An Efficient Data collection method for Digital Twin Network

draft-zhu-nmrg-digitaltwin-data-collection-01

https://datatracker.ietf.org/doc/draft-zhu-nmrg-digitaltwin-data-collection/

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Introduction

The definition of Digital Twin Network

Digital Twin Network is a network system with Physical Network and Twin Network, which can be mapped interactively in real time. The construction of Digital Twin Network requires real-time data of Physical Network to update the state of Twin Network.

Reference：draft-zhou-nmrg-digitaltwin-network-concepts

The disadvantages of the existing method

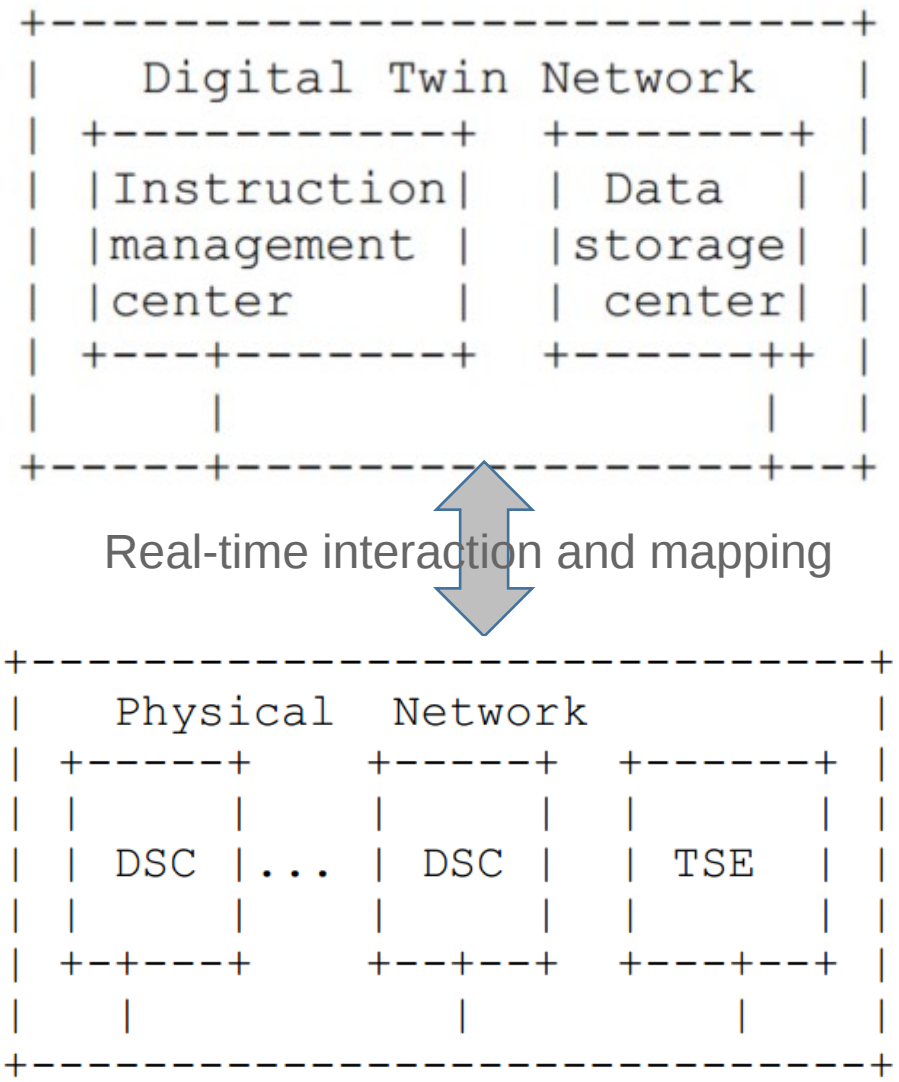
The existing method collects the full amount of data from the Physical Network for modeling, and does not consider the problems,

Time-lag

insufficient storage resources

low computational efficiency

waste of bandwidth resources caused by data transmission.

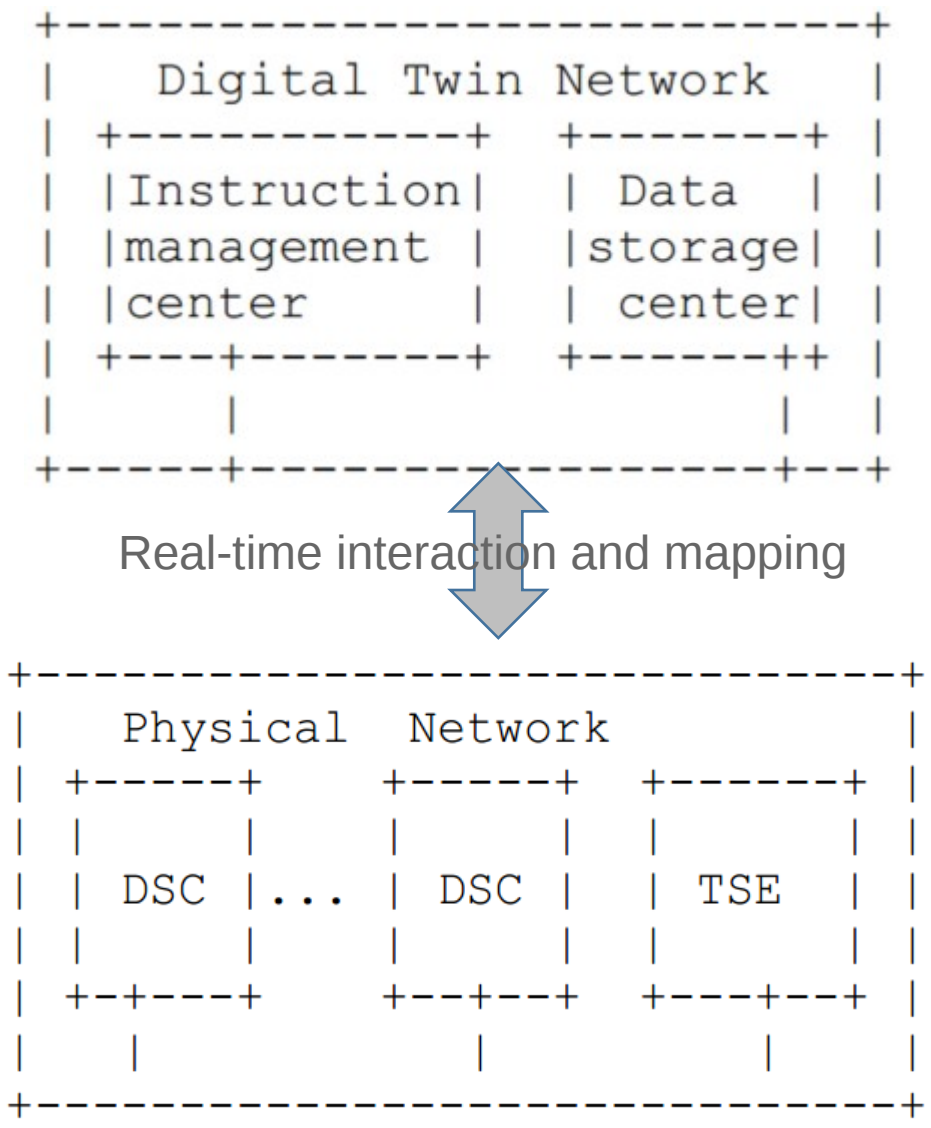


Overview

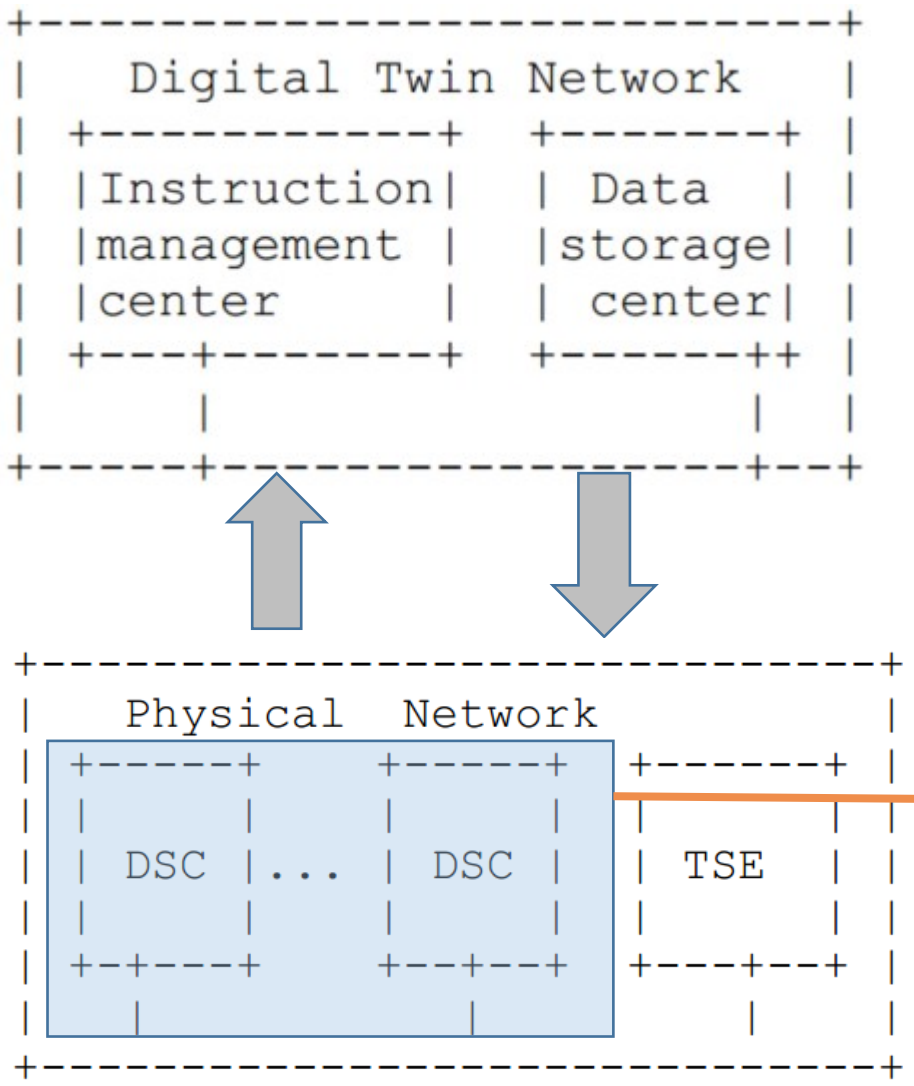
In order to solve these problems, this draft introduces an efficient and lightweight data collection, aggregation and correlation method. Twin Network sends instructions to the Physical Network to collect data on demand, and then the Physical Network completes instructions such as knowledge representation, Telemetry Streaming Element of Physical Network completes data aggregation and correlation. Finally Telemetry Streaming Element sends the processed or represented data to the Twin Network.

The composition of DTN

- DTN consists of Physical Network and Twin Network.
- The Physical Network includes multiple Data Storage Centers and Telemetry Streaming Element (TSE).
- The twin Network includes the Instruction Management Center and Data Storage Center.



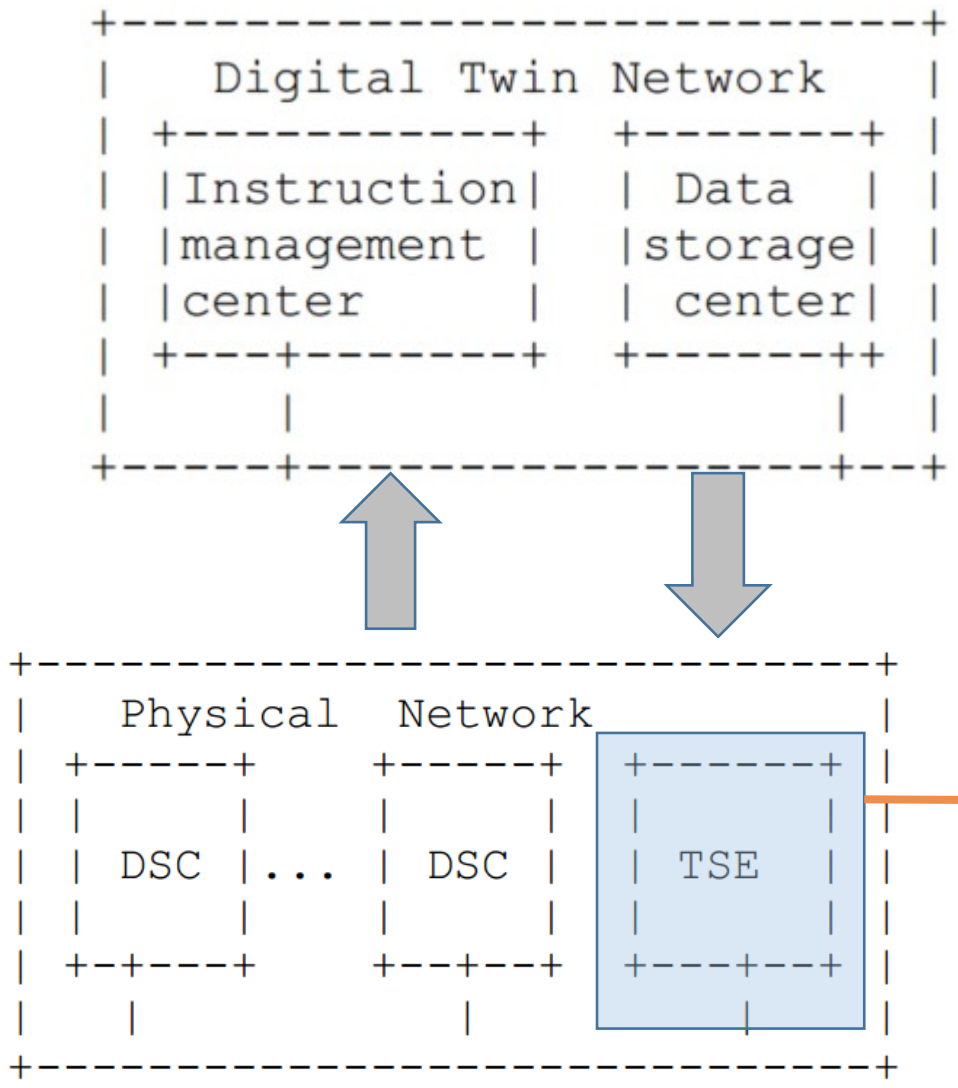
The introduction of Data Storage Center in the PN



Data Storage Center in the Physical Network has two functions：

- It can store data, such as performance indicators, operational status, logs, traffic scheduling, business requirements, etc.
- It has the function of automatically parsing the instructions sent by the Instruction Management Center in the Twin Network or sent by the telemetry streaming element..

