TERCOM
人を育て未来を創造
Develop My Talent,
Create Our Future

JGSDF 2040

15 JULY 2025

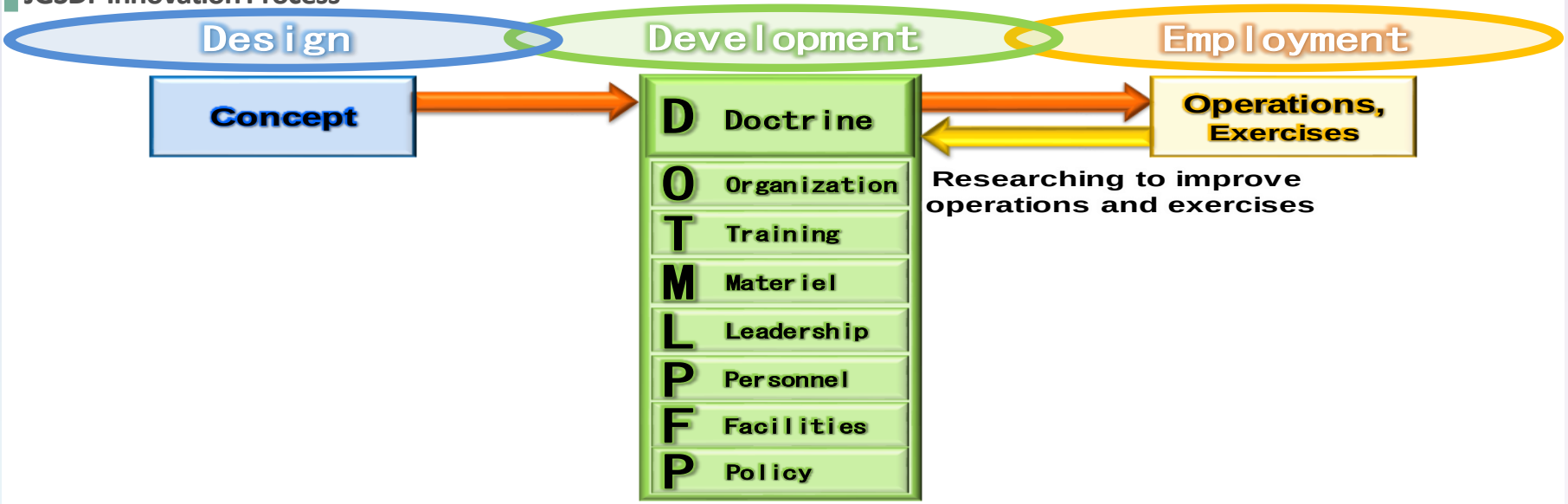
JGSDF Training Evaluation, Education, Research and Development Command (*TERCOM*)

Leading Innovation of the JGSDF

Research of “Future Operations and Ways of fighting of JGSDF around 2040 ”

Aim of this Research	- As TERCOM , a think tank of JGSDF, we are thinking about JGSDF's future concept. - For contributing to proceed “JGSDF Innovation Process”, we research and discuss with various organizations, and publish our report.

JGSDF Innovation Process



Methodology	Based on strategic environment, advanced scientific and technological trends, and developments in military theories of various countries around 2040, we consider direction of future fighting and exemplify new equipment and technologies to acquire capabilities to realize the ways.
Item	1 Future Strategic Environment 2 The Future of the Characters of Warfare(1/3) 3 Military theories 4 Direction of Future Warfighting 5 New equipment and technologies to acquire capabilities in the future , etc.

- Changes in Power balances and intensifying geopolitical competition.
- Development in science and technologies changes national security aspects.
- Global issues; cyber, disinformation, climate change, etc.

Emerging Challenges

→ Severer and more complex environment

Emerging technology and affects to War-Fighting Functions

Summary

With the advancement of science and technology, the use of AI, information and communication technology, and non-kinetic means are increasing. Therefore, each War-Fighting Function around 2040 will change dramatically.

Tech		Element
AI		Information mass processing, decision making , unmanned
Robotics		Human replacement, swarm control
Nano		Reinforced material , micro sensors
Bio		Regenerative medicine (some organs), artificial blood
Neuro		Machine control by human brain waves, reading emotions from human brain waves
Quantum	PC	Ultra-high-speed information processing, cryptanalysis
	Crypt	Highly secure encryption
	Sensor	High-precision sensors (positioning, detection)
ICT		High speed, high capacity, low latency, many connections
Energy	High power laser	Low cost, instantaneous engagement, continuous engagement
	HPM	Low cost, instantaneous engagement, destruction by non-physical means
	Railgun	Instantaneous and continuous engagement
	Power storage	High energy density next-generation batteries
	Generation	Power generation from waste, ultra-compact power collection
Manufacture		3D printing
Space	SAT Com	Large tolerance of satellite
	Collect Info	Precision positioning
	Obstruct GNSS	Satellite use jamming, EM attack to ground stations
EMS	Sensor	Miniaturization and high performance of various sensors
	Deception	Location spoofing, decoy
Fire	Missile/Rocket	Longer range, higher speed, higher power
	Heavy caliber	Longer range and higher power
Mane-uver	Air	eVTOL , stratosphere maneuver
	Under water	USV,UUV
Prote-ction	Multi-layered	Active protection
	Deception	Visible decoys, EM decoys,…etc.

Function	Tendency
C2	AI and information and communication technologies will improve intelligence and communication capabilities.
Information	Emergence of new means of information gathering and analysis through AI and other means will increase importance of cognitive abilities.
Intelligence	Developments of sensors, UAVs, and satellites will improve the ability to collect and share target information.
Strike	Means of striking, including non-kinetic, such as energy weapons will be increased. Long-range firepower will be achieved.
Movement and maneuver	Means of maneuver and space to be utilized will be diversified due to elimination of needs for strategic maneuvering of long-range firepower and developments of unmanned vehicles.
Protection	Developments of disguise, deception and multiple protection techniques actively nullify strikes.
Sustainment	AI, drones, and energy generation will improve human and organizational resilience.

(Originally created by TERCOM based on “Defense Technology Guideline 2023(Previous section)”, etc.)

The Future of the Characters of Warfare(1/3)

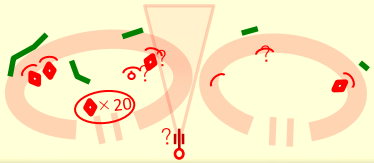
Transformation of Battlefield

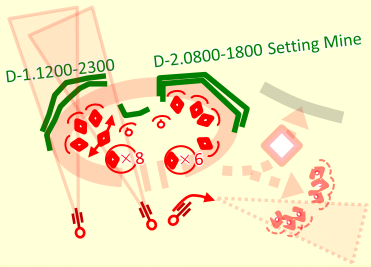
Summary

- The future battlefield will be transformed as more extend, integrated, and accelerated.
The three main reasons for this are
(1) The visualization of the battlefield and information sharing.
(2) Expansion and contraction of the battlefield.
(3) Changes in the relationship between space and time.

