

The Development of Space Payload Technology

Beijing Institute of Remote Sensing Equipment

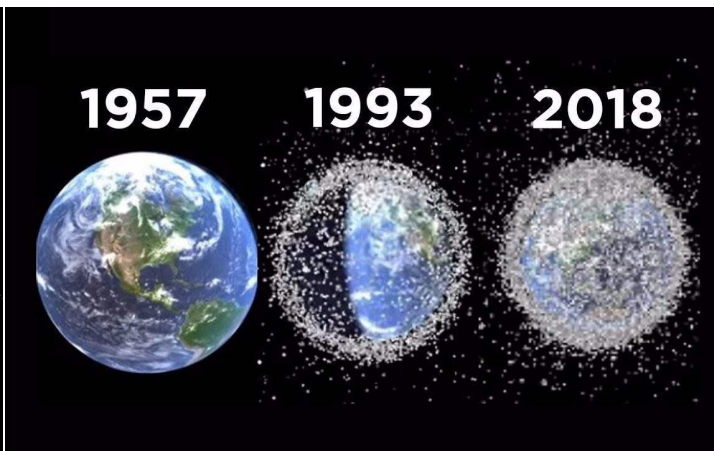
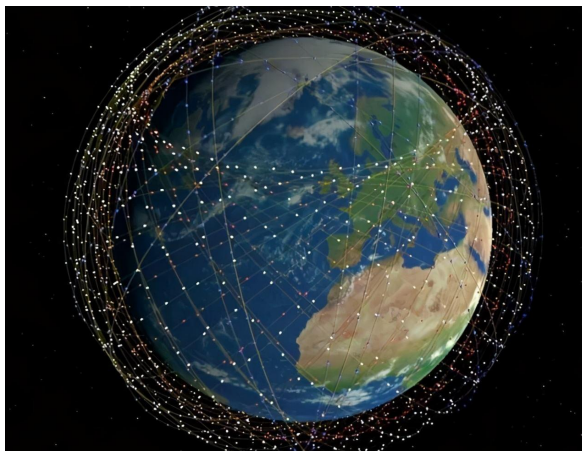
2022.11

FORWORD

Satellite and space resources

At present, the number of satellites in the world has exceeded **4000**.

While mankind benefits from satellite applications, it is also facing a severe situation: the space is already **very crowded** with detectors and various **space junk**.



FORWORD

Satellite and space resources

The satellite accident may produce **thousands of fragments**, which are irregular bombs for other normal detectors.





01

Space Environment

02

Payload and Satellite

03

Key Technologies

1. Space Environment

Space Junk

If space junk collides with satellites in operation, it will endanger equipment and even the lives of astronauts. It is calculated that a piece of space junk with a diameter of **10cm** can completely destroy spacecraft, and space junk with a size of **several millimeters** may disable them.

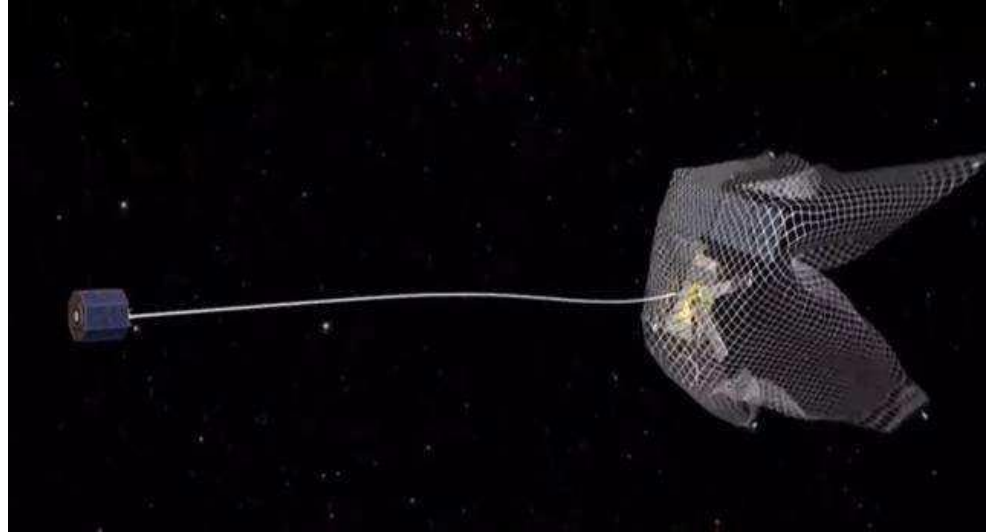


1. Space Environment

HOW?

