Dynamic Domain ID Based on DDS for AIoT

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Weibin Su[1,2,*], Ivy Kim D Machica[1], Cristina E Dumdumaya[1], Randy S Gamboa[1], Gang Xu[1,2] and Zhengfang He[1,2]

[1]College of Information and Computing, University of Southeastern Philippines, Davao City, 8000, Philippines
[2]Edge Computing Network Center, Yunnan Technology and Business University, Kunming 651701, China
*Email: weibin_su@usep.edu.ph

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Introduction

Edge computing, combining information and communication technology (ICT) with operation technology (OT) and cloud computing, has become a vital area of industry development. While AI technology's core factors such as data, computational power, and algorithms have received significant attention, there remains a lack of research on the underlying hardware network structure for AI operations. This paper defines two stages in the development of AI technology's network infrastructure: stand-alone intelligence and cloud computing integration. A new type of Data Distribution Service (DDS) middleware network for AIoT has emerged, and this paper proposes a dynamic domain identification method to enhance DDS performance.

In the stand-alone intelligence stage, vehicles and UAVs are equipped with numerous sensors and AI computing modules, elevating their stand-alone intelligence but also increasing hardware costs. For UAVs with limited load capacity, excessive onboard sensors hinder their development. Industrial control systems suffer from a lack of production flexibility due to strong coupling between controllers and sensors.

In cloud-based control, high real-time and reliability requirements face challenges due to multi-level route caching and data transmission between the cloud and physical devices. Cloud computing's dependence on fixed public domain names or network addresses can lead to problems during downtime or platform migration, hindering system performance.

Edge computing offers a solution by providing low-latency, high-reliability services for control processing near end devices. This paper advocates for a more friendly communication protocol supporting the distributed architecture of edge computing, addressing these limitations.

Methods

The purpose of inter Domain ID clustering is to automatically construct local communication clusters based on spatial location. As shown in Figure 1, clusters are temporary clusters based on domain identifiers, which will form a complete distributed composite control system at close range, including sensors, computational power units, and controlled objects. In industrial automation control, processing units should also be included. It should be noted that sensors, computing units, and processing units are generally fixed in position, while the controlled object will change its spatial position based on time, with spatiotemporal evolution characteristics, such as the movement in automobiles, UAVs, or industrial products.

