R&D VISION

Toward Realization of Multi-Domain Defense Force and Beyond

2019

MINISTRY OF DEFENSE

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What is the R&D Vision?

The R&D vision is a document which presents the principles on Research & Development (R&D), technological challenges, and roadmaps of the technologies required to realize our future defense capability for the purpose of strategically conducting advanced R&D from the viewpoint of the mid-to-long term.

The Ministry of Defense (MOD) has formulated *R&D vision concerning Future Fighter Aircraft* in 2010, and *R&D vision of Future Unmanned Vehicles* in 2016 based on *Strategy on Defense Production and Technological Bases* and *Defense Technology Strategy*. According to the direction shown in *National Defense Program Guidelines for FY 2019 and beyond* (approved by the National Security Council and Cabinet on December 18, 2018), the MOD has formulated the new R&D vision. They are leading to encouragement to acquisition and enhancement of the capabilities required for cross-domain operations such as "Electromagnetic spectrum (EMS) technologies", "Technologies for Persistent ISR including Space", and "Cyber defense technologies" as well as leading to that in traditional domains such as "Underwater warfare technologies" and "Stand-off defense technologies" in order to contribute to realization of Multi-domain Defense Force and to realize technological innovation required for further enhancement of future defense capability.

According to the R&D vision, the MOD will hereafter strategically foster technologies that become necessary in the future and conduct R&D effectively and efficiently.

Remarks: A decision-making whether to initialize a development for a deployment or not is comprehensively done by the perspective of defense program on various then-conditions including progresses of researches conducted depicted on the R&D vision, a latest national security environment, an availability of procuring a foreign weapon system, etc.

Introduction

1. Due to advances in military technologies, a variety of threats can now easily penetrate national borders. States endeavor to develop weapons that leverage cutting-edge, potentially game-changing technologies. They also engage in research of autonomous unmanned weapon systems equipped with artificial intelligence (AI). Further technological innovations hereafter are expected to make it difficult still to foresee future warfare.
   As for AI technologies and ICT, large-scale investments and utilization are being made continuously in the private sector, and at the same time, research of various innovative technologies such as quantum computer, etc. is also being done.

2. According to National Defense Program Guidelines for FY 2019 and beyond published on Dec. 2018, MOD/SDF will make focused investments through selection and concentration in technologies related to new operational domains such as space, cyber and EMS and cutting-edge technologies including AI and other potential technologies for game-changing. Moreover, MOD/SDF will also drastically shorten R&D periods of time by streamlining their processes and procedures.

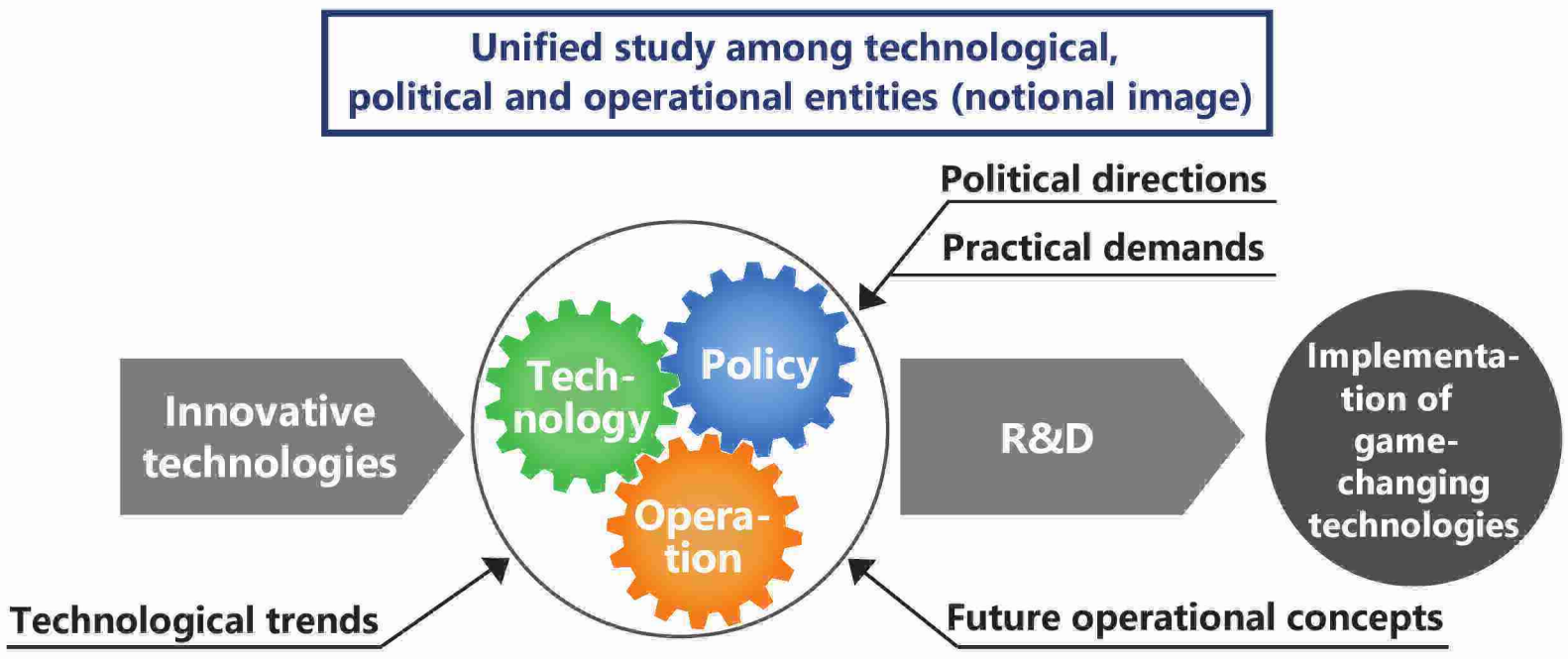
3. In conducting specific R&D, it is important to coordinate technological seeds and operational needs considering political direction, through sharing of operational demands such as necessary capabilities for future warfare, or future operational concepts planned by each SDF, etc. It is also required to acquire cutting-edge technologies more promptly toward realization of truly practical defense capability, i.e. multi-domain defense force, and beyond.

4. Considering the above background given severe fiscal situation and allocating resources to important R&D flexibly and intensively without adhering to existing budget and human resource allocation to strengthen defense capability effectively, MOD/SDF determined to formulate the new R&D Vision regarding technologies which will be potentially significant for future joint operation, leading to acquisition and enhancement of the capabilities required for cross-domain operations such as "Electromagnetic spectrum (EMS) domain", "Persistent ISR capability over wide area including space" and "Cyber defense capability", as well as leading to improvement of the capabilities in traditional domains such as "Underwater warfare technologies" and "Stand-off defense capability" in order to strategically show our direction of mid-to-long-term R&D effort.

The principles of R&D

1 Harmonization among technological seeds and operational needs considering political direction

To implement future game-changings with innovative technologies, R&D shall be conducted parallel to continuous discussion where technological, political, and operational parts act in unison because of considering future political evaluation and operational concepts for those technologies, taking various reasonable requests (including political concerns, legally and/or budget constraints) into account.



2 Efficient R&D utilizing advanced technologies

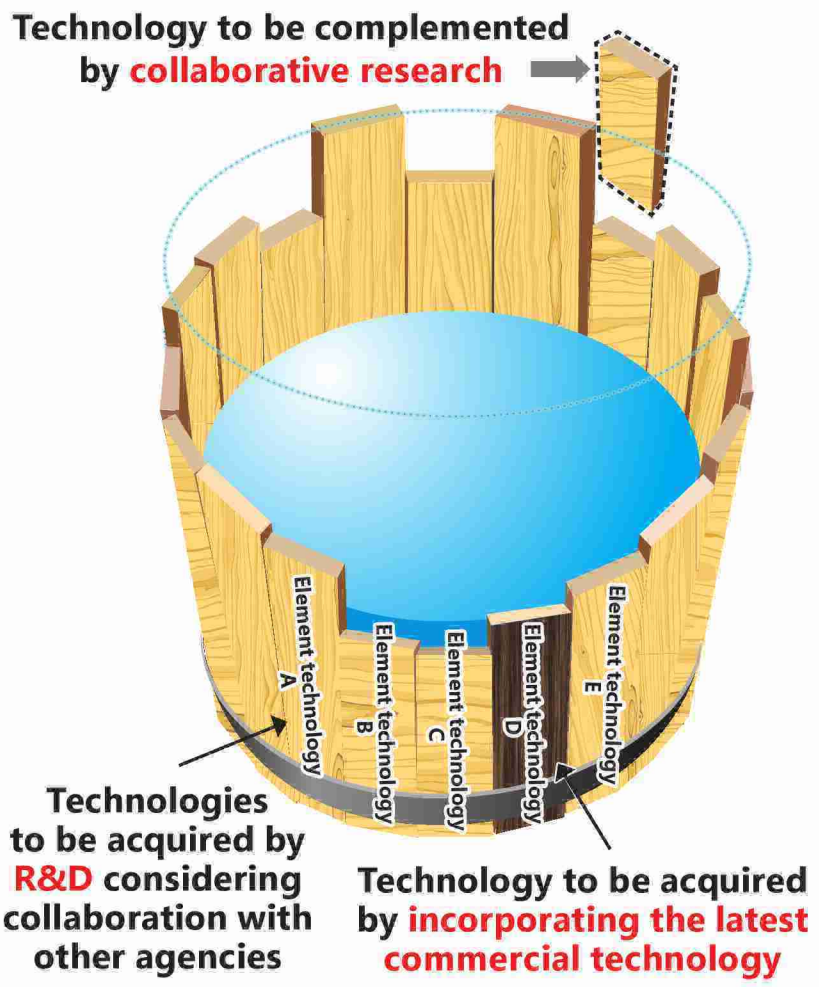
To acquire an innovative weapon system with limited technological recourse, it is important to overlook the whole system and to specify all of each element technology consisting of the system before nurturing and acquiring them.

As an essential element technology to be a future potential game-changer rapidly grows especially in the commercial sector due to progress of borderlessness and dual use, it is also vital to actively utilize an advanced commercial technology applicable for defense use.

Accordingly, necessary technologies should be acquired not only by independent ATLA's research but by various means or its combination. (e.g. collaboration with other ministries or agencies, cooperative research with domestic or international partner, utilization of the latest commercial technologies, etc.)

At the same time, to reinforce the basis of the defense technology, improvement in the level of national comprehensive science and technology in the mid-to-long term should be continuously challenged, for example trying to discover and develop emerging technologies with ATLA's funding system named "the Innovative Science and Technology Initiative for Security".