Recycle cleaning+ **Detection**, the main way to deal with space junk.

At present, the ability of space **payload** to detect space junk is in urgent need of **improvement** to meet the needs of the space environment.





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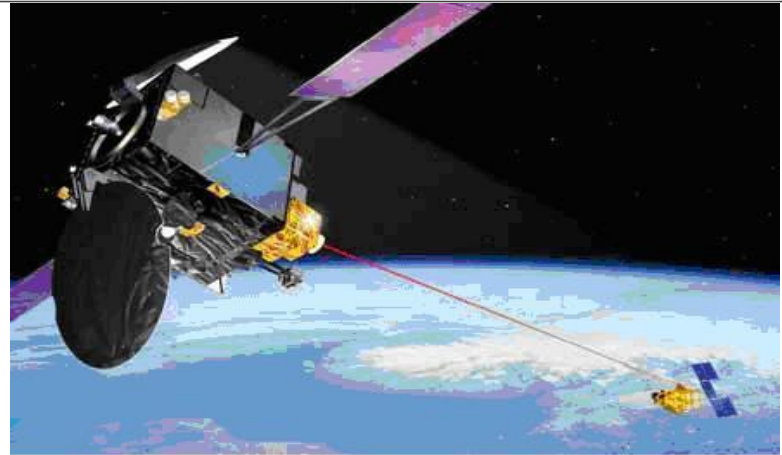
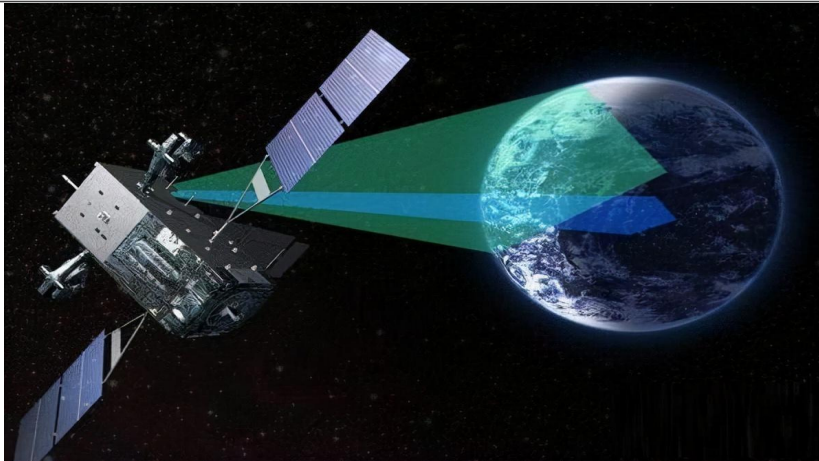
Key Technologies

2. Payload and Satellite

Status of Space Payload

In order to adapt to the complex space environment, space payloads have to be **more functional** and **higher performance**.

The **combination** of various working bands and systems, more **complex** equipment, **higher** cost, and more **difficult**.