Visualization of battlefield

【Current】
- Less info
- Estimation based enemy analysis

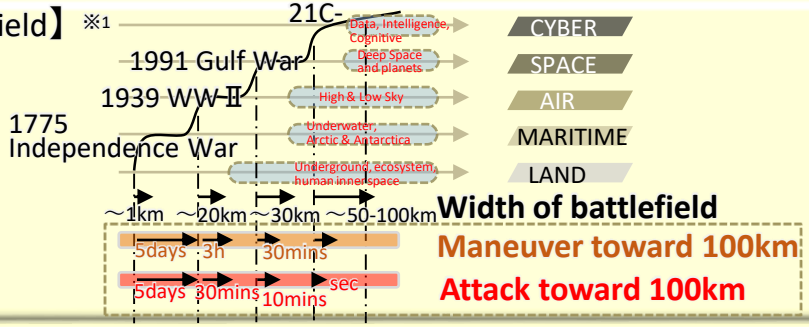




【Future】
- Realtime monitoring
- Analyzing past data and assuming enemy's next action.

Expansion & Contraction

【Expanding the Battlefield】 ※1

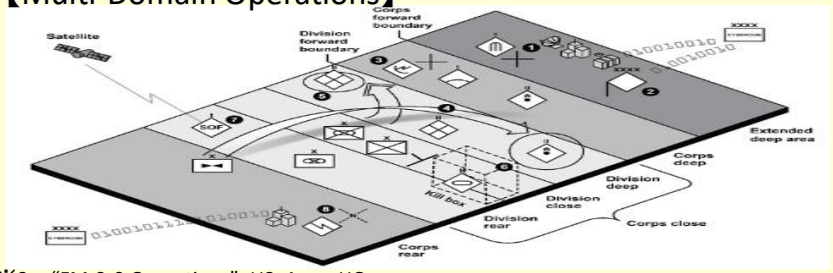


※1 L.gen Eric Wesley, US. Army.

- The domain and width of battlefield is expanding.
- The time to reach is decreasing by high speed movement and long range fires.

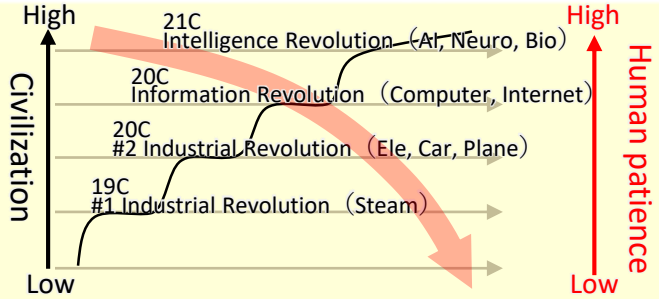
Changing relation between Space & Time

【Multi-Domain Operations】 ※2



※2 "FM-3-0 Operations", US. Army HQ.

There are no frontline and each side engage wide area.



Improving Quality of life lessen human patience.

(Originally created by TERCOM based on "Emerging technology (Previous section)" and "Military theory(Previous section)")

The Future of the Characters of Warfare(2/3)

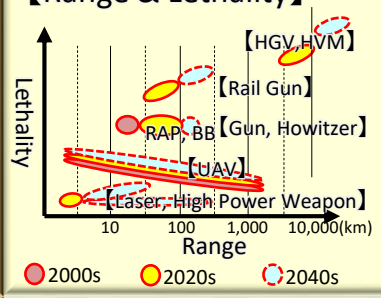
Transformation of relationship between Strike & Protection, Fire & Move, Attack & Defense

Summary

- It is difficult for each actors to take advantage or predominant because of increased firepower effectiveness, redundancy, and web-structured military organization.
- These factors also alter the relationships between striking and protection, fire and maneuver, and attack and defense.
- The competition to adapt military systems extends not only to the software but also to the hardware, like optimizing weapon capability, even for short-duration operations.

Strike has advantage Protection

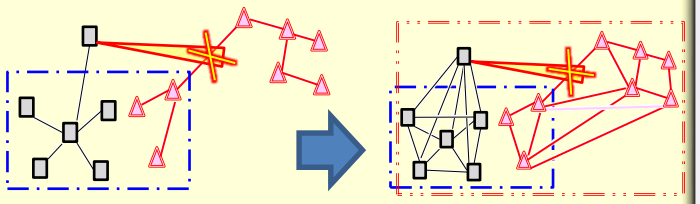
【Range & Lethality】



【Survivability of Onion】

It will be hard to protect by ordinal methods.

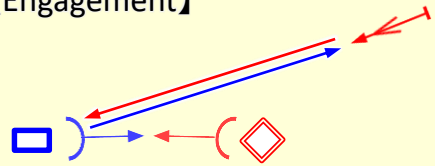
【Kill-Chain to Kill-Web】



- Kill Web decreases structural vulnerabilities.
- Quantity is more emphasized than Quality.

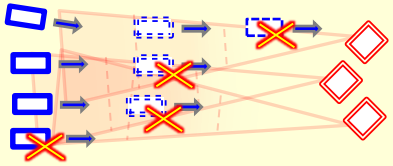
Relations between Fire & Move, Attack & Defense

【Engagement】

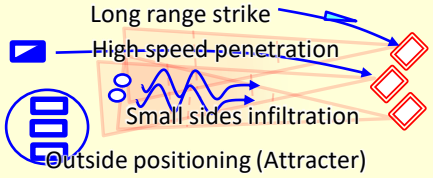


- Each engagement area will be extended.
- The ground engagement area will not chang so much.

【Relationship between Attacker & Defender】



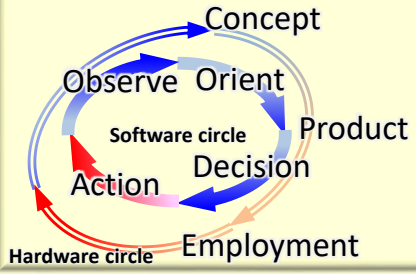
- The Maneuver element risks not reaching target position.



- Each actor seeks to avoid adversary's detection and fire.

Competition of adaptation

【Competition of Software & Hardware Adaptation】



- Weapon will be optimized and modified in less time.
- Each actor compete with not only software adaptation but also hardware.

【Using Positive feedback system】

- Generally every organization works based on negative feedback.
- It's useful to use positive feedback system for controlling adversary.

(Originally created by TERCOM based on "Emerging technology (Previous section)" and "Military theory(Previous section)")

The Future of the Characters of Warfare(3/3)

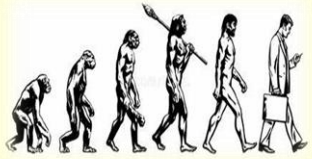
Expansion of human and organizational capacity

Summary

- Human abilities will improve as the human body and brain are elucidated, and human senses and values will change along with these changes.
- Changing the ways of cooperation among humans, human forms, and the roles and relations man-machine teaming

Improving human ability

【Importance to learn Anthropology】



- Human stopped evolution until Neolithic era.
- We also need to know unconscious mechanism.

