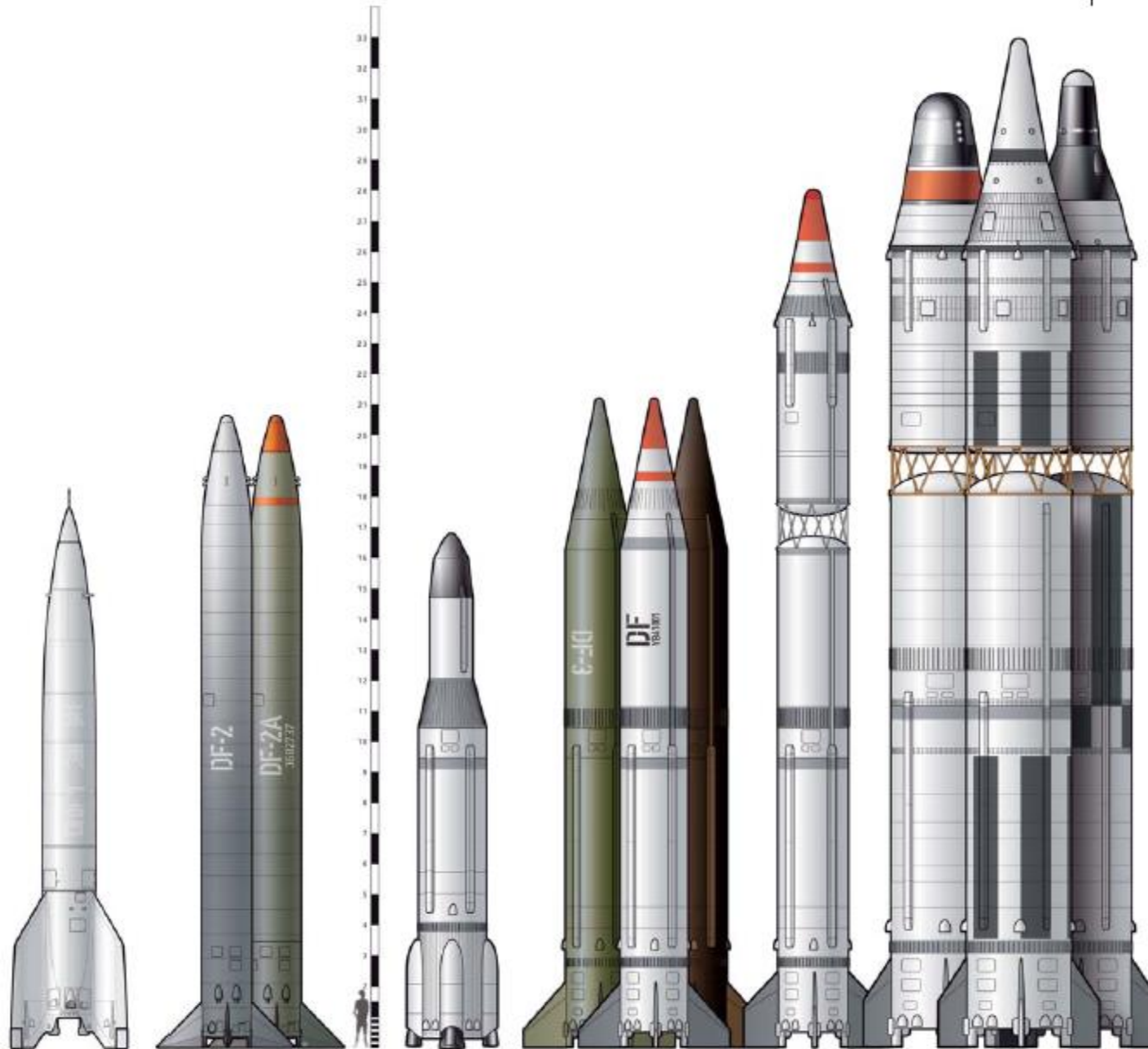
However, for more than three decades, the pace of China's ballistic missile development was slow and gradual;

→ Phased R&D Strategy "*Three Moves*:"

- (1) Preliminary basic research and project exploration to minimize risks;
- (2) R&D model phase of design, development, testing, and trial production;
- (3) Low-rate initial production, modifications to improve range, operability, and reliability, operational deployment, and follow-on systems development;