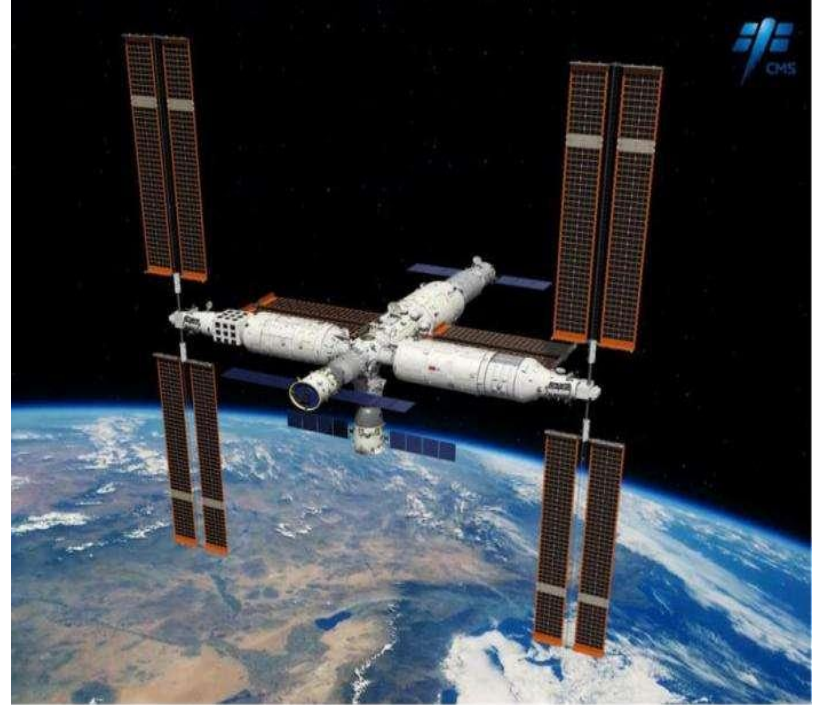


2. Payload and Satellite

Status of Space Payload

In order to meet various needs, there are **satellites** with different functions and different volumes, such as communication, navigation, remote sensing, manned, unmanned platforms, etc., more and more kinds of loads are carried.

How to protect our satellite platform? In particular, how can high-value satellite platforms **independently respond** to the threat of space junk?



2. Payload and Satellite

Single Function to Multi-function

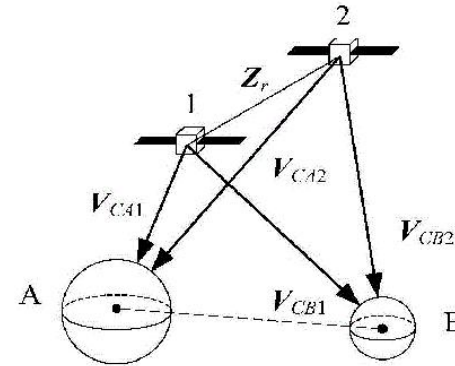
Single satellite-Develop **multi-functional and highly integrated** space payloads to reduce costs and increase efficiency.



2. Payload and Satellite

Multiple Satellite Cooperation

Satellites -multiple satellite **cooperative detection**.

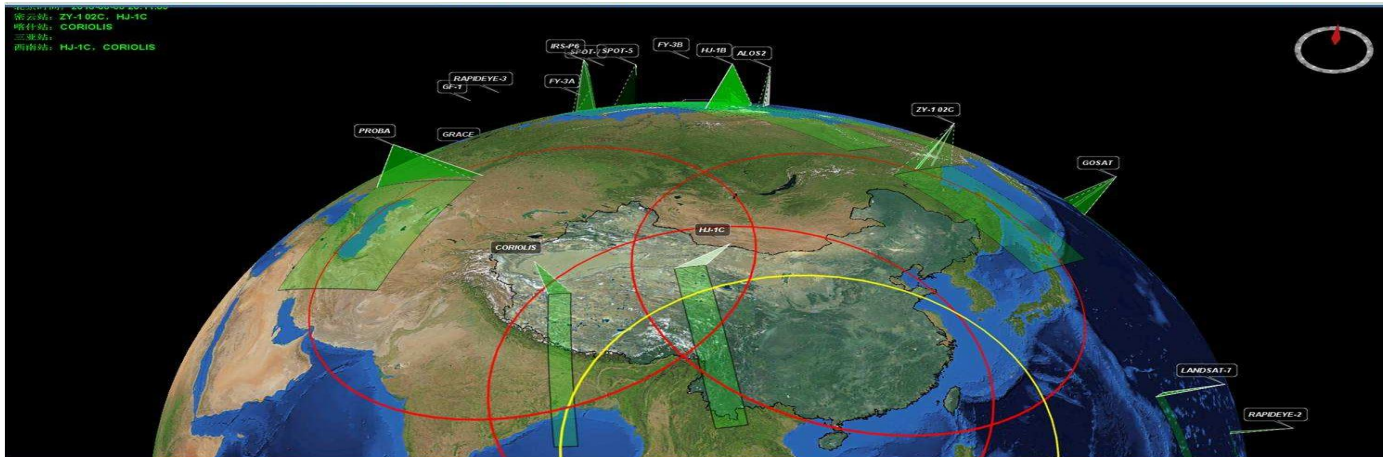


2. Payload and Satellite

Multiple Satellite Cooperation

Problems: different domains, platforms, and bands of sensors with different space-time benchmarks, information formats, interface definitions, transmission forms, etc.

We propose: **Signal level fusion, cooperative detection and linkage of loads of different Satellites.**





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3. Key Technologies

Cooperative detection: Multiple satellite payload to form an **overall** detection situation.