【Expanding the ability of sense, brain, communication】

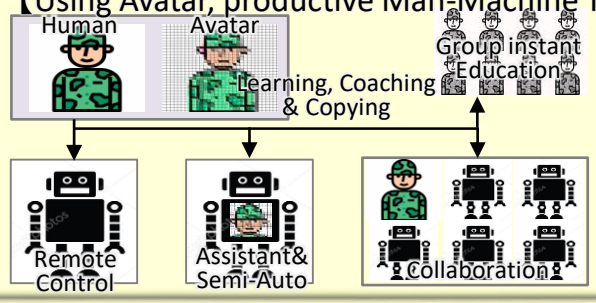
- Haptics enable to obtain new sense & experience.
- Tech enhances human ability of sense, brain etc…

Transformed human and using Avatar

【Transformed human 】

- Tech change definition of “Intelligence” and “Human”.
- Machine-sense, trained Organoid

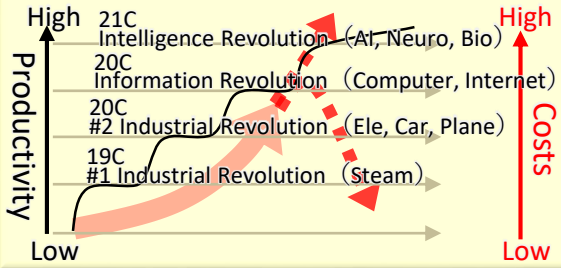
【Using Avatar, productive Man-Machine Teaming】



- Virtual assistant & Avatar help human tasks.
- Remote control & behavior copy enable Man-Machine Teaming.

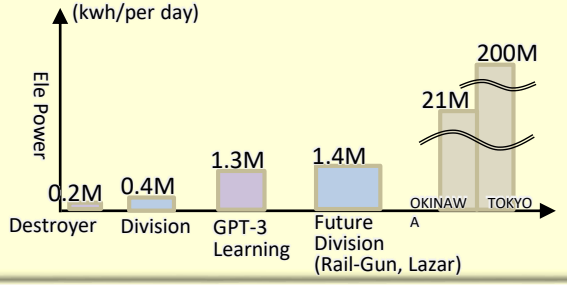
Productivity & Costs

【Increasing productivity & costs】



- Productivity will continue increasing.
- Will singularity come or not?
- Will running cost decrease?

【Increasing Electric power requirement】



(Originally created by TERCOM based on “Emerging technology (Previous section)” and “Military theory(Previous section)”)

Developments of military theories after WWI

Summary	○ Since Industrial Revolution, military theories have been developed dramatically in various countries. Especially, after WWI, the field of military issues were regarded as "not the field of soldiers own." In addition, issue of military and security field, domains and measures have been expanding sequentially. ○ Each actors seeks to their advantage by establishing their own unique solution, especially using asymmetric means. We also need to think about our own military theory and thought based on our unique history and strategic culture.

Strategical

Operational

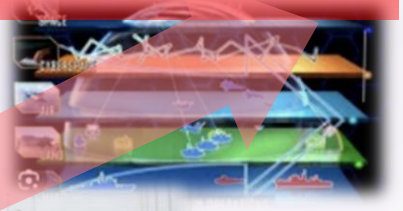
Tactical

People's War

Local wars under high-tech conditions

Intelligentized Warfare

Multi-Domain Operations



Maneuver Warfare

Strategic Paralysis

Deep Operations

Air Land Battle

Trench Warfare

- Since WWI, military theory has been progressively developed in the direction of expanding their field, space, and domain to avoid attrition and enhance their efficiency.
- In Europe and the U.S., they expand military thought beyond the military aspects(politics, space, cyber), and since Gulf War they emphasis the technology.
- China has developed their own unique military theory, drawing on Europe and the U.S. for reference.

WW Ⅰ | WW Ⅱ | Gulf War | Iraq War

1900 | 1940 | 1990 | 2020～

【Source： U.S Army, "FM-3.0 Operations", Oct 2022, U.S Army, "Operations FM100-5",1982 , National Defense University(China), "ZHANLUEXUE",2020】

Defeat Mechanism(1/2)

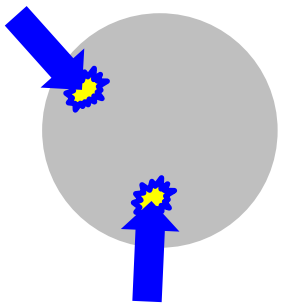
Summary

- There are two conventional defeat mechanisms: “Attrition," which attempts to defeat the enemy by physically destroying the enemy, and “System Disruption," which attempts to defeat the enemy by destroying the enemy's core and severing critical networks.
- The conventional system collapse approach will become more difficult as networks become more interconnected and redundant in the future. For this reason, two techniques ("dislocation" and "disorientation") are introduced to the traditional approach with the goal of leading the adversary's system to collapse more efficiently

Conventional Defeat Mechanism

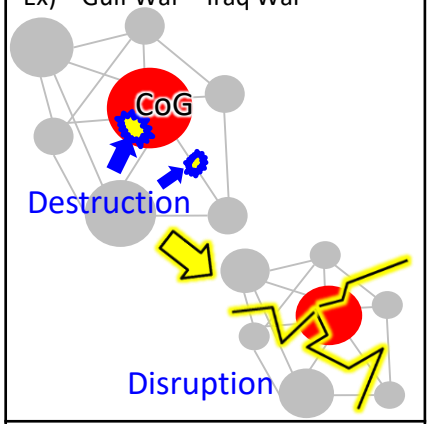
Attrition

Ex) -Trench warfare(WW Ⅰ)



- Destroy enemy directly.
- Counting accumulation of killed soldiers or destroyed equipment.

Ex) – Gulf War - Iraq War



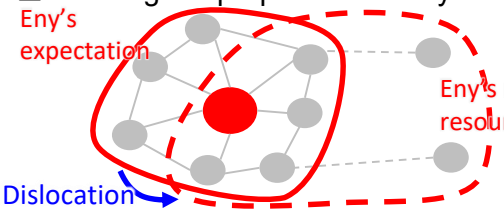
- Regarding enemy as whole system and striking CoG(Center of Gravity) or cutting links.
- Evaluating enemy’s organizational paralysis.

Extended Defeat Mechanism

System Disruption

Dislocation

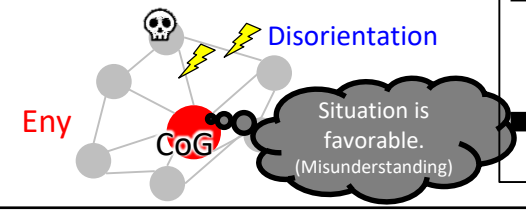
- Losing the purpose of enemy’s actions by changing boundary.



- Changing enemy’s structure or elements of whole system.
- Indirect-approach, circumvent, changing vital battlefield, deception

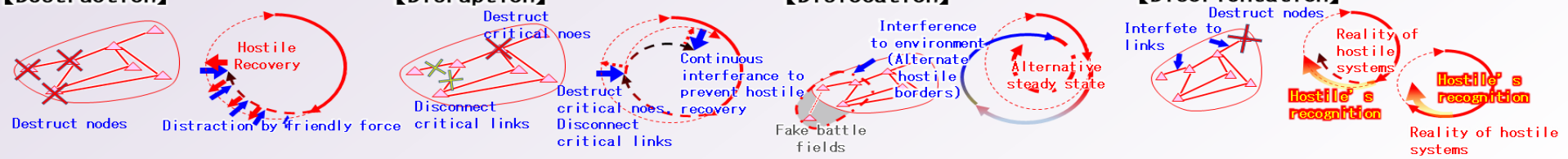
Disorientation

- Misleads enemy’s commander about situation and inhibits normal decision making.



- Misleading enemy commander into thinking a favorable is unfavorable or vice versa.
- Cyber attack, EW, false signal, overfitting.