Efficient R&D by combined various advanced technologies(notional image)



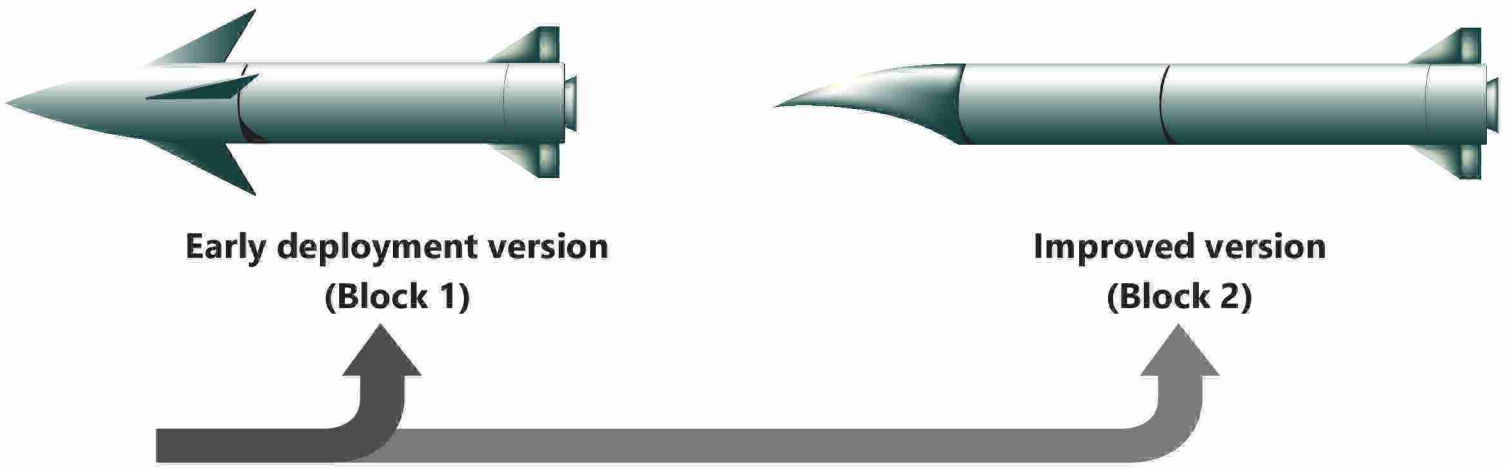
*A system depends on element technologies with various maturity and its total performance is constrained by the lowest immature technology. This characteristic is often compared to the illustration of the unbalanced barrel (called "Liebig's barrel" model)

3 Streamlining the process of R&D

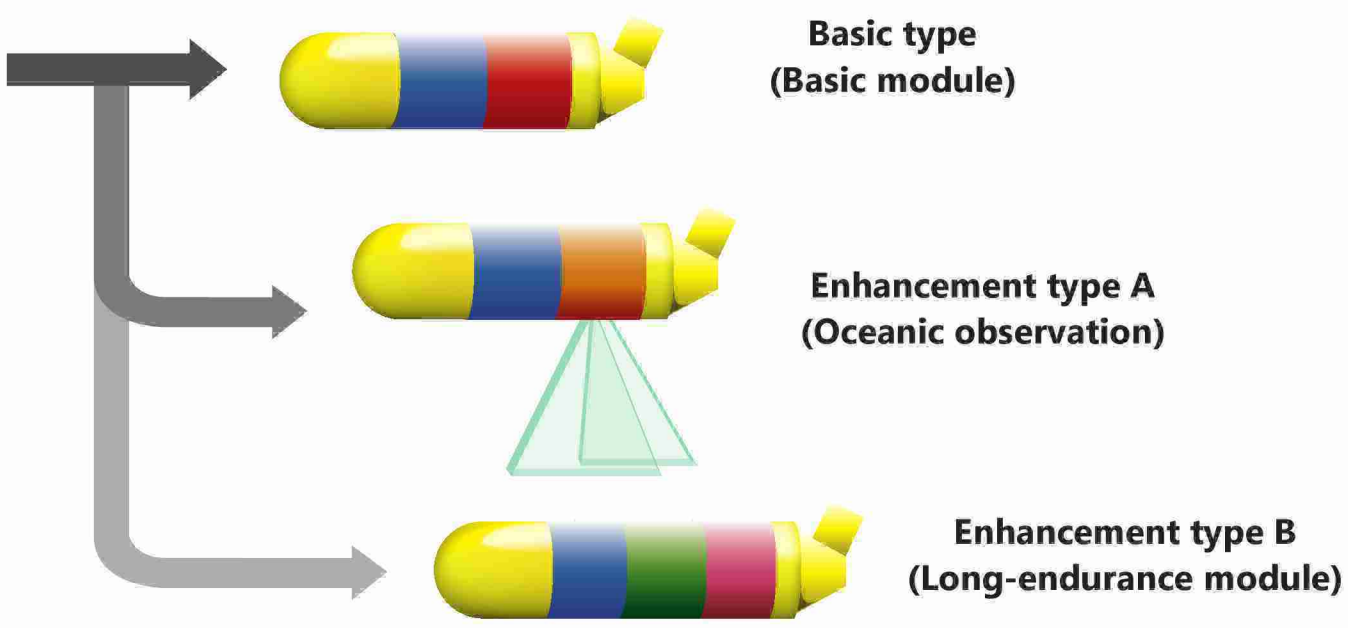
Based on the fundamental concept on NDPG for FY2019 and beyond, to strengthen defense capabilities at speeds that are drastically different from the past, streamlining the process of R&D, such as block approach and modularization, and demonstrating the outcome of R&D in the earlier stage should be positively conducted.Additionally, MOD will improve cost-effectiveness of R&D investment through strengthening cost management and reduction throughout the lifecycle from the R&D stage.
Offerings the idea for the acceleration of the process of R&D would be expected with sharing and spreading the R&D Vision to the private industries, accompanying by encouraging the industries to have spontaneous discussion and prior investment regarding cutting-edge technologies required by MOD/SDF toward realization of future game-changing.

Streamlining R&D processes (notional image)

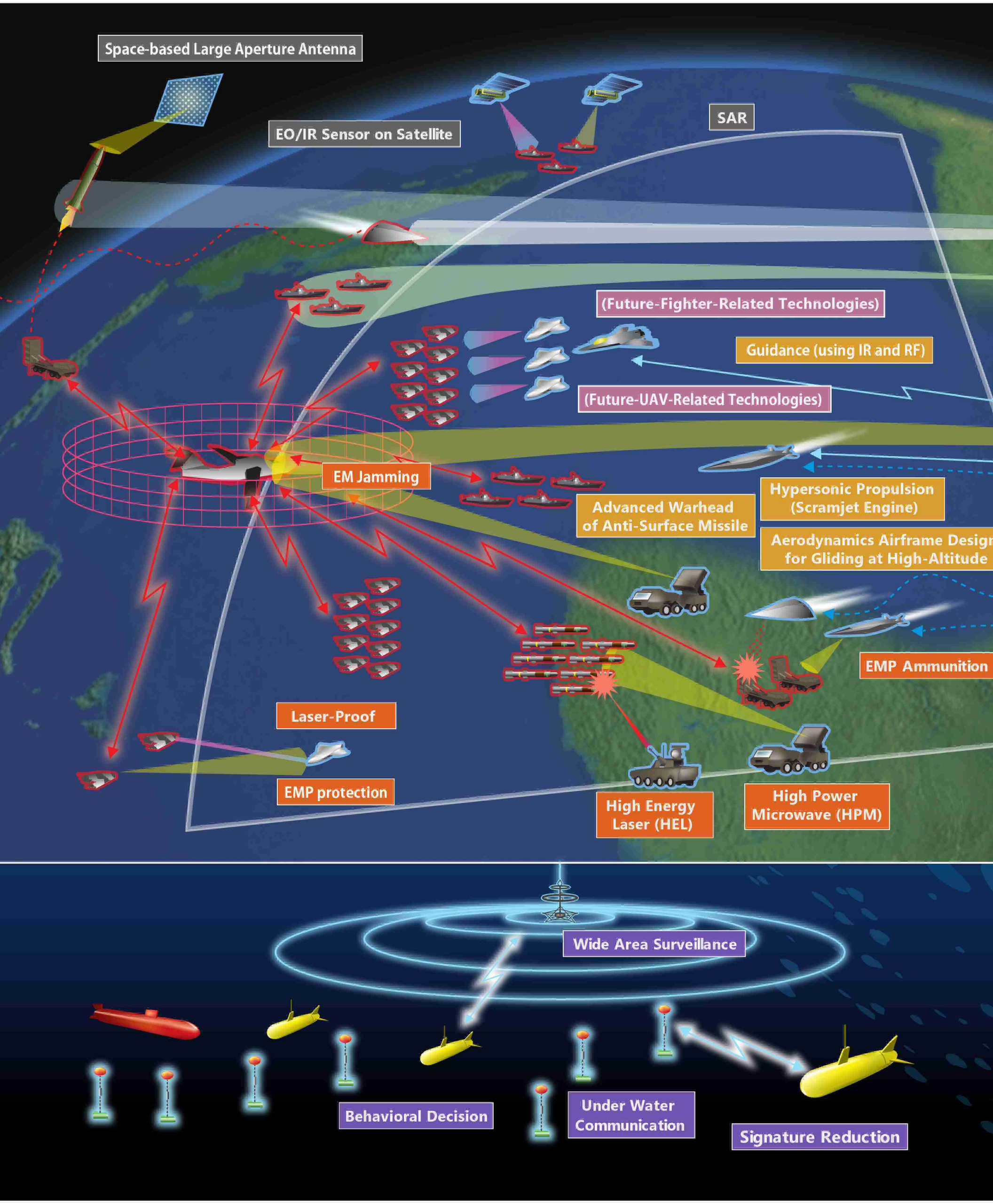
Block approach Early application of outcome from R&D to weapon systems



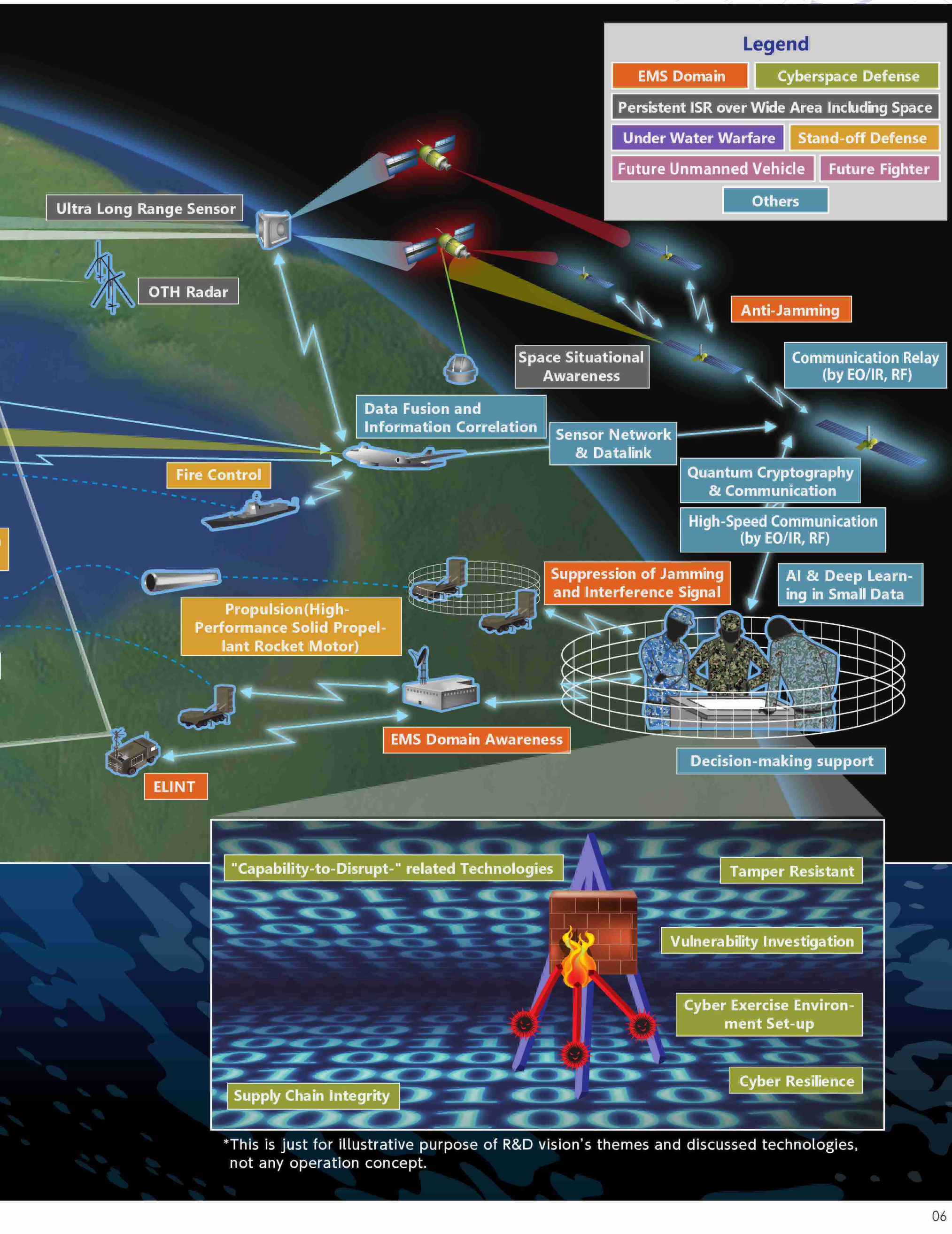
Module approach Improvement of weapon systems' function in shorter period at a lower cost