The **nature** of cooperation: Give full play to the overall resultant force to **maximize** the detection effect.

T

- Top-level theory

S

- Satellite platform

S

- Space-time benchmarks

I

- Interface definition

M

- Module reconfiguration

F

- Front segment detection

G

- Function integration

B

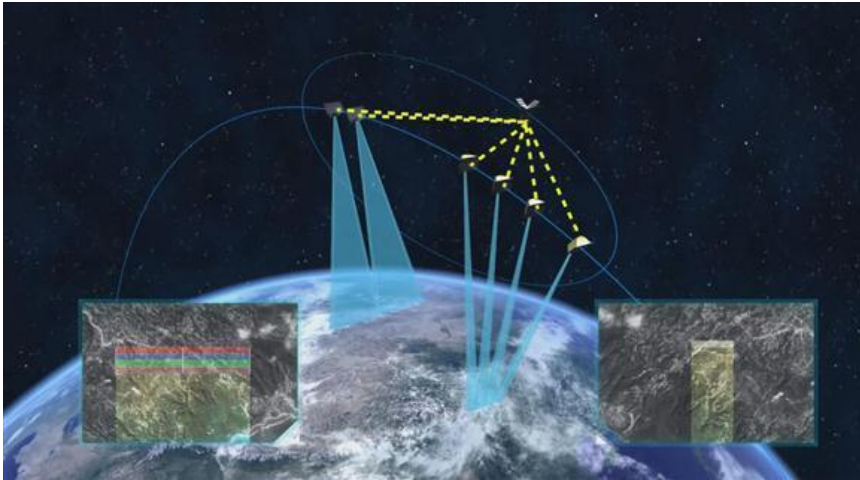
- Back end processing

3. Key Technologies

Cooperative **Detection**: High precision and large error tolerance;

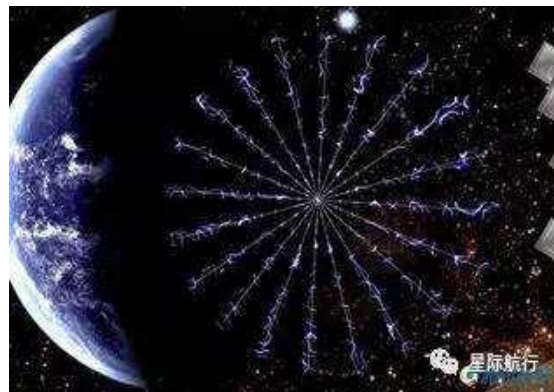
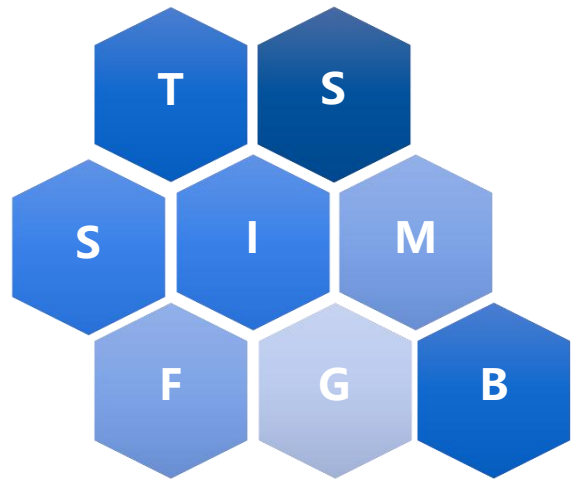
Cooperative **interception**: lower cost;

Cooperative **imaging**: Fine.



3. Key Technologies

- ① Common cooperative detection **architecture**
- ② Space-time benchmarks **synchronization**
- ③ Detection and communication **integration**
- ④ **Chip** and **modularization**
- ⑤ **Reconfiguration**
- ⑥ Cooperative detection **operating system**
- ⑦ Multiple systems **detection** and **access**
- ⑧ **Edge** computing and **advanced computing**