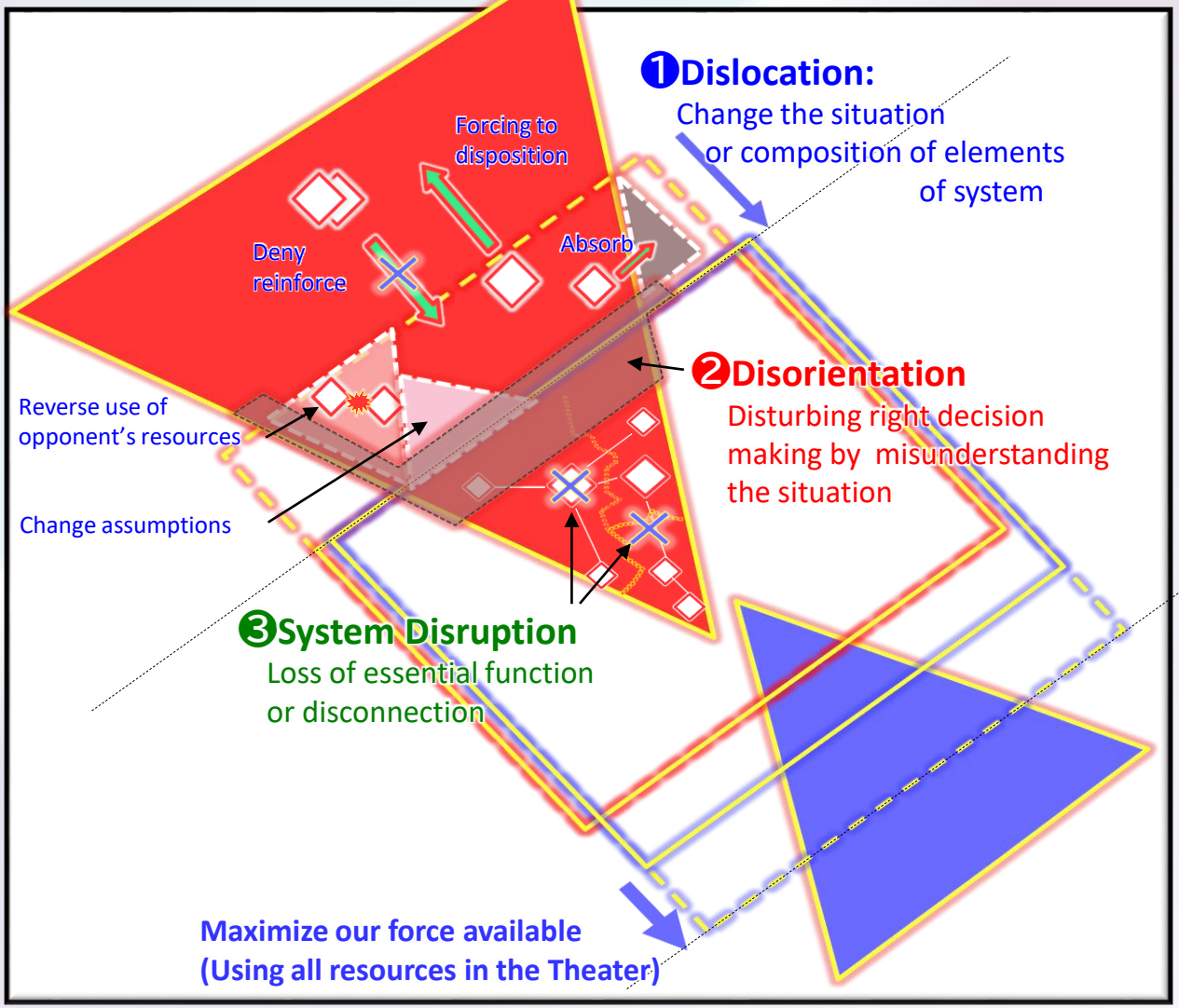
Utilization of Feedback Systems in “Defeat Mechanism”



Footnote: Marinus, “On Defeat Mechanisms: Maneuverist Paper No. 10”, Marine Corps Gazette July 2021
OZAKI Anna, “War in Time and Space - A new way to fight a maneuver warfare utilizing “Speed” of time as an advantage- ”, TERCOM Research 2023

Defeat Mechanism(2/2)

Specific measures for each method of defeat mechanism	- Specific measures for realizing the defeat mechanism include "Dislocation" , “Disorientation“, “System Disruption” and ” Attrition ” ,which are shown in the table below. - “Disorientation,” which prevents normal decision-making and behavior due to misperception, includes “Dislocation” and aspects used as means of “System Disruption" also exist.



Specific measures and some examples		
❶	Absorb	Forcing waste of forces and efforts
	Deny reinforce	Difficulty in bringing in follow-on and reinforcement forces (attrition while moving)
	Reverse use of opponent’s resources	Adversely use opponent's forces and efforts (self-destruction, refutation of his discourse)
	Change of assumptions	Difficulty in utilizing the expected effects and resources of the other party (bypass)
	Forcing to disposition	Diversion to other fronts (formation of a second front)
❷	Misunder-standing	Induce erroneous judgments by creating false perceptions
	Making optimistic	Increased difficulty in grasping unfavorable situations, overconfidence
	Making pessimistic	Increased difficulty in understanding favorable situations and reluctance to act
	Confusing	Difficulty in making decisions due to flood of conflicting information
❸	Destructing nodes	Difficulty in organizational actions due to loss of critical functions/capabilities
	Destructing Links	Difficulty in organized actions due to division of forces and information blockage
❹		Difficulty in actions due to quantitative reduction in forces and resources