Historically, China never aimed to achieve strategic parity with the U.S. or Russian missile programs. Instead, China focused on maintaining and improving the credibility, reliability and effectiveness of its minimal deterrent;

First Generation: Liquid-Propelled Missiles



DF-1 (SS-2),

DF-2 (CSS-1),

DF-3 Tchien

DF-3 (CSS-2),

DF-4 (CSS-3)

DF-5 (CSS-4) SJ 2 (FB-1)
CZ-2C

1960

DF-1

Copy of Soviet R-2/SS-2
(Sibling)

1964

China's first nuclear test;

1965

"Banian Sidan" Plan –
"four types of missiles
in eight years"

First Generation: Liquid-Propelled Missiles

- Missile programs driven primarily by technical imperatives, rather than strategic purpose;
- Basic features of the missiles remained unchanged;
- Implicit nuclear doctrine;
- Path dependence on Soviet missile technologies: R-1/R-2 (1957)
- Fixed-based systems; vulnerability to a preemptive strike;
- Relatively long pre-launch preparations;
- Incremental innovation;

	Stages	Payload-kg	Range-km	Propellant	CEP-m	First Test
DF-2A	1	1,500	1,250	Liquid	4,000	1965
DF-3/A	1	2,150	2,500	Liquid	2,000	1966
DF-4/A	2	2,200	4,000	Liquid	1,500	1970
DF-5/A	2	3,000	12,000	Liquid	800	1971

Sources: Chinese Defense Today (2011); Jane's Strategic Weapon Systems

First Generation: Liquid-Propelled Missiles

DF-5 (CSS-4) - Pinnacle of China's first generation of ballistic missiles;

First Test: 1971

Operational: 1981



2010: China is believed to retain about 20 operational DF-5s, some possibly modified to a MIRV configuration;

Second Generation: Solid-Fueled Missiles

1980s-1990s:

- Basing & pre-launch survivability – central concern;
- Shift from fixed-based to mobile systems;
- Shift from liquid to solid-fueled missiles;
- Shift from strategic to tactical missiles;
- SRBMs: Taiwan + Export

	Stages	Payload-kg	Range-km	Propellant	CEP-m	First Test
JL-1 SLBM	2	600	1,700	Solid		1982
DF-21	2	600	2,150	Solid	300	1985
DF-31	3	700-1,750	12,000	Solid	300	1999
DF-15 /A	1	500 ; 650 ;	605	Solid	100	1987
DF-11 /A	1	500; 800	300; 620	Solid	10	1990

Sources: Chinese Defense Today (2011); Jane's Strategic Weapon Systems

Second Generation: Solid-Fueled Missiles



JL-1 (SLBM): 1982



DF-21: 1985



DF-31: 1999



Third Generation: Stealth Modernization

- Next generation of nuclear and conventional missiles;
- with solid fuel motors;
- increased range and accuracy;
- multiple warheads; countermeasures;
- benchmarked with 4th & 5th generation of missile systems developed by the U.S. and Russia:

Nuclear :

Next generation of solid-propellant, road-mobile
ICBMs: DF-31 / A; DF-41?
SLBMs JL-2