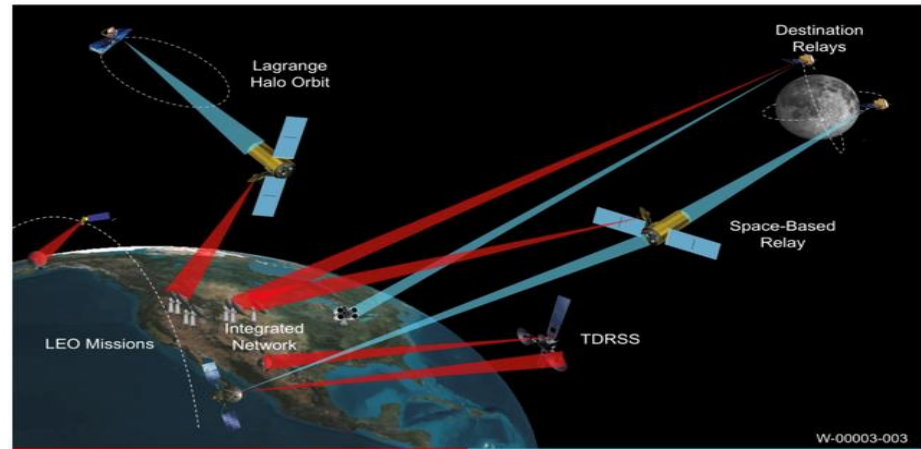
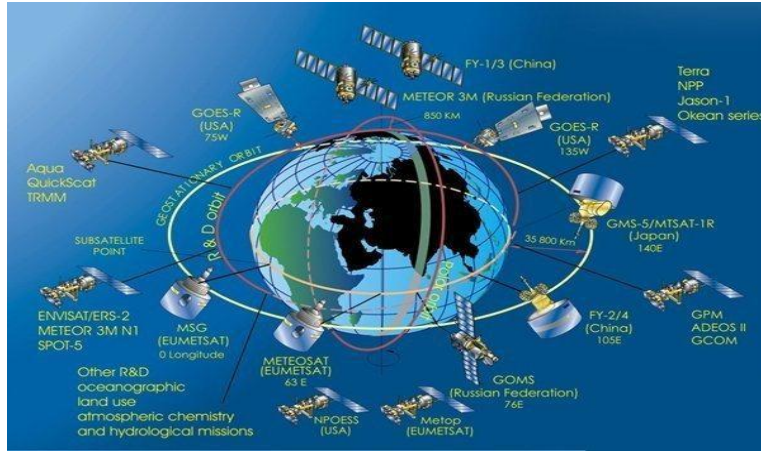


3. Key Technologies

Common cooperative detection architecture

Research contents: requirement analysis, pattern classification, Information **representation**, transport **protocol** , etc.

Significance: The universal detection capability and **interaction basic model** of each platform.



3. Key Technologies

Space-time benchmarks synchronization

Research contents: **High-precision timing technology, Synchronization error coherent correction**, etc.

Significance: **Key** technologies.

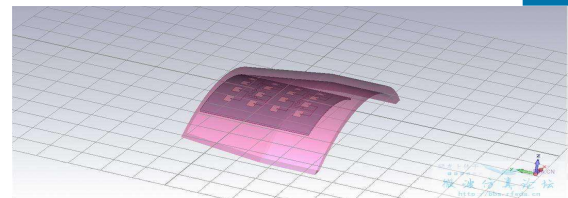
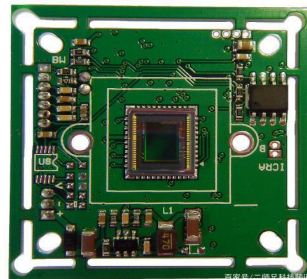
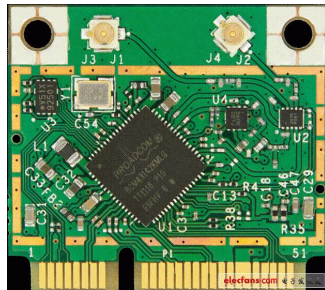
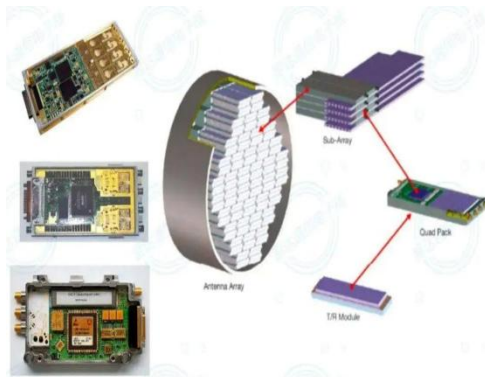


3. Key Technologies

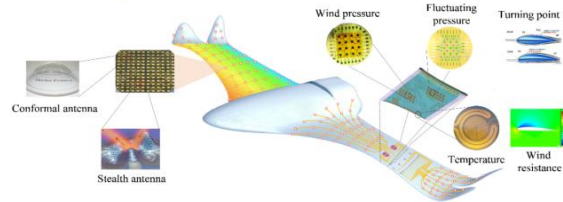
Chip and modularization

Research contents: Detection **sensor standardized** chip, microwave **signal and image processing standardized** chip, detection equipment modularization, surface detection technology, etc.