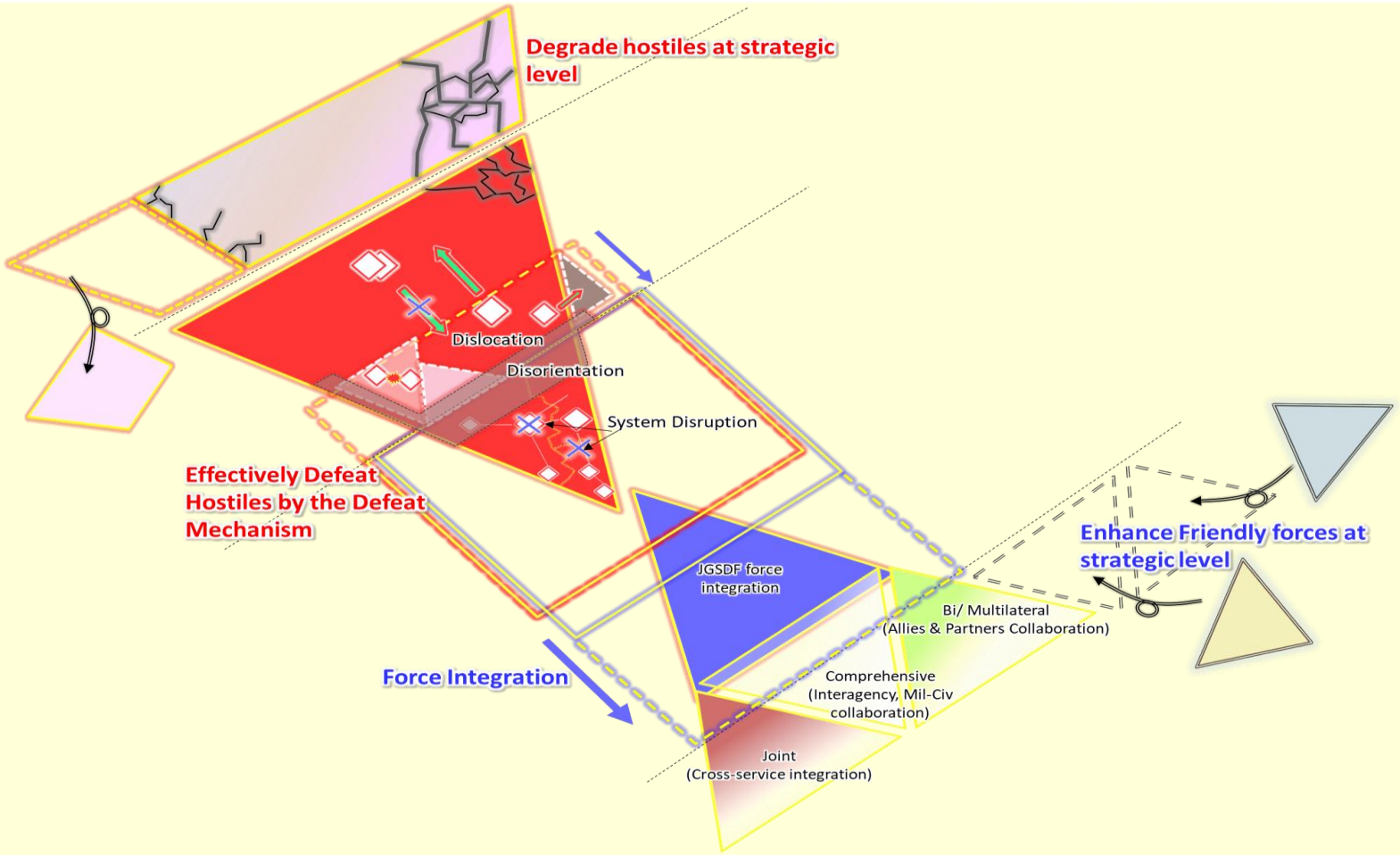
(Originally created by TERCOM based on “Defeat Mechanism (Previous section)”)

Basic Concept for development of Future Warfighting (around 2040)

Concept

1. Fundamental idea of the future warfighting; considering the development of military theories in each country, aspects of future warfare and the new Defeat Mechanism, is to defeat hostiles by minimizing (degrading) their capabilities while maximizing (enhancing) friendly forces.
2. Perspectives to archive the fundamentals above include...
   a. **Effectively defeat hostiles** by the Defeat Mechanism.
   b. **Integrate forces** to maximize friendly capabilities.
   c. **Degrade hostiles** while **enhancing friendly forces** at levels including strategic level.

Image



Future Warfighting around 2040

[Future Warfighting (around 2040)]

1. - In order to deal with obsolescence of weapons and tactics due to visualization of battlefield, machine learning and increased speed of adaptation of military organizations as a whole, retaining multi-measures of strike including measures that he can not recognize and imitate and utilize them collaboratively.

(Example)

- Disperse and waste opposite power. - Multi-measure of Strike. - Collaborating various strikes

2. Integrating various forces separated geographically and from other domains to accomplish operations by longer fire weapons and increased impact on operations in domains such as space and cyber beyond conventional spatial concept.

(Example)

- Integrated defense posture. - All domain, whole theater, Real time ISR. - Sustainment and Resilience

3. While cooperating with allies and other ministries ,agencies and private organizations, conducting various types of operations in joint operations and contributing to shape security environment.

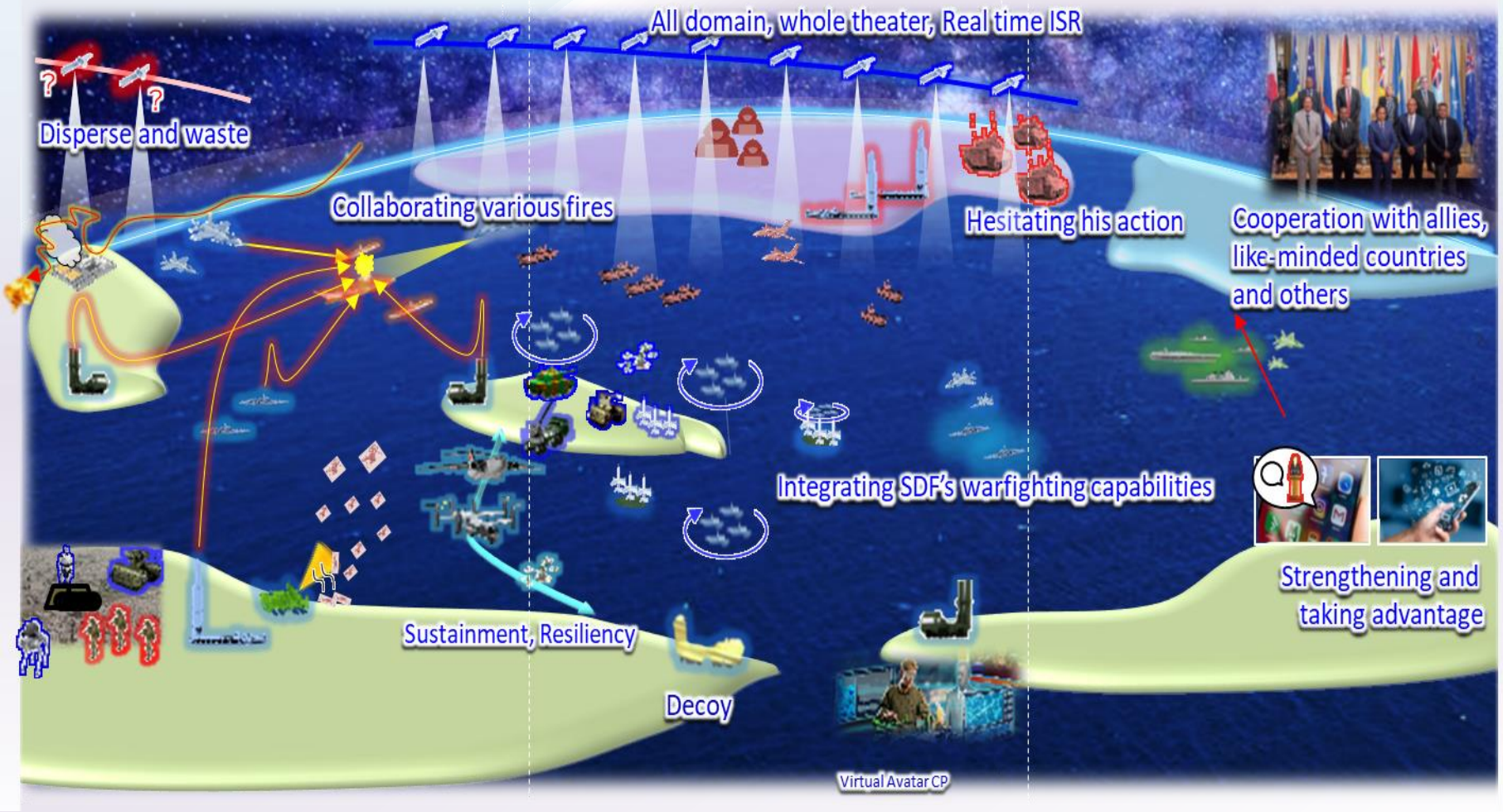
(Example)

- Strengthening and taking advantage. - Multilateral, Joint, interagency cooperation.