Notional picture of technologies to be realized



through R&D vision in the future



*This is just for illustrative purpose of R&D vision's themes and discussed technologies, not any operation concept.

Electromagnetic Spectrum (EMS) Techn

The significance and issues

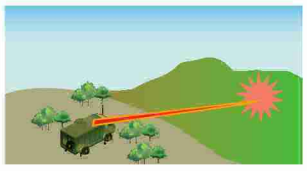
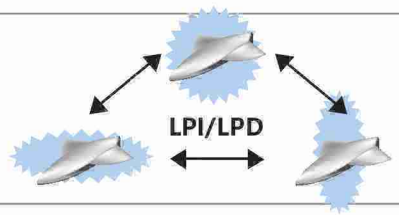
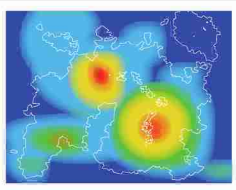
The EMS domain is an important domain related to wide-ranging defense activities such as ISR, information sharing, precise guidance, etc. Among foreign countries improving their EW capabilities, therefore, is it necessary to endeavor to achieve effective and efficient use of EMS

Function		The status quo	Issues
EW Capability	EA	• Evasion from a missile, etc. is a major application • Large-size jamming platform is the mainstream • Jamming capability needs to progress against improvement of target electronic device's EP capability	• Realization of missile defense by high-power energy • Divergence of jamming platform • Jamming capability exceeding advanced EP of target electronic device
	EP	• Possibility of long-range detection by various enemy EM sensors • Possibility of disruption to radar and communication by advanced jamming capability • Possibility of damage by EMP ammunition, etc	• Evasion from long range detection by various enemy EMS sensors • Avoidance or alleviation from effects of advanced jamming • Protection from effects of EMP
	ES	• Progress of LPI/LPD technology • Large-size SIGINT platform is the mainstream	• Enhancement of the capability to detect LPI/LPD radio wave • Divergence of SIGINT platform
EMS Management		• Necessity of EMS situational awareness for efficient use of EMS • Non-flexible EMS allocation	• Centralized EMS situational awareness • Flexible EMS allocation

It is necessary to acquire the technology to realize cost-effective countermeasure by advanced EW weapon systems exceeding foreign countries' EW capability, while realizing efficient EMS usage through EMS management

Technologies for the MOD/SDF to acquire

It is necessary to acquire such technologies as high-power directional energy technology, LPI/LPD technology, advanced SIGINT technology, EMS domain awareness technology, etc. to solve issues

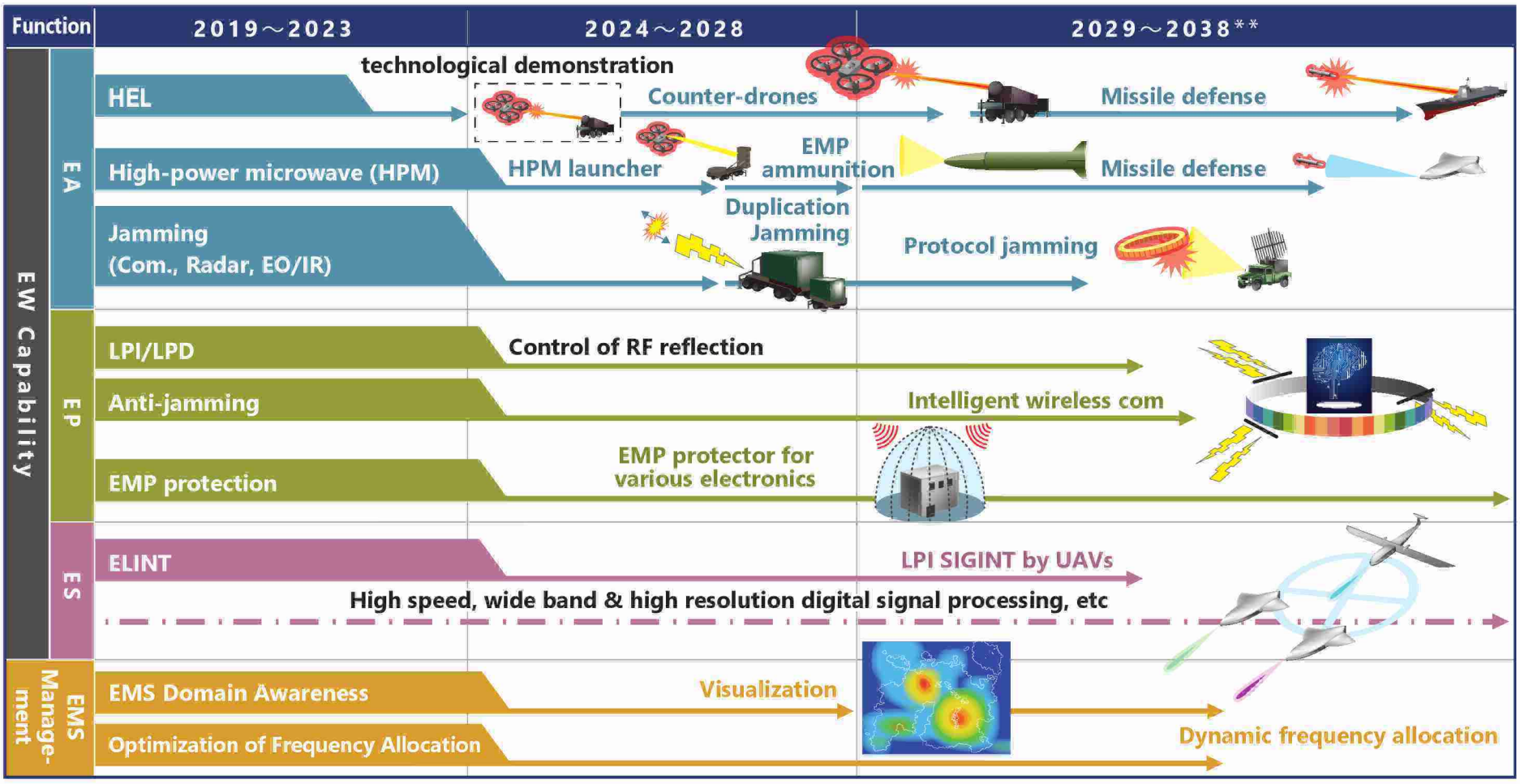
Function		Examples of the technologies to acquire
EW Capability	EA	• High-power directed energy technology (HEL and HPM) to be able to neutralize a variety of objects such as drones, various missiles, etc • Jamming (communication, radar, and EO/IR) technology which corresponds to various platforms and realizes optimal jamming against targets including network, according to various communication environment and target's EP capability  HEL
	EP	• LPI/LPD technology corresponding to the EMS situation • Anti-jamming technology avoiding or alleviating influence of jamming • Protection technology against EMP effects 
	ES	• Broadband and high-resolution reception technology enabling reception and collection of LPI/LPD signal and weak electromagnetic wave under the presence of jamming • Small and lightweight ELINT technology mountable on unmanned platform
EMS Management		• EMS domain awareness technology enabling centralized grasp of EMS situation in the space and allocation status necessary for efficient EMS management • Optimal EMS allocation technology enabling effective and efficient use of EMS by flexible reallocation of EMS according to EMS situation in the space  EMS domain awareness

ologies - Towards EMS Superiority

Technological Roadmap

*These are just for illustrative purpose of possible future weapon systems, not any determined development plan.

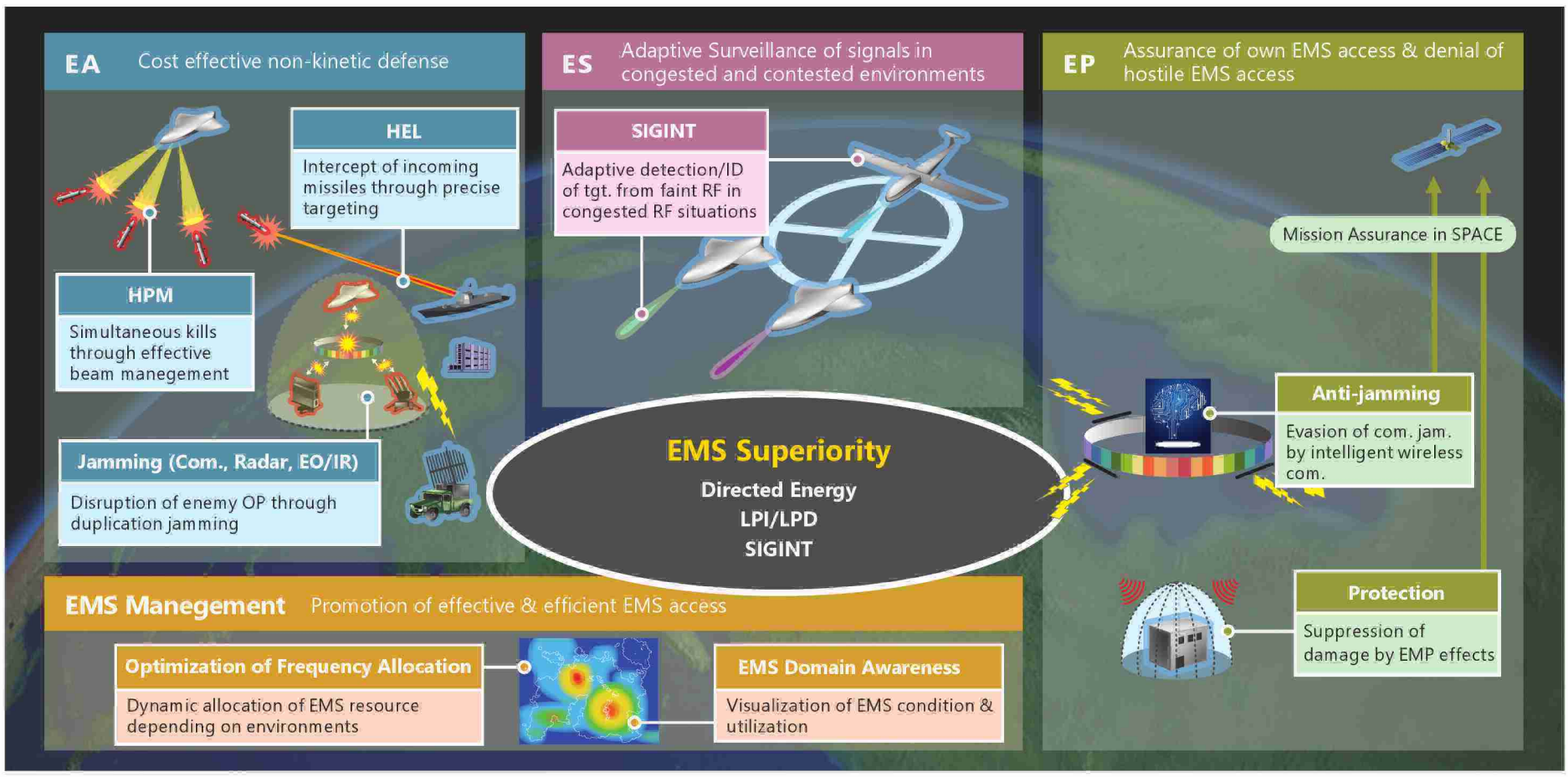
In the shorter-term viewpoint, the core technologies in the EMS domain such as a ground defense system (including HEL and HPM) against drones and other new threats, EMP ammunition, etc. should be established. Afterward, it is to realize diversity of mountable platforms and improvement of their power as well as other general EW capabilities and EMS management capability to support them



**The endpoints of arrows are tentative. In the view of the concept of streamlining R&D, we will endeavor to obtain the technologies earlier.

Future Notional Picture

Superiority in EMS domain should be achieved that affects the defense activity in any domains with core technologies: directed energy, stealth, SIGINT, optimization of frequency allocation and others



Technologies for Persistent ISR includ

The significance and issues

Considering surrounding countries' activities and expansion of ISR targets and domains, the issue is to realize efficient and effective ISR based on improvement of sensors' detecting capability and increase of sensor platforms.

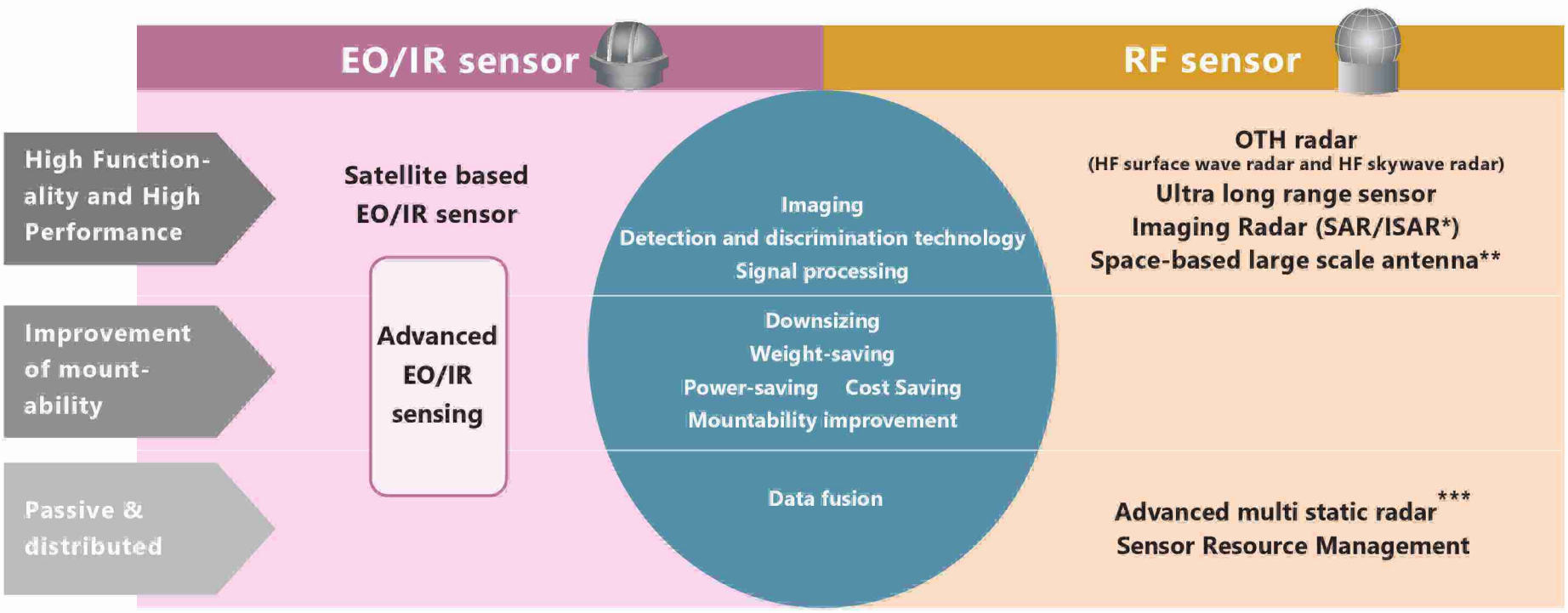
Items	The status quo	Issues
Sensor detection capability	• Expansion of ISR domain and area exceeding current sensor detection capability • It is necessary to increase ISR platforms considering manpower reduction and increase of ISR domains and targets. • It is necessary to detect the targets with improved LPI/LPD performance. • Active search may cause preemptive detection and attack by enemy. • Possibility of difficulty in conduct of ISR due to improvement of a foreign country's A2/AD capability	• Enhance persistent ISR capability in various domains such as space, over-the-horizon, etc. • Acquire sensor's high-accuracy and high-speed discrimination capability against various targets • Realize distributed detection system using multiple platforms and sensors with high protection against jamming • Improve passive detection capability for various targets in situations with limited active search opportunities • Acquire persistent ISR capability under threat by using UAV, etc.
Sensor platform	• It is necessary to increase ISR platforms considering manpower reduction and increase of ISR domains and targets.	• Sensor Integration to utilize unmanned platforms such as UAV, satellite, etc. as ISR platforms

A2/AD: Anti Access/ Area Denial,

It is necessary to acquire the technologies to realize persistent ISR of various domains, areas, and targets by using passive distributed detection, increasing ISR platforms, improving the mountability of the sensors, and upgrading sensor's functionality and performance.

Technologies for the MOD/SDF to acquire

It is necessary to acquire RF sensor technology and EO/IR sensor technology to realize high-functionality and high-performance, distributed detection with many sensors, and improvement of sensors' mountability.
As it is difficult for ATLA alone to acquire various technologies, especially related to space, the MOD acquires these in collaboration with relevant agencies such as JAXA, relevant countries such as the U.S., and also through active use of commercial technologies. The MOD also promotes technology cooperation with relevant agencies such as JAXA for mission assurance in the space domain to assure resiliency of access.



* SAR utilizes the flight path of the platform and ISAR utilizes the motion of the target to form a large virtual aperture and generate high resolution images.
** GEO-based km-scale power transmission antenna technology to be used by the Space Solar Power System (SSPS).
*** Multi-static radar: Radar which utilizes spatially diverse transmitter(s) and receiver(s).

ing Space

Technological Roadmap

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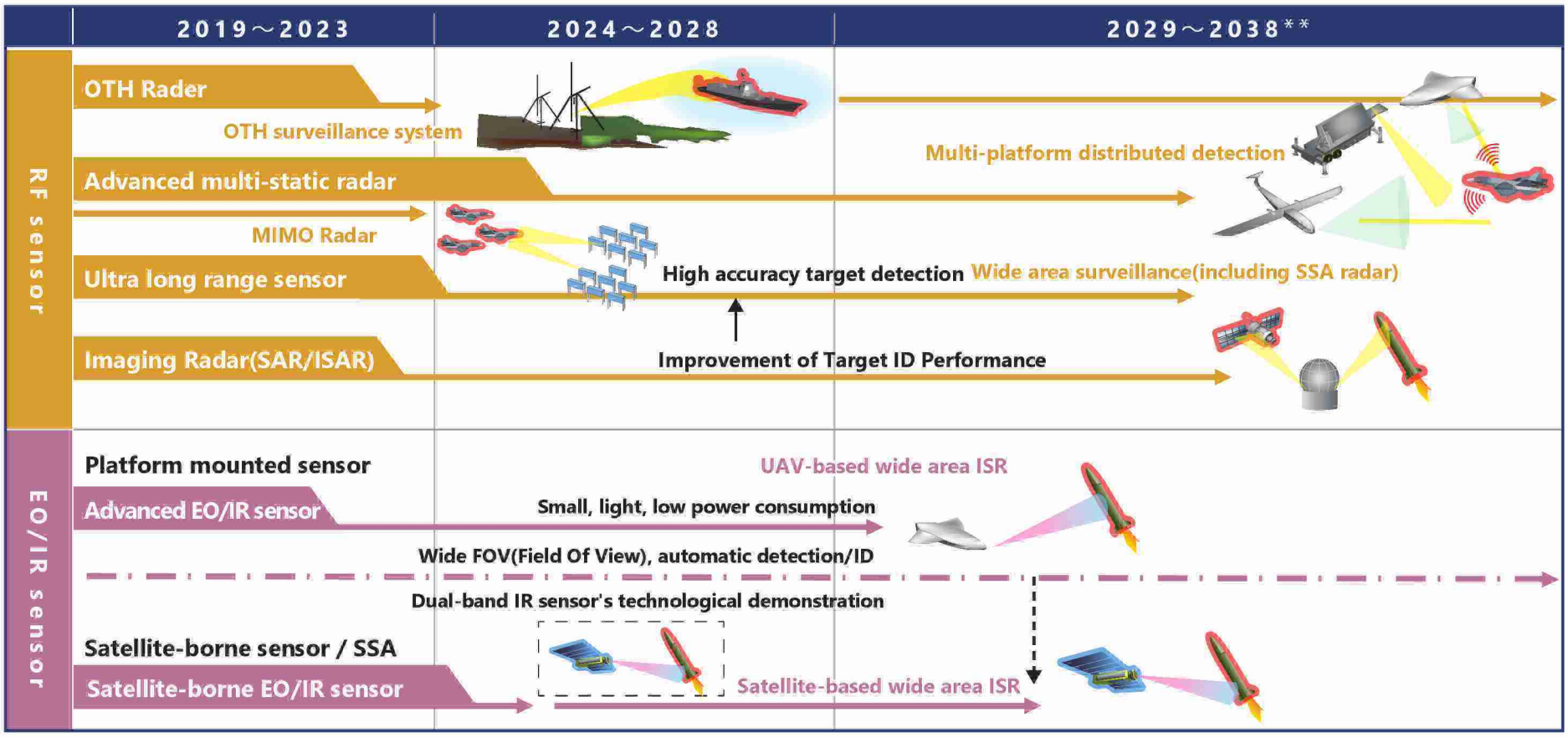
In the shorter-term viewpoint, the core technologies for wide area ISR such as MIMO radar and dual-band IR sensor should be established. Afterwards, advanced distributed detection will be realized by expanding surveillance areas and diversifying platforms through improved sensor technologies and mountability.



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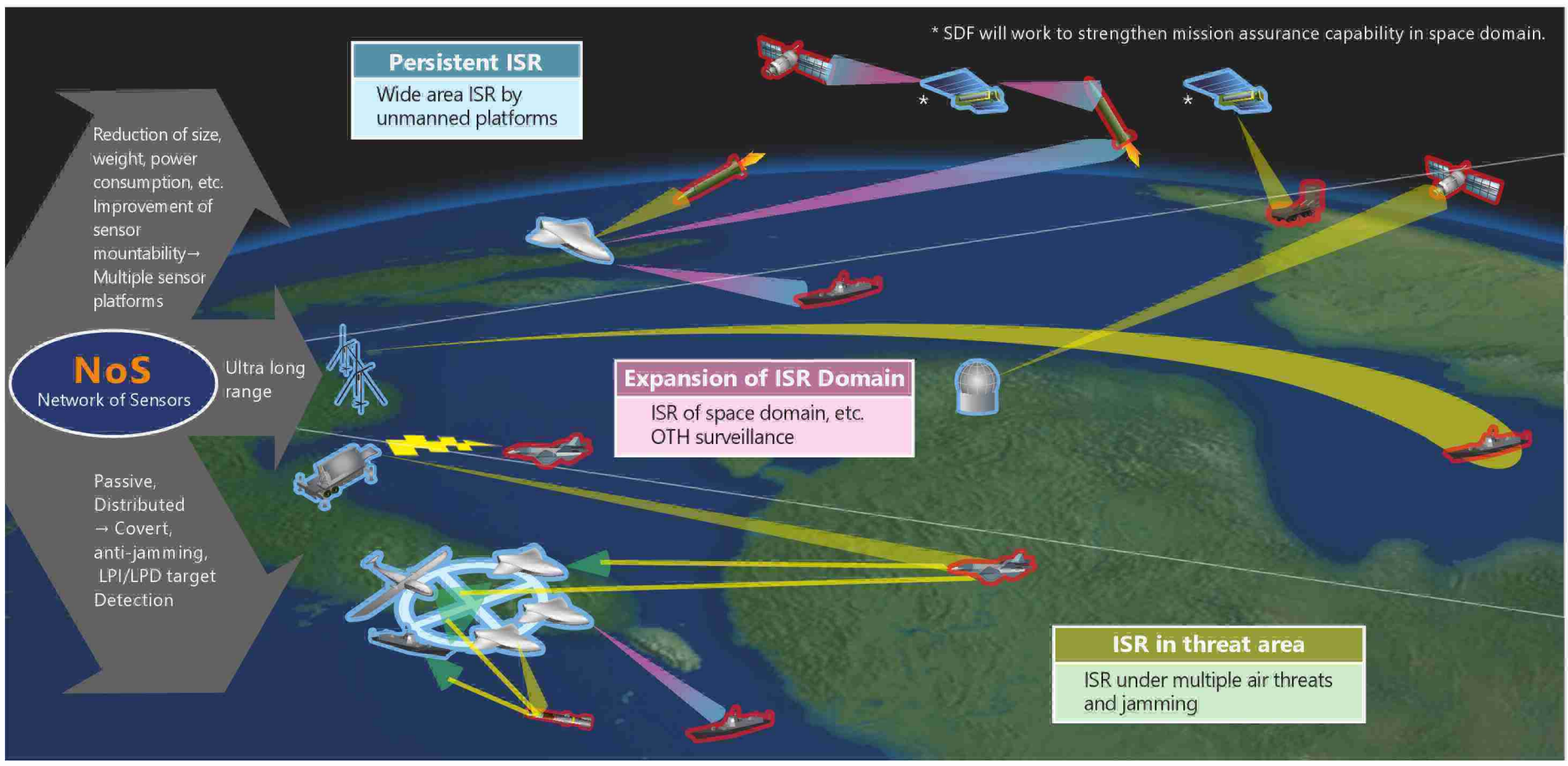
Future Notional Picture

Realization of effective persistent ISR for various targets across wide areas and multiple domains by utilizing combinations of multiple platforms including UAVs and satellites



Cyber Defense - Compatibility between preventive mea

The significance and issues

The stable use of cyber space is also absolutely imperative for the MOD/SDF. It is necessary to advance research of the latest technology centered around operation continuity measures of the system supporting the MOD/SDF activities, with strengthening close collaboration with relevant ministries and agencies.

Function	The status quo	Issues
General	• If stable use of cyber domain is disrupted, it may pose serious impact on the nation and the people. • Fundamental enhancement of cyber defense capability is required.	• Respond to sophisticated and complicated cyberattack • Need to strengthen close collaboration with relevant Ministries and Agencies • Acquire the capability to hinder use of cyber space by the opponent party to be used for attacks on our country in emergencies • Efficient operation using common and automation technology
Technology	• Separated networks consisting of open and closed systems • Utilize commercial technologies such as firewall and virus detection software, etc. to prevent cyberattack damage • Research of cyber exercise environment construction technology has been carried out from FY 2013.	• Optimization of cyber defense measure according to characteristics of closed network system (1. Fixed system; 2. Mobile system; 3. Built-in system) • Pursue compatibility between "Preventive measures" and "Operation continuity measures" because MOD/SDF's system cannot be stopped for a long time due to the characteristics of the system • Prepare practical training environment

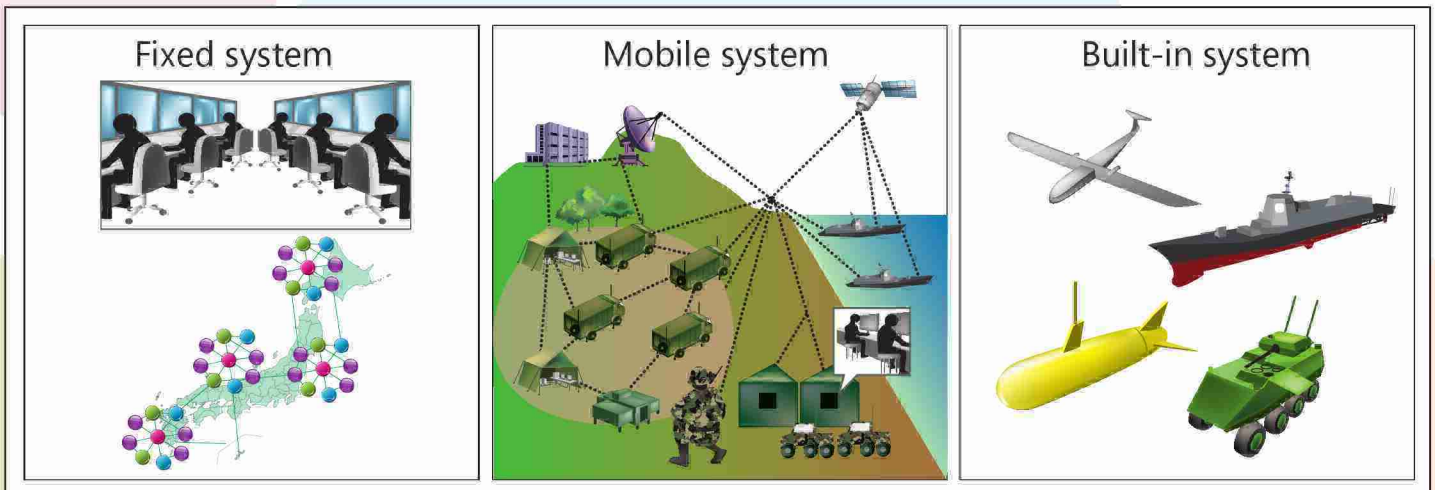
Technologies for the MOD/SDF to acquire

*Exemplifying potential important element technologies

"Capability-to-Disrupt" related Technologies

Preventive measures

Supply Chain Integrity　Vulnerability Inspection
Anti-Tamper　Cyber Counter Measure Technology for Platform
Built-in Systems　Firewall Anti-malware



Systems to support MOD/SDF activities

Manual Operation Continuity Measure

Cyber Range Construction

System simulation　Cyberattack Simulation
Cyber Countermeasure Measure　Cyber Countermeasure Evaluation
Cyber Range Control Information Collection　Cyber Range Recovery

Automatic Operation Continuity Measure

Cyber resilience technology

Resiliency of Control
Information management for system infrastructure and network infrastructure
Infrastructure controlling for system infrastructure and network infrastructure

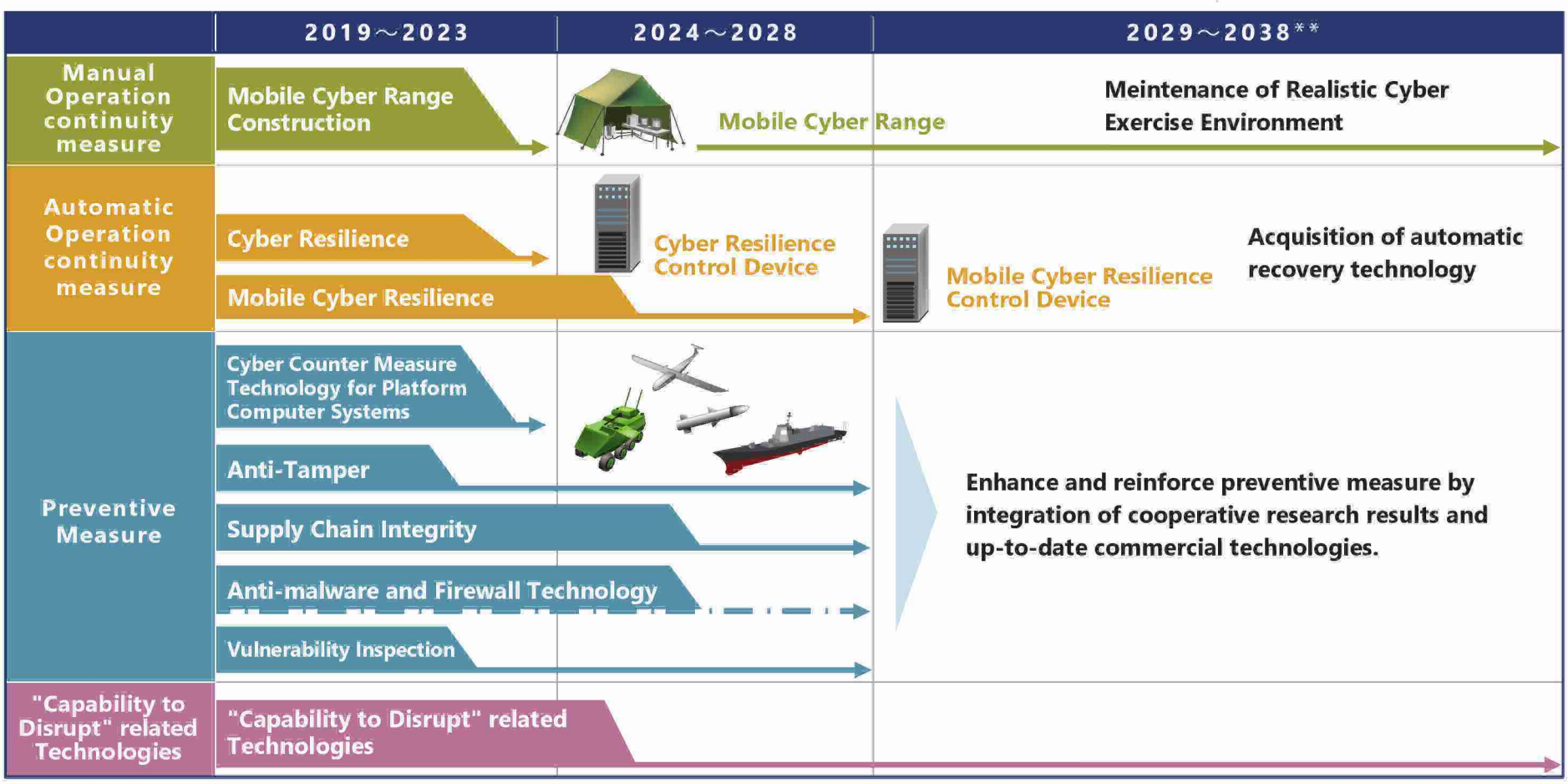
As for the technologies common to commercial sector among preventive measures, necessary technologies will be acquired by active use of advanced commercial technologies. On the other hand, as for the technologies difficult to procure from the market, such as equipped system cyberattack coping technology, vulnerability investigative technology, and operation continuity technology, we will strategically acquire those through our R&D because these are the MOD/SDF's specific requirements.

sures and operation continuity measures

Technological Roadmap

*These are just for illustrative purpose of possible future weapon systems, not any determined development plan.

In the shorter-term viewpoint, maintenance of a practical cyberspace training environment and reinforcement of cyber-security measures should be carried out. It will be corresponded with increasing threats and replacing systems in order to achieve compatibility between preventive measures and operation continuity measures as well as researches that contribute "capability-to-disrupt" related technology will be promoted at the same time.

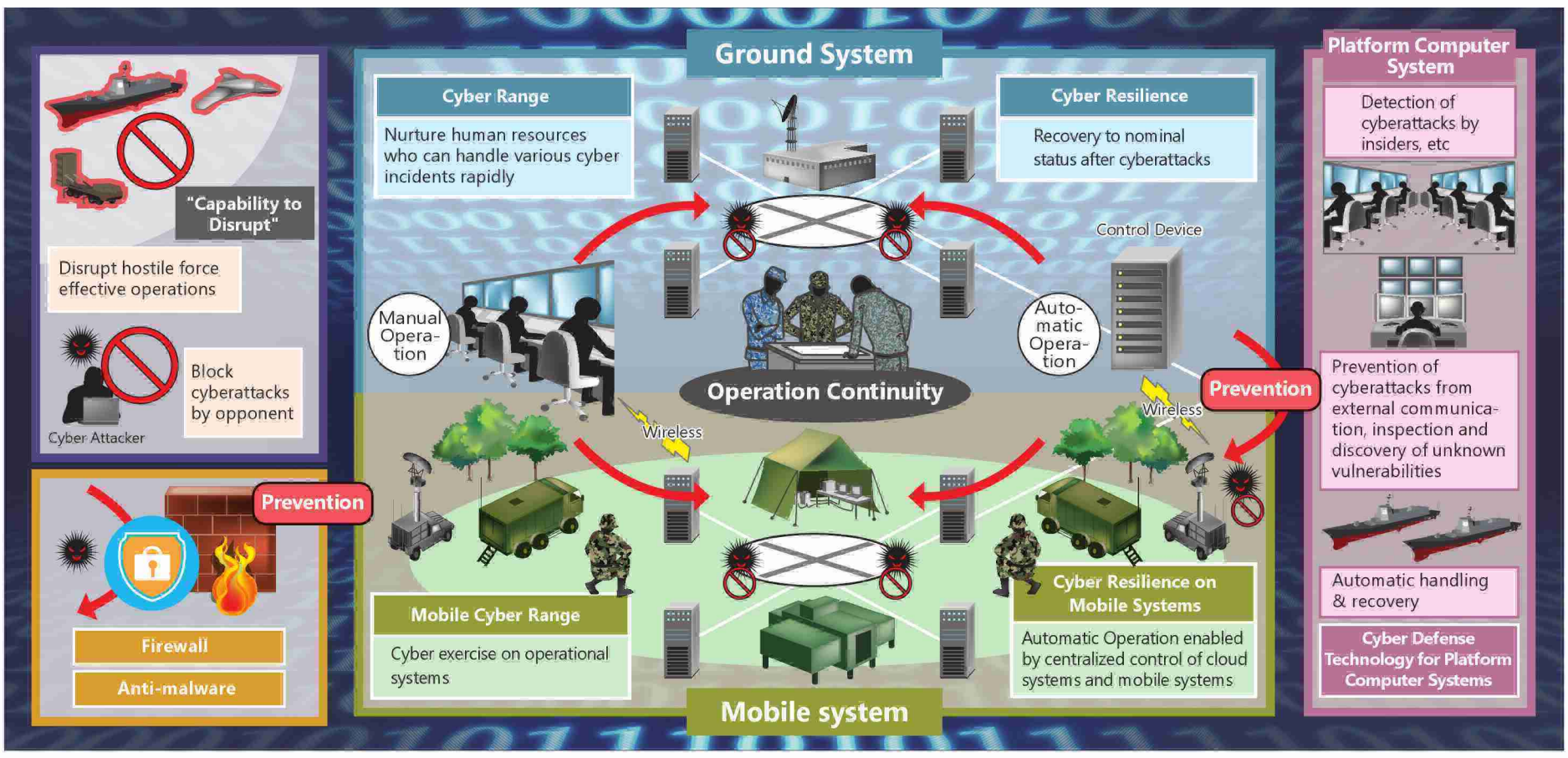


Acquisition by R&D led by ATLA, etc. Integration of latest commercial technologies

**The endpoints of arrows are tentative. In the view of the concept of streamlining R&D, we will endeavor to obtain the technologies earlier.

Future Notional Picture

Automatic recovery capability will be acquired in parallel with introduction of realistic cyberspace exercise environment as operation continuity measures suitable for MOD/SDF's systems as well as preventive measures will be improved and reinforced.



Underwater Warfare(UWW) - Towards the Re

The significance and issues

It is a basic issue to realize multi mission unmanned vehicle as well as to realize overall technology for unmanned and manned vehicle to collaborate organically as underwater defense systems in order to improve underwater defense capability and efficiency drastically.

Function	The status quo	Issues
ISR	• Wide search area, increase of underwater ISR targets and activation of their activities • It is necessary to collect vast oceanic data over a wide area for underwater ISR. • It is necessary to share collected data in real time.	• Improve search efficacy by way of improvement of sonar performance and collaboration between unmanned and manned vehicles • Realize efficient collection of oceanic data in the long time using many UxVs • Realize high-speed and high-capacity long range underwater communication.
Support	• The method for unattended deployment and supply of the vehicles related to underwater defense in the ocean is necessary. • In case UUVs increase, efficient command and control from ground HQ is necessary.	• Realize automatic deployment, recovery, supply, power charge, maneuver, etc. of unmanned vehicle, etc • Realize efficient command and control and support for unmanned vehicle's activities from ground and manned vessels
CM	• Inexpensive neutralization method against inexpensive underwater vehicles such as UUV, etc. is necessary. • Covert invasion, etc. into the area where maritime dominance is not secured is high-risk.	• Realize inexpensive neutralization method against mobile targets such as unmanned vehicle, etc • Improve LPD by interfering target's sensor and reducing UUV signature
General	• It is necessary to improve situational awareness, decision making and reliability of unmanned vehicle to realize completely unmanned long endurance operation.	• Improve unmanned vehicle's autonomy and reliability through enhancement of situational awareness and decision making to realize long endurance completely unmanned operation

UUV : Unmanned Underwater Vehicle, UAV: Unmanned Aerial Vehicle

* Underwater includes water's edge.

Technologies for the MOD/SDF to acquire

It is required that the acquisition of component technologies to enhance ISR, support and CM capabilities and that of the autonomy technologies that is essential to persistent wide-area operation by unmanned systems through integration of results of domestic R&D organizations and reflection of up-to-date technologies.

Component technologies required to resolve tasks

ISR

Detection
- Multi-static sonar (multi source)
- Broadband
- Small & power saving (sensor & signal processor)

Wide Area ISR
- Small & high capacity energy source

Underwater Communication
- Acoustic (long range)
- Optical (high capacity)

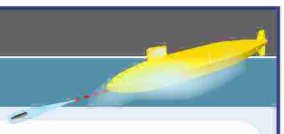
Support

Automatic docking
- Automatic UAV T/O & L/D
- Automatic launch & recovery of UxVs

Charge, Supply, Maneuver
- High-speed underwater power transfer
- Unmanned amphibious Vehicle

Command & Control
- Automatic DB configuration
- Planning support
- Underwater communication relay via satellites

CM



Counter Measure
- Super cavitation ammunition
- Anti-torpedo torpedo

Signature Reduction
- Acoustic meta-material
- Active noise cancelling

Sensor Jamming
- High power acoustic jamming
- Acoustic signal responder as decoy

UxVs' essential technologies

Autonomy

Situational Awareness (SA)
- Automatic detection, ID, classification
- Data fusion of heterogeneous sensor info

High Reliability
- Anomaly detection
- Trouble shooting

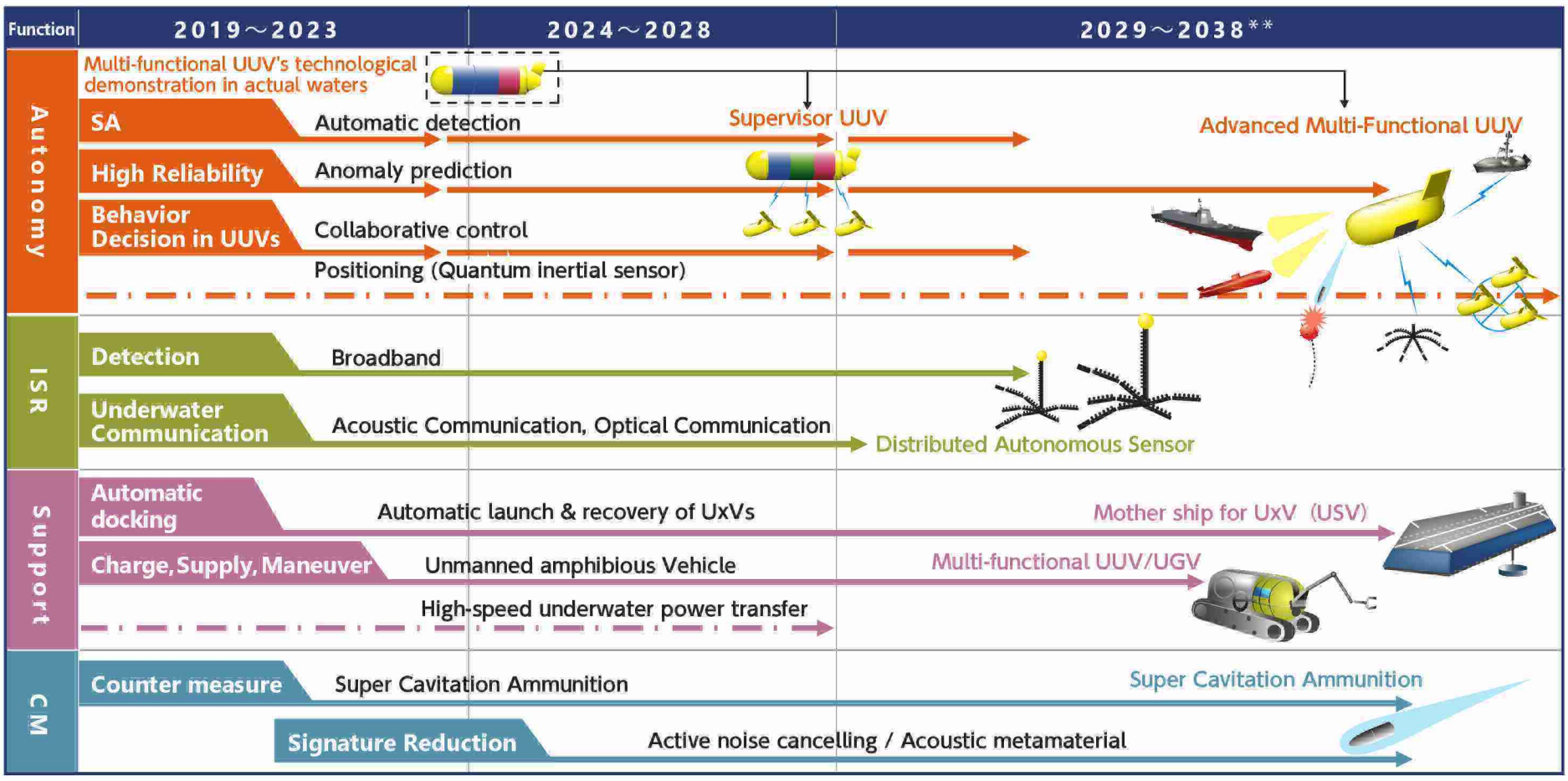
Behavioral Decision
- Collaborative control
- Positioning

alization of Effective UWW Using Unmanned Technologies

Technological Roadmap

*These are just for illustrative purpose of possible future weapon systems, not any determined development plan.

In the shorter-term viewpoint, the underwater core technologies such as long-range UUV, etc. should be established. Afterward, underwater defense will be realized that utilizes unmanned vehicles by improving underwater communication and other element technologies for underwater ISR through module approach for early acquisition.

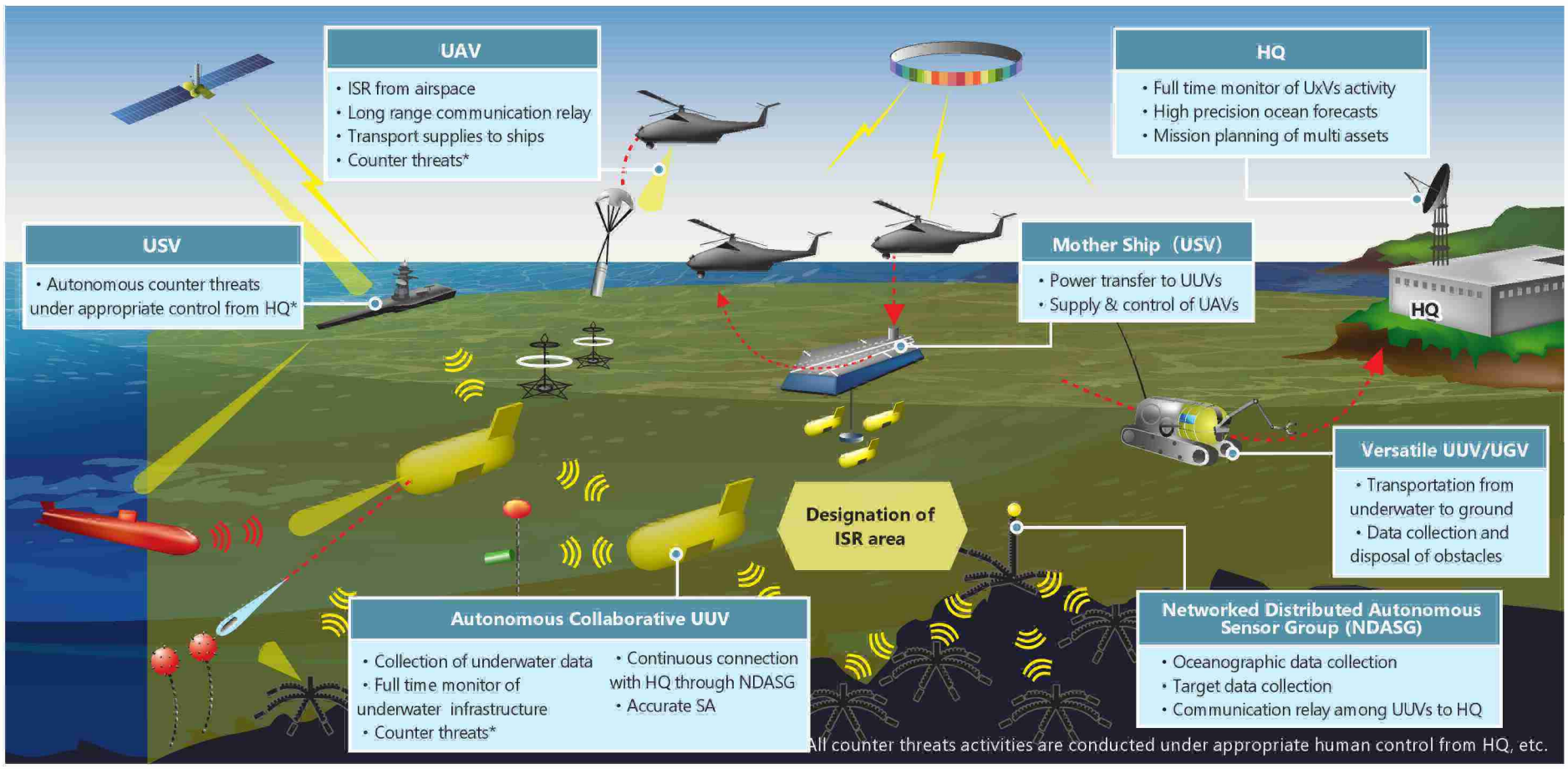


Acquisition by R&D led by ATLA, etc. Integration of latest commercial technologies

**The endpoints of arrows are tentative. In the view of the concept of streamlining R&D, we will endeavor to obtain the technologies earlier.

Future Notional Picture

Multiple UxVs such as UUV, USV, UAV, etc. autonomously coordinate each other, and conduct UWW activities such as ISR, support, CM, etc. in designated area under monitoring from HQ, etc.



Stand-off defense technologies - Realization of Stand-off defe

Significance and issues

It is necessary to acquire technologies contributing to a stand-off capability out of foe's effective zone that enables to negate highly-threatened targets, securing personnel's safety thanks to its high survivability with long range, hypersonic velocity, etc.

Function	The status quo	Issues
Fire control	• In case of invasion to our country, it is necessary to collect accurate information of the objects such as invasion warship and to assess effectiveness of firings after events in a wide area and at long distance. • It is necessary to have communication means to guide missiles and so forth to over-the-horizon area. • Redundancy of positioning means is necessary.	• Improve abilities to search and track a warship and a landing force in wider area and at longer distance • Secure communication means beyond the horizon • Secure alternative positioning means replacing the capability of GPS
Guidance	• Considering higher stealthy of worships of each country, further improved technology of guidance is necessary.	• Improve technology relevance to guidance against the object being difficult to track • Secure environmental resistance during flight corresponding to the progress of propulsive technology
Proplusion	• It is necessary to take counter actions while securing safety of SDF personnel due to improvement of each country's wide-area warning and surveillance capability, as well as of anti-ship and anti-surface missile. • It is necessary to secure high survivability in response to the improvement of the capability of each country's interceptor.	• Acquire propulsive ability to allow missile to negate at longer distance and shorter time from outside the opponent's defensive zone (longer-time and higher-speed operation) • Acquire propulsive ability and maneuverability to make opponent interceptor's response difficult (flight at high altitude and at the speed, and so on to have a difficulty to respond)
Airframe and warhead	• It is necessary to acquire effective attacks against the warship and landing force invading to our country. • It is necessary to acquire heat-resistant materials to correspond to upgrade of missile's performance.	• Acquire the effective and efficient defense capability with less missile against the warship with thick armor and the landing force landed and deployed • Improve heat resistance of airframe's capable of corresponding performance upgrades

Technologies for the MOD/SDF to acquire

Intensively foster the following technologies regarding: 1. fire control; 2. guidance; 3. proplusion; 4. airframe and warhead, to be necessary to realize a stand-off defense capability with hypersonic velocity, utilizing effectively technologies of non-military area.

Function		Issue
Fire control technology		(Refer to "Persistent ISR Capability over Wide Area Including Space" in the R&D Vision for the improvement of search and track capability) (As for the over-the-horizon communication, relay by satellites, etc. is assumed.) • GNSS/INS guidance technology which improves not only accuracy of positioning for projectile with high velocity and agility but resistant against GNSS jamming by integrating information of multiple GNSS including quasi-zenith satellites with INS
Guidance technology		(Required functions and performance depend on allocation for satellites' and sensors' capability.)
	Infrared technology	• Guidance technology utilizing infra-red imaging which discriminates low-contrast object with referring seeker information with database • IR seeker dome technology to realize both IR imaging and discriminating objectives which makes securement of heat resistance for hypersonic environment
	RF technology	• Guidance technology with RF imaging which realizes discrimination of stealth vessel, etc. by creating picture with Doppler information
Propulsive technology		• Scramjet engine technology for longer operating time in hypersonic velocity • Advanced solid rocket motors, having its case made with carbon fiber filament wound on propellant for longer range
Airframe and warhead technology		• Advanced warhead technology for anti-surface missile, such as a light-weight and high-effective penetration warhead or a high-density EFP warhead for area suppression • Aerodynamic design of hypervelocity gliding projectile to allow its heat-resistance and stable gliding over a various flight path from high altitude to low altitude at the impact • Aerodynamic control for stable gliding in the weak atmosphere, combined its attitude control by thruster with its aerodynamic control by fin surface

Effective applying of non-military technologies
- Sensor devices
- High-density outfitting
- AM technologies
- Dispersive and collaborative processing technologies

Acquisition of vital technologies by cooperation or collaboration with research institute, etc.

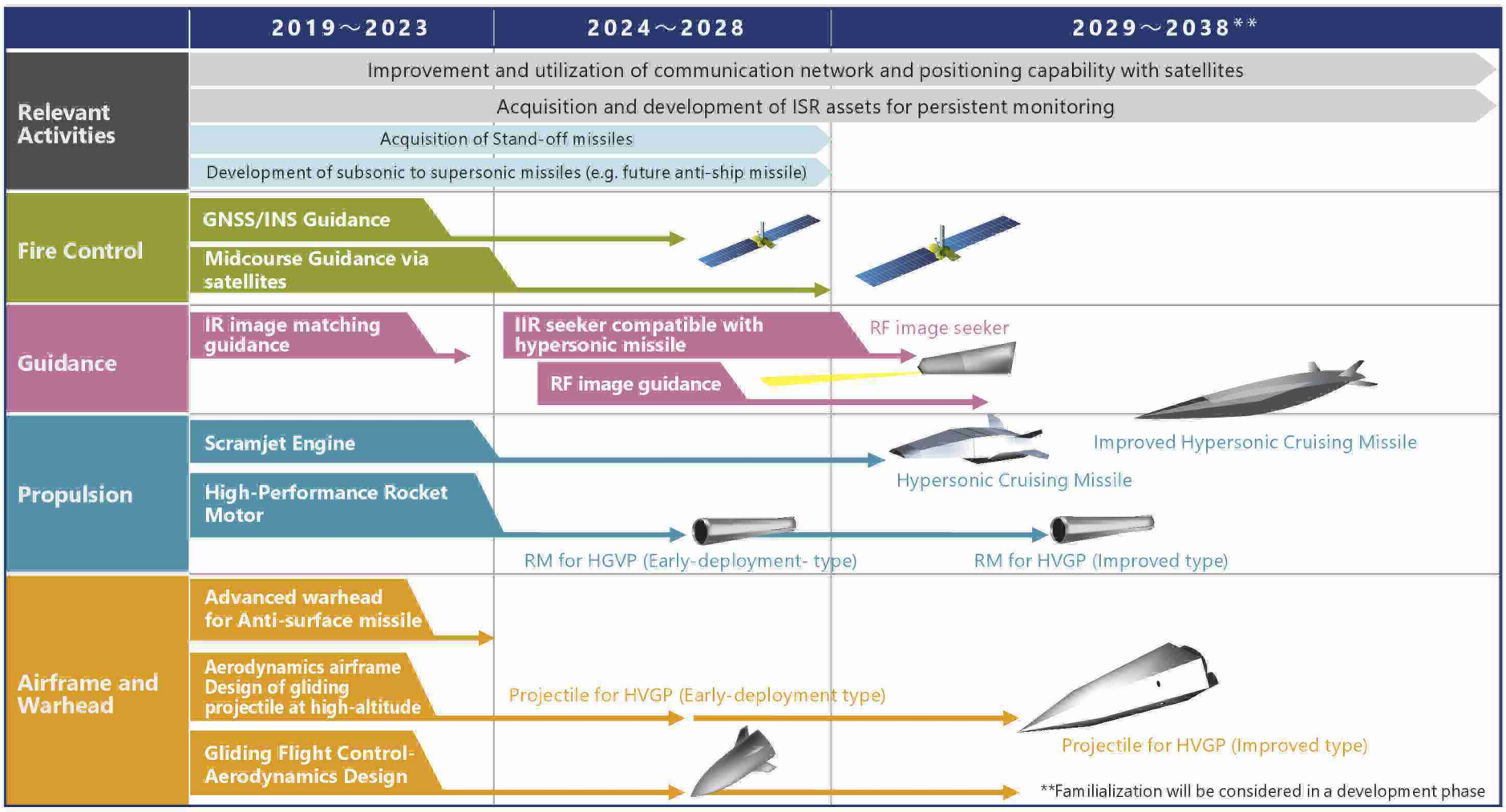
* Exemplifying potential important element technologies

nsive attack capability out of foe's effective zone with Hypersonic Projectiles

Technological Roadmap

*These are just for illustrative purpose of possible future weapon systems, not any determined development plan

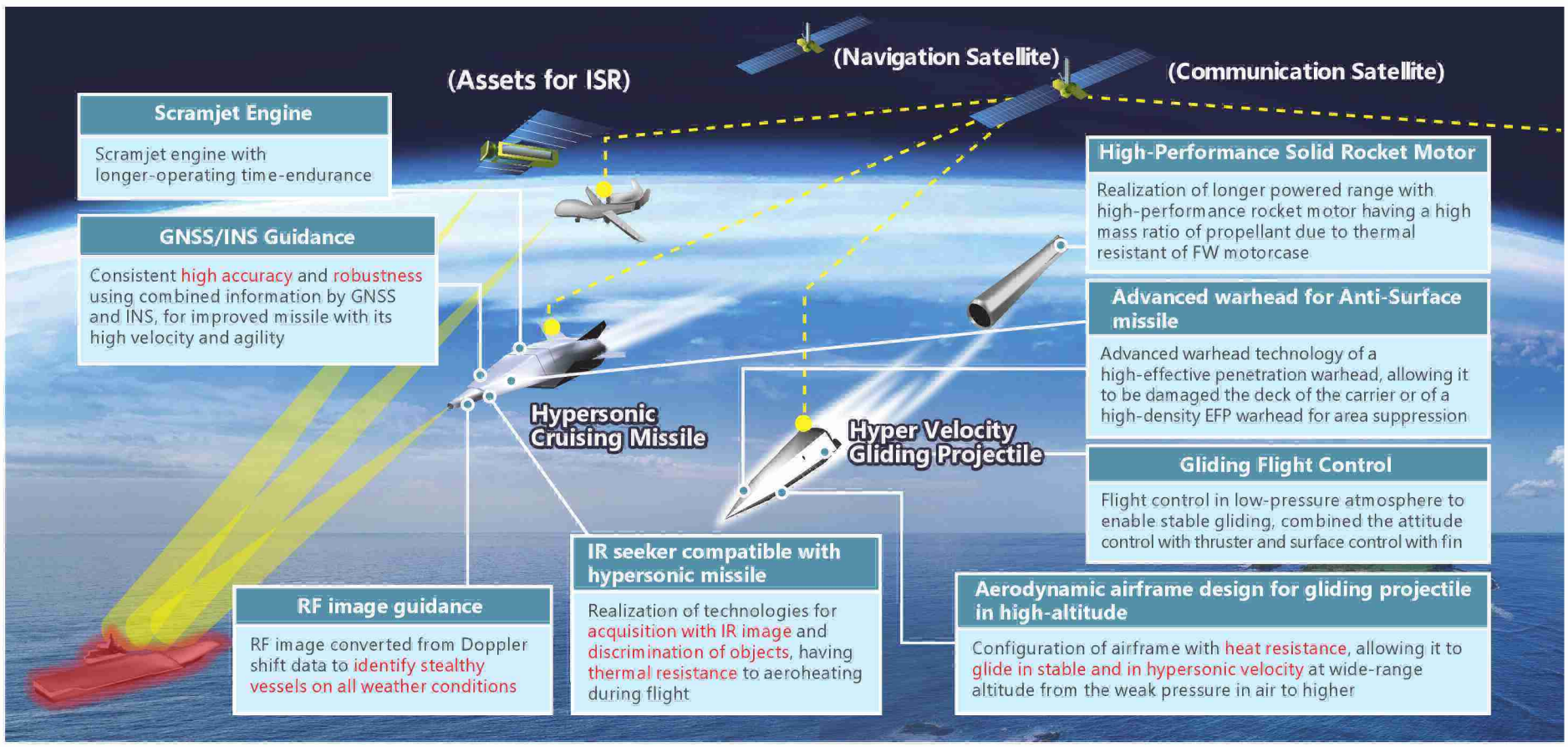
In the shorter-term viewpoint, the core technologies of an early-deployment-typed hypersonic projectile, etc. should be established. Afterward, the technological outcomes of R&D for warhead, guidance, and hypersonic propulsion will be quickly reflected to the weapon system, doing stepwise improvement and earlier technological demonstration



**The endpoints of arrows are tentative. In the view of the concept of streamlining R&D, we will endeavor to obtain the technologies earlier.

Future Notional Picture

To be prepared for future threats, with various assets for ISR and communication network, stand-off defensive attack capability by hypersonic missiles with scramjet engines and/or hyper velocity gliding projectiles accelerated by solid-propellant rocket motors should be strengthened



Conclusion

To strategically foster promising technologies given severe fiscal situation, it is important to implement steadily relevant research projects in line with the R&D Vision.

In promoting these projects, not only continuous study by technological, political and operational parts in unison within the MOD, but strengthen of technological exchanges with related agencies and collaboration with governmental ministries, and/or application of ATLA's funding system named "the Innovative Science and Technology Initiative for Security" should be done, then usage of advanced technologies, especially of dual-use technology, should be necessary.

As AI and quantum technologies for computing, sensing, and communication make rapid progress due to their advancement borderlessly and in dual use, especially in commercial area, contentious progress and reflection of state-of-art technologies should be endeavored according with technological advancement in domestic and international.

The R&D Vision shows technologies to be acquired for MOD/SDF accounting on current outlook, considering discussion of MOD/SDF, not including thoughts or any information of industries.

Afterward, in promoting the relevant project, discussion for drastically shortening of acquisition period including R&D phase and earlier deployment would be accelerated with active proposals from industries and so on.

In addition, promoting activities in R&D under the R&D Vision would contribute to secure safety and peace of our country and people, accompanying not only with acquisition of vital capabilities necessary for our defense, but with comprehensively level-up of national scientific technologies.

Besides, the R&D vision would be timely and properly reviewed, considering not only change of security environment surrounding our country and remarkably rapid progress of scientific technology, but political direction, operational needs, technological trend, etc.

Acronym List

A2/AD	Anti Access/Area Denial
AI	Artificial Intelligence
AM	Additive Manufacturing
ATLA	Acquisition, Technology & Logistics Agency
CM	Counter Measure
EA	Electronic Attack
EFP	Explosively Formed Projectile
ELINT	Electronic Intelligence
EMP	Electromagnetic Pulse
EP	Electronic Protection
ES	Electronic Support
EW	Electronic Warfare
FW	Filament Winding
EO/IR	Electro-Optical / Infrared
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HVGP	Hyper Velocity Gliding Projectile
HQ	Head Quarters
ICT	Information Communication Technologies
ISAR	Inverse SAR
ISR	Intelligence, Surveillance and Reconnaissance
INS	Inertial Navigation System
JAXA	Japan Aerospace eXploration Agency
LPI/LPD	Low Probability of Intercept / Low Probability of Detection
MIMO	Multi-Input Multi-Output
MOD/SDF	Ministry Of Defense / Self Defense Force
NDPG	National Defense Program Guidelines
OTH	Over The Horizon
RF	Radio Frequency
RM	Rocket Motor
SA	Situational Awareness
SIGINT	Signal Intelligence
SAR	Synthetic Aperture Radar
SSA	Space Situational Awareness
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
USV	Unmanned Surface Vehicle
UUV	Unmanned Underwater Vehicle

R&D vision was orchestrated by R&D vision formulation committe in MOD.

【R&D vision formulation committe】

Chairperson: Deputy Commissioner and Chief Defense Scientist, ATLA

Member: Deputy Director General, Bureau of Defense Policy;
Deputy Director General, Bureau of Defense Buildup Planning;
Director, Defense Plans and Policy Department, JSO;
Director, C4 Systems Department, JSO;
Director, Defense Policy and Programs Department, GSO;
Director, C4 Systems and Intelligence Department, GSO;
Director General of Operations and Plans Department, MSO;
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Director, Defense Planning and Policy Department, ASO;
Director General, Department of Equipment Policy, ATLA;
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