Significance: Create a **new form** of detection and guidance equipment.



Large-area, multi-functional flexible smart skin

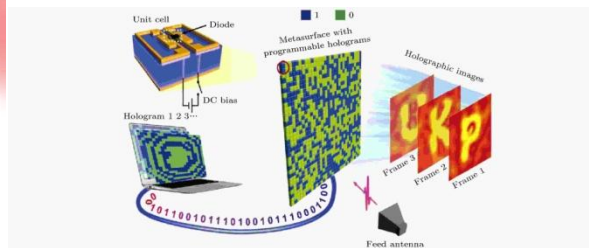
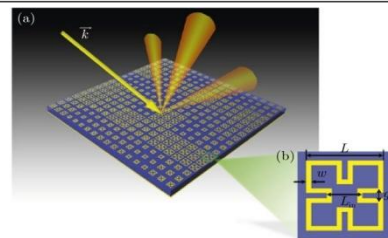
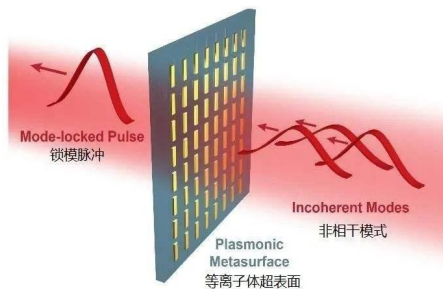
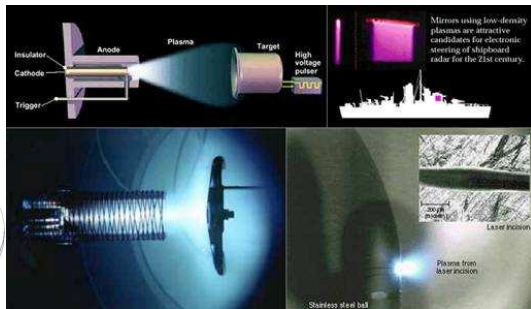
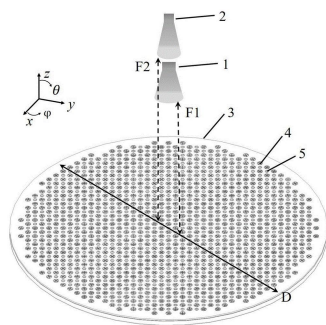


3. Key Technologies

Reconfiguration

Research contents: **Solid state plasma antenna**, **Liquid crystal materials antenna**, etc.

Significance: Interference **suppression** and **improve** detection capability.

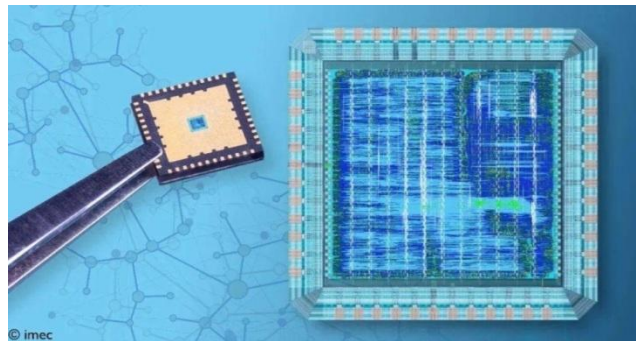


3. Key Technologies

Edge computing and Advanced Computing

Research contents: **Edge computing** algorithm、**General node processing** algorithm、**AI**, etc.

Significance: **Real-time response** capability, **Immediate feedback decision-making** ability.



Peroration

The space payload technology is developing in a multi-mode and multi-platform cooperative way. The cooperative detection technology is required to have a unified architecture, standard interfaces, instant access, rapid upgrading, and dynamic adjustment to cope with the transient situation environment and support the needs of subsequent space tasks!

Thanks for your attention.