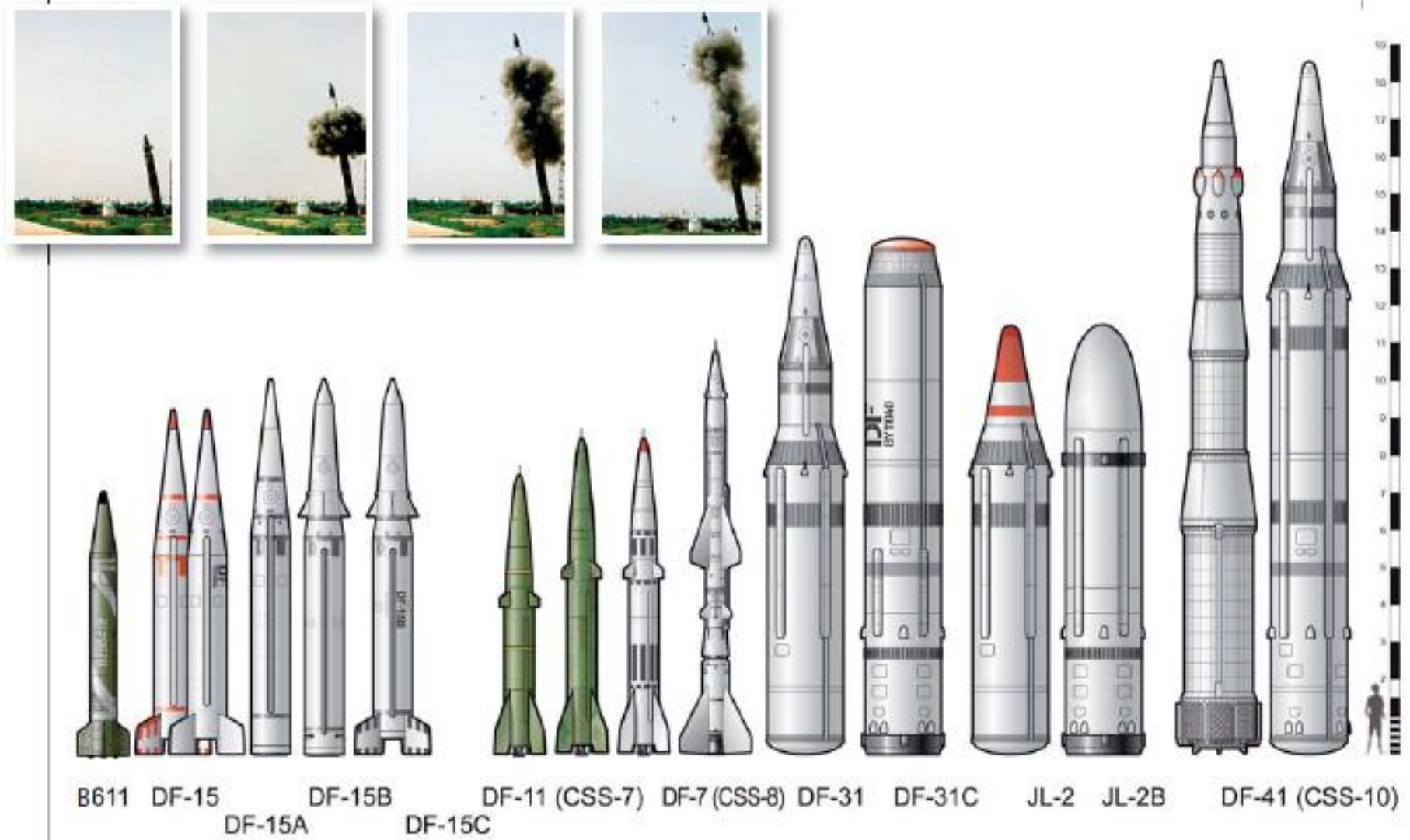
Conventional:

Mobile, solid-fueled, **SRBM DF-15 B/ C**

MRBMs – DF-21 A/ C/ D

- short-system reaction time, longer range,
- more accurate terminal guidance capability,
- countermeasures,
- anti-ship ballistic missile / anti-satellite weapon capability

Third Generation: Stealth Modernization



Third Generation: Stealth Modernization

DF-31A



Configuration	Three Stage
Length [meters]	10+
Diameter [meters]	2.0
Mass [kilograms]	20,000+
Propellant	Solid
Guidance	Inertial
First Flight	29 April 1992
Range (km)	3,000 - 8,000
Re-entry Vehicle Mass (kg)	700 kg
Warhead Yield	1 @ 0.35 - 1.0 MT or 3 @ 50-100 KT
CEP (meters)	300-500
Launch Preparation Time	10-15 minutes

DF-21C



Configuration	Two Stage
Length [meters]	10.7
Diameter [meters]	1.4
Mass [kilograms]	14,700
Propellant	Solid
Guidance	Inertial
First Flight	May 1985
Range (km)	1,800
Re-entry Vehicle Mass (kg)	600
Warhead Yield	200-300 KT
CEP (meters)	300-400
Launch Preparation Time	10-15 minutes

Source: GlobalSecurity.org

DF-21D: Architectural Innovation

Changes the way in which the components are linked together, while leaving the core design concepts intact:

JL-1 (SLBM): 1982



DF-21: 1985



DF-21C:



DF-21D ?





Part 4

Conclusion