(Originally created by TERCOM based on "Emerging technology (Previous section)" , "Military theory(Previous section)" ,"Future operations" etc.)

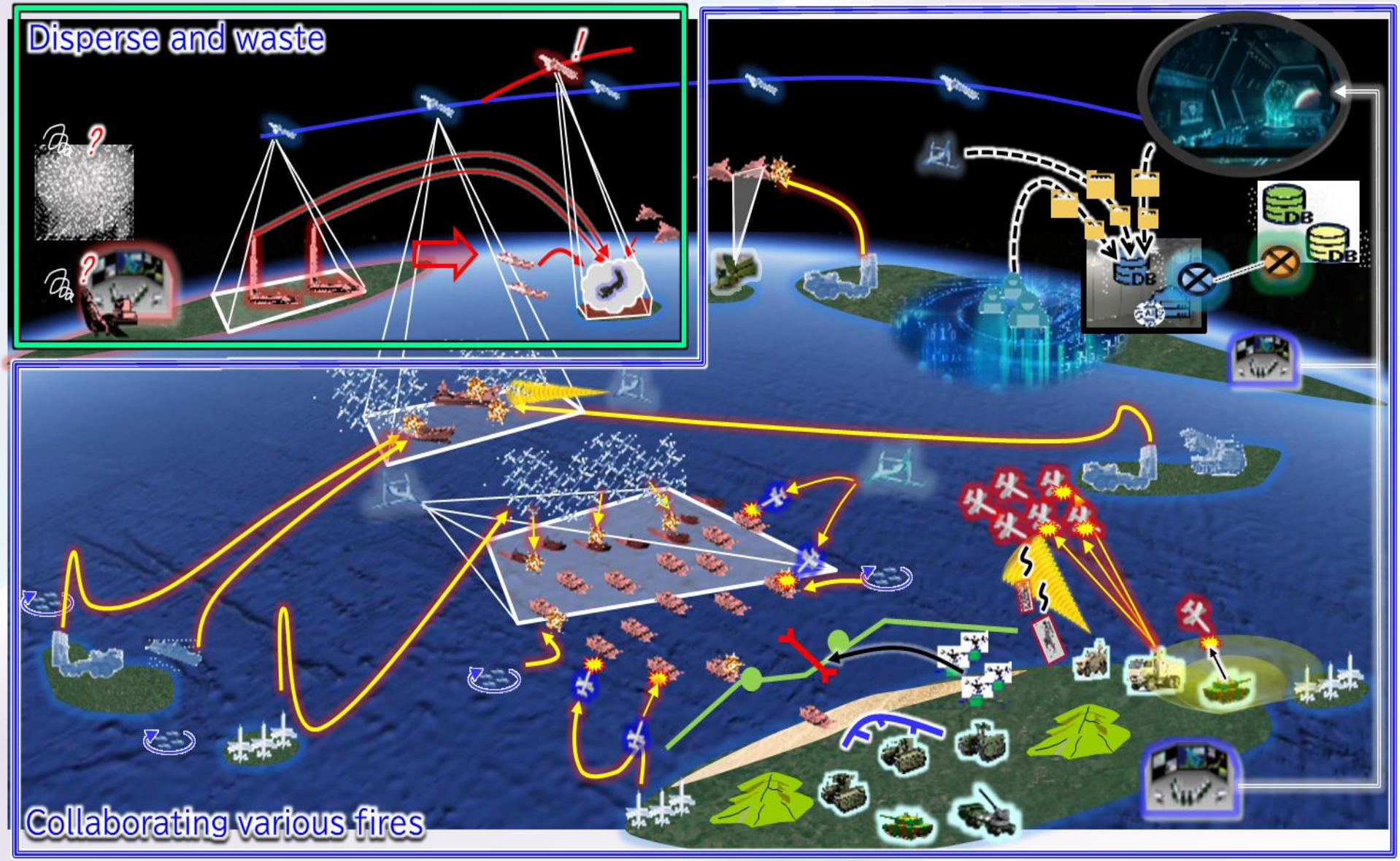
Future Warfighting around 2040 (Image)

1. Integrating SDF's warfighting capabilities in geographic distance and in multiple domains to maximize friendly combat power.
2. Effectively defeat the opposite by executing various Cross-Domain Fires to address obsolescence of weapons and tactics resulting from visualization of battle fields and opposite's holistic faster response.
3. Maximize friendly forces while minimizing opposite's forces by cooperating with ally, like minded countries and others at strategic level to establish advantageous security environment.

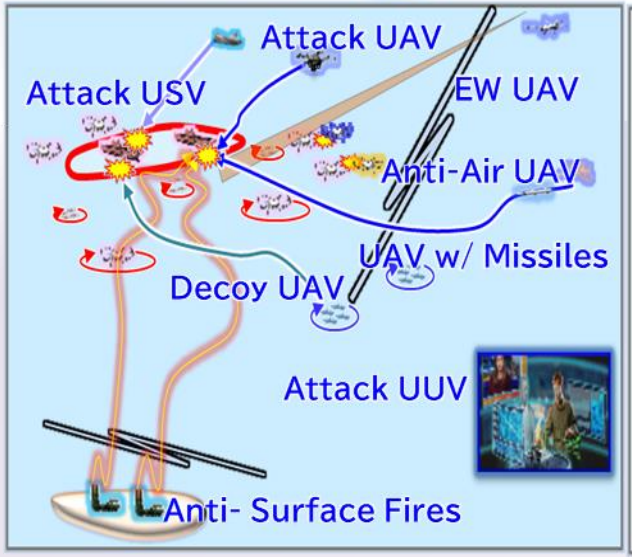


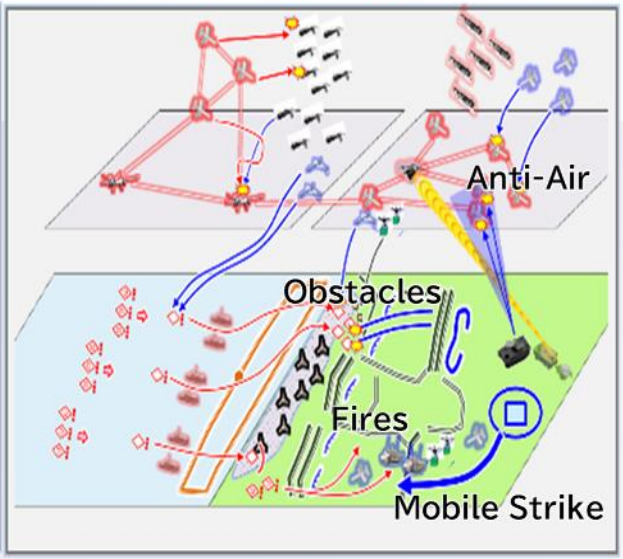
(Originally created by TERCOM based on "Emerging technology (Previous section)" , "Military theory(Previous section)" ,"Future operations" etc.)