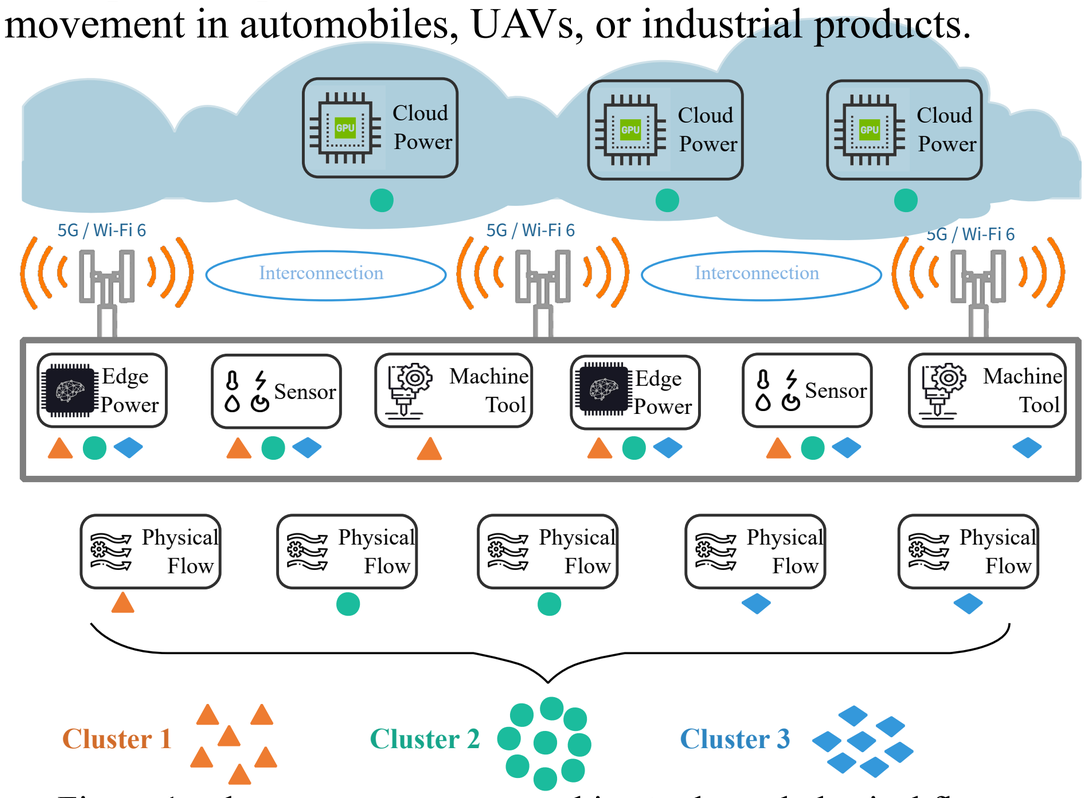

Figure 1, edge power, sensors, machine tools, and physical flows such as automobiles are all aggregated at close range based on spatial location, while cloud power is a dynamic combination based on network conditions and computing load.

Example

DDS is a powerful middleware technology for real-time communication in AIoT applications, offering reliability, scalability, and performance. It empowers edge computing systems by enabling efficient data exchange, make crucial component in modern AIoT infrastructure. The Dynamic Domain ID (DDID) is a significant innovation in this paper, enabling quick switching and optimization of communication resources in large-scale spatial transfer or physical flow scenarios. DDID based on DDS technology is applicable to dynamic and static AIoT application scenarios.

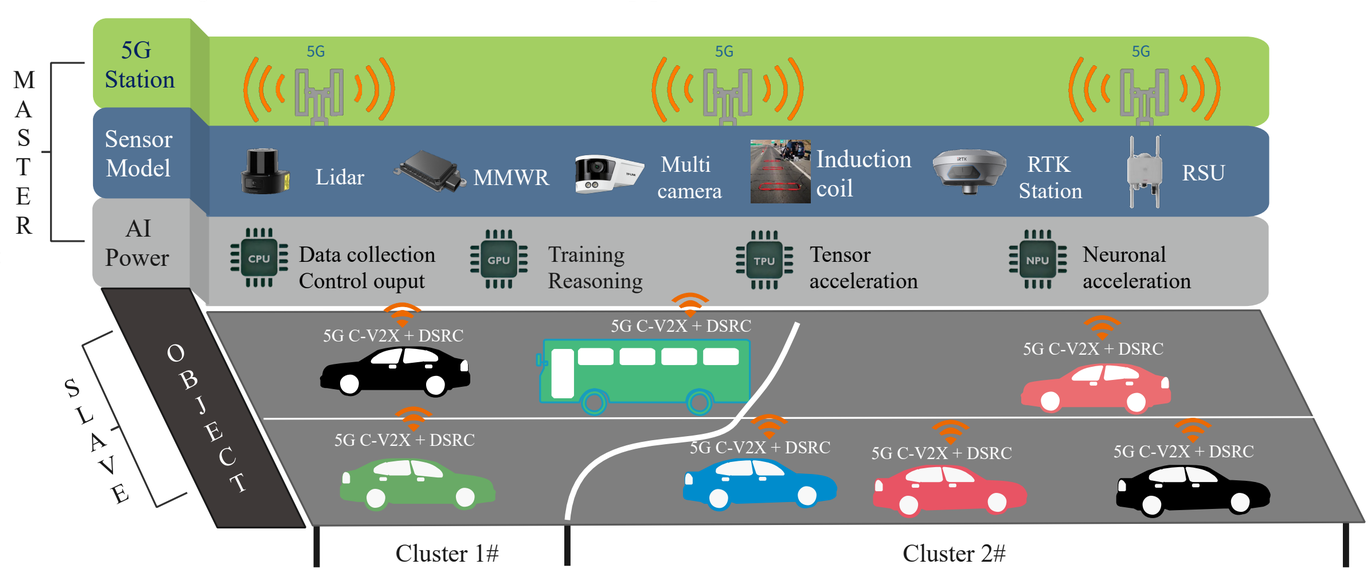

Figure 2, three vehicles on the left and four vehicles on the right dynamically and temporarily form clusters 1 and 2 based on ground sensors, computing power, and 5G stations. Relying on DDS to dynamically build Domain ID, enhancing the communication ability between vehicles and edge ground stations on the basis of 5G C-V2X cellular vehicle to vehicle technology and DSRC dedicated short range communication technology.

Target

Through DDID based on DDS, various components of edge nodes can communicate and share data more easily, simplifying the development of distributed systems, improving the reuse rate of code, and eliminating the need for programmers to spend a lot of effort researching and implementing the communication process between applications and systems.

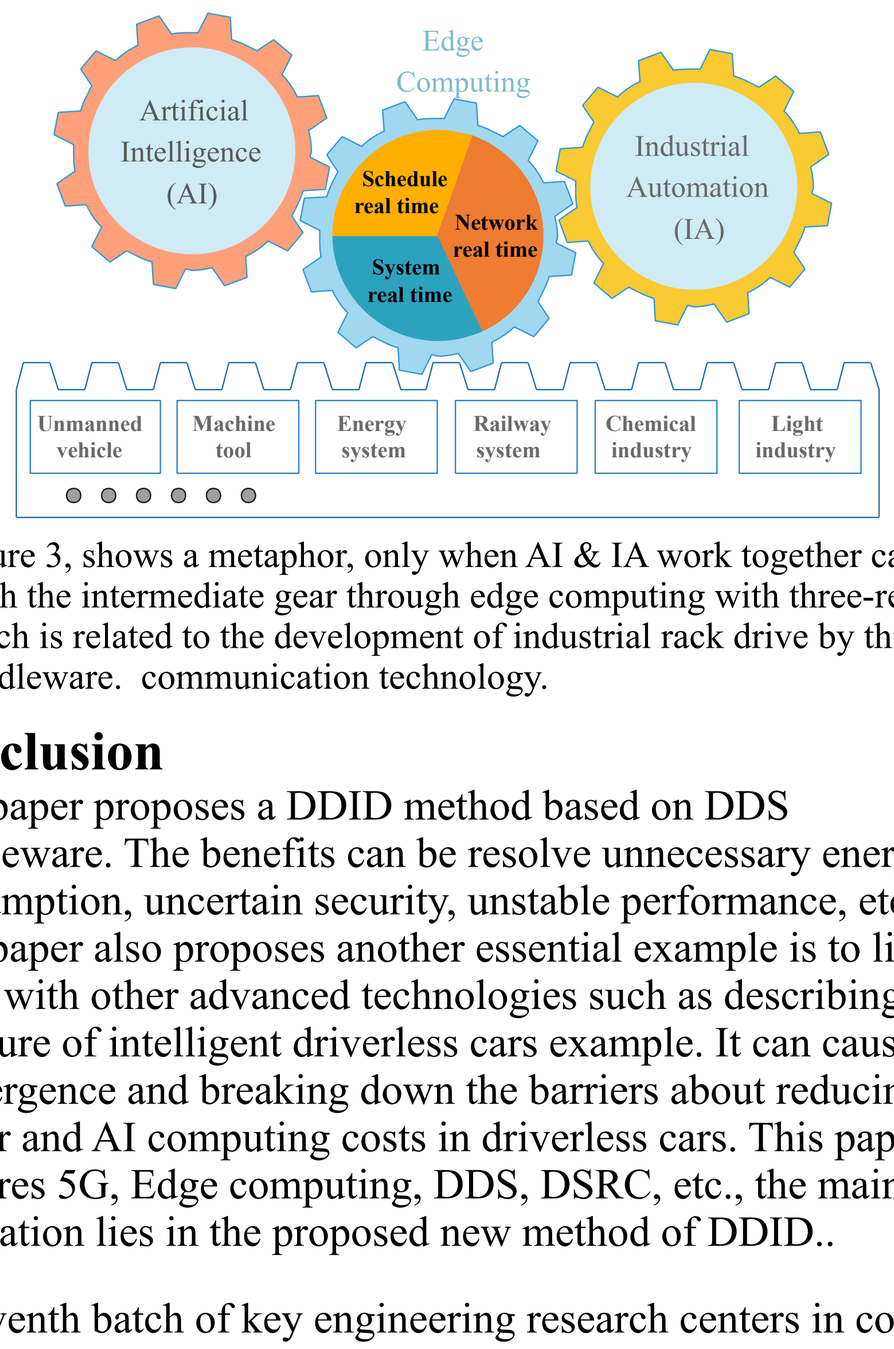

Figure 3, shows a metaphor, only when AI & IA work together can they mesh the intermediate gear through edge computing with three-real-time , which is related to the development of industrial rack drive by this DDS middleware. communication technology.

Conclusion

This paper proposes a DDID method based on DDS middleware. The benefits can be resolve unnecessary energy consumption, uncertain security, unstable performance, etc. This paper also proposes another essential example is to link AIoT with other advanced technologies such as describing a structure of intelligent driverless cars example. It can cause convergence and breaking down the barriers about reducing sensor and AI computing costs in driverless cars. This paper explores 5G, Edge computing, DDS, DSRC, etc., the main innovation lies in the proposed new method of DDID..

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