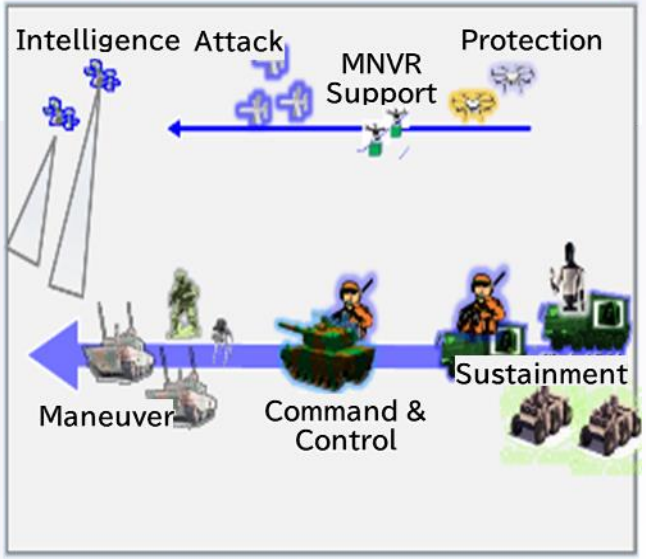
Future Warfighting around 2040 (1 of 2) –Before Opponents Approaching to seashore-



Future Warfighting around 2040 (2 of 2) –After Opponents Approaching to seashore-

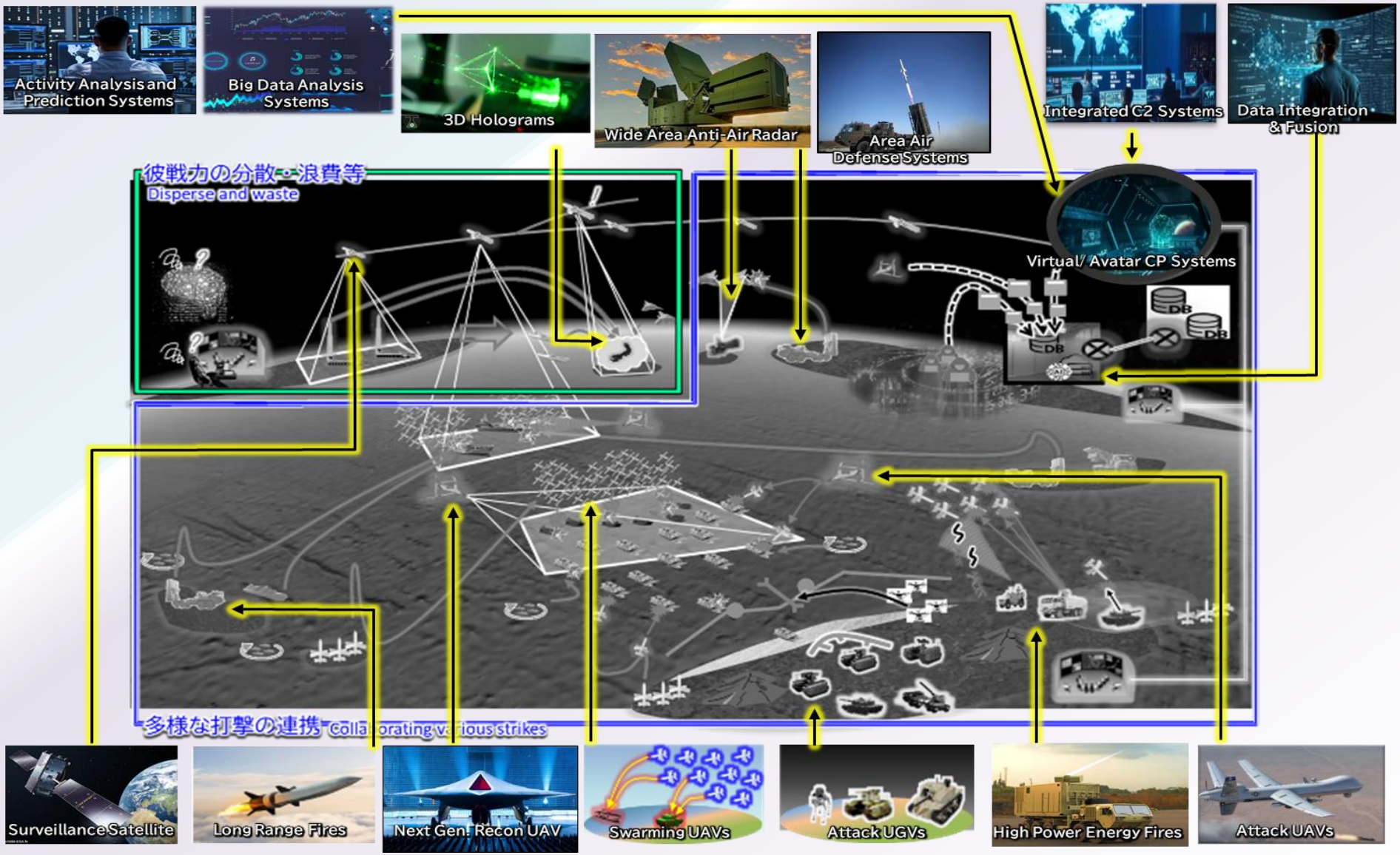






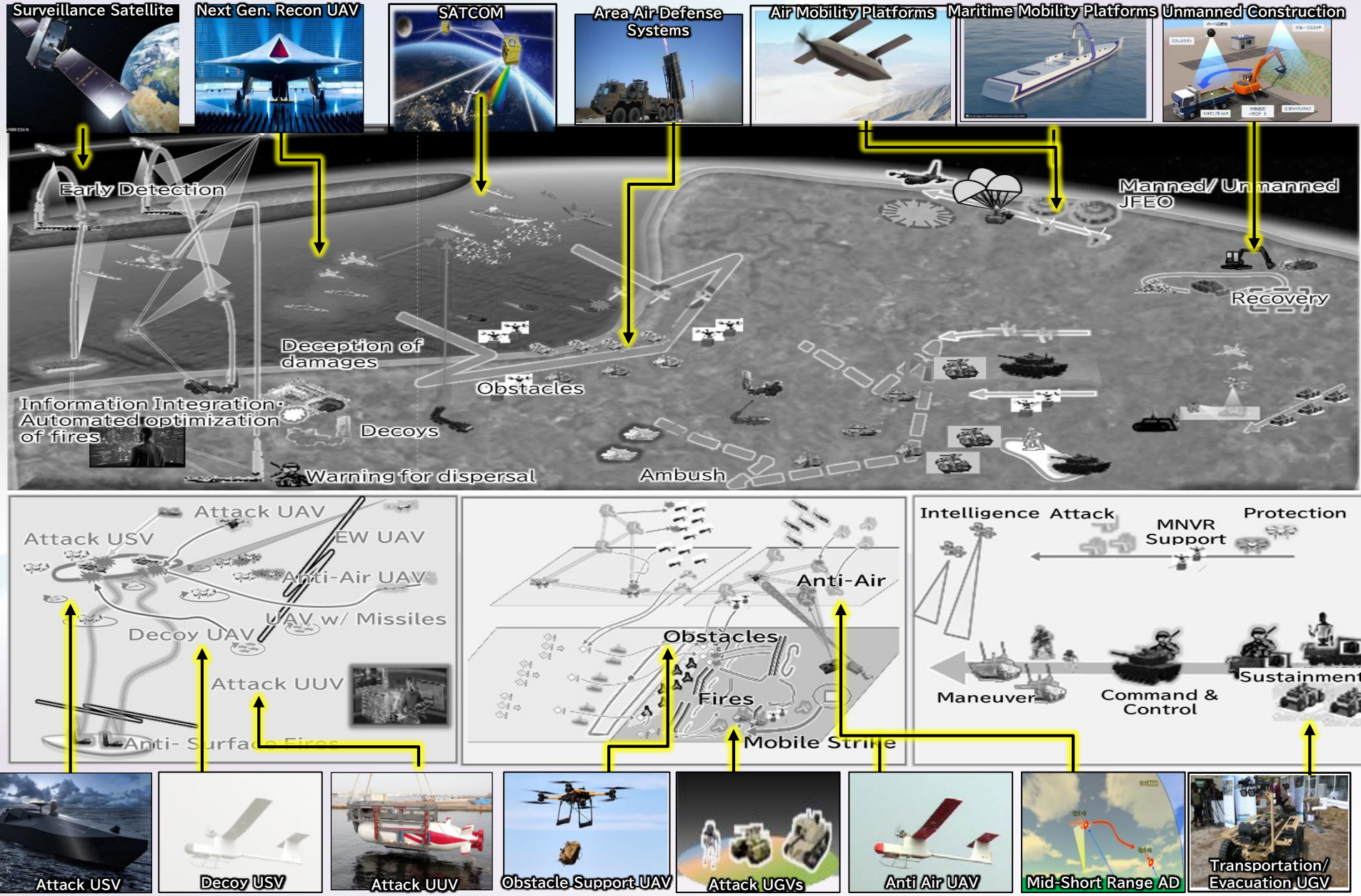
Next Generation Equipment to archive future warfighting (1 of 3)

Summery This page Illustrates necessary equipment to archive future warfighting around 2040.



(Originally created by TERCOM based on "Emerging technology (Previous section)" , "Future Operational Concept(Previous section)" , etc.
* Introduction of the equipment displayed in this material to JGSDF is currently under consideration, yet to be determined.

Next Generation Equipment to archive future warfighting (2 of 3)



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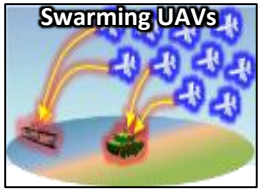
Next Generation Equipment to archive future warfighting (3 of 3)

Command & Control

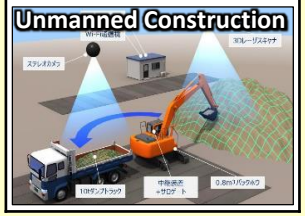
Intelligence

Fires

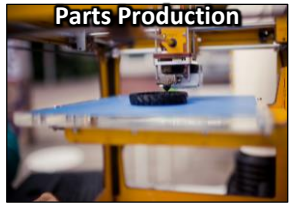


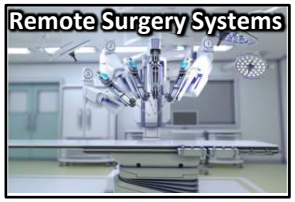
Movement & Maneuver

Protection



Sustainment





(Originally created by TERCOM based on "Emerging technology (Previous section)" , "Future Operational Concept(Previous section)" , etc.
* Introduction of the equipment displayed in this material to JGSDF is currently under consideration, yet to be determined.

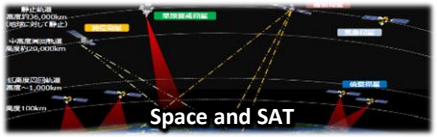
Next Generation Technology for our Innovation

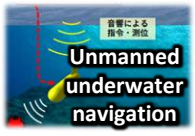
Summary

Typical examples of technology to realize ways of fighting around 2040 are following from the viewpoints of important technological areas(physical , information and cognitive domains) determined in ”Defense Technology Guideline 2023”.

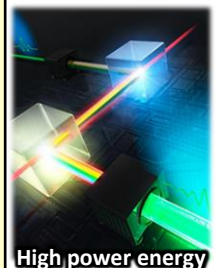
Unmanned/Autonomous

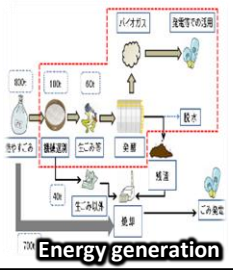
Unused platforms





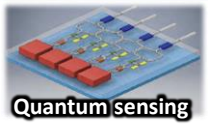
Unused energy

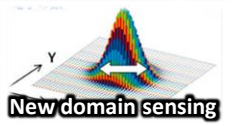




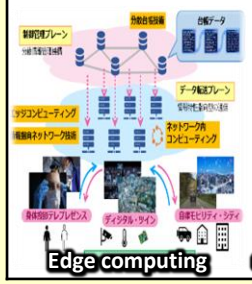
New functional materials

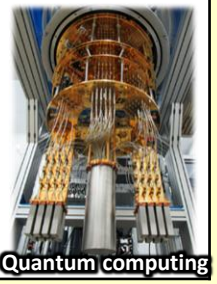
Sensing



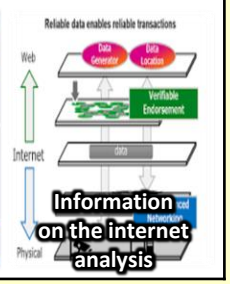


Computing

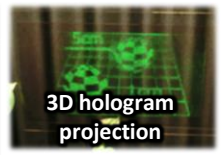




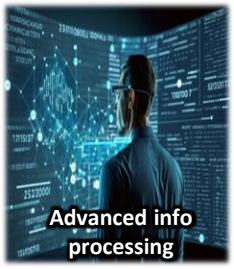
Visualization



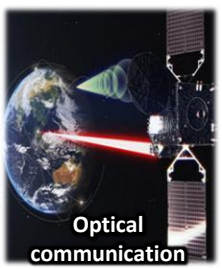
Virtual/imaginary info



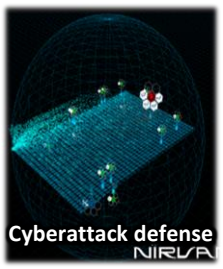
Situation analysis/Forecasting future



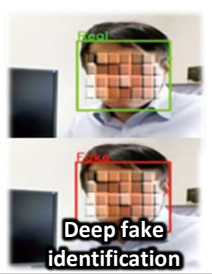
Network



Cyber defense



Cognitive



【Legend】Technology for gaining superiority over each domain : Physical : Information : Cognitive

(Originally created by TERCOM based on “Emerging technology (Previous section)” , “Future Operational Concept(Previous section)” , etc. with reference to ”Defense Technology Guideline 2023”(ATLA).)

Images derived from..

1. Future Strategic Environment

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2. Future Warfighting around 2040

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- https://president.jp/articles/-/47827?page=1

3. Future Warfighting around 2040 (1 of 2) –Before Opponents Approaching to seashore-

- https://wallpaperaccess.com/command-center

4. Future Warfighting around 2040 (2 of 2) –After Opponents Approaching to seashore-

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5. Next Generation Equipment to archive future warfighting (1 of 3)

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Images derived from..

6. Next Generation Equipment to archive future warfighting (2 of 3)

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- https://thedefensepost.com/2022/08/23/darpa-defiant-ship/

7. Next Generation Equipment to archive future warfighting (3 of 3)

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8. Next Generation Technology for our Innovation

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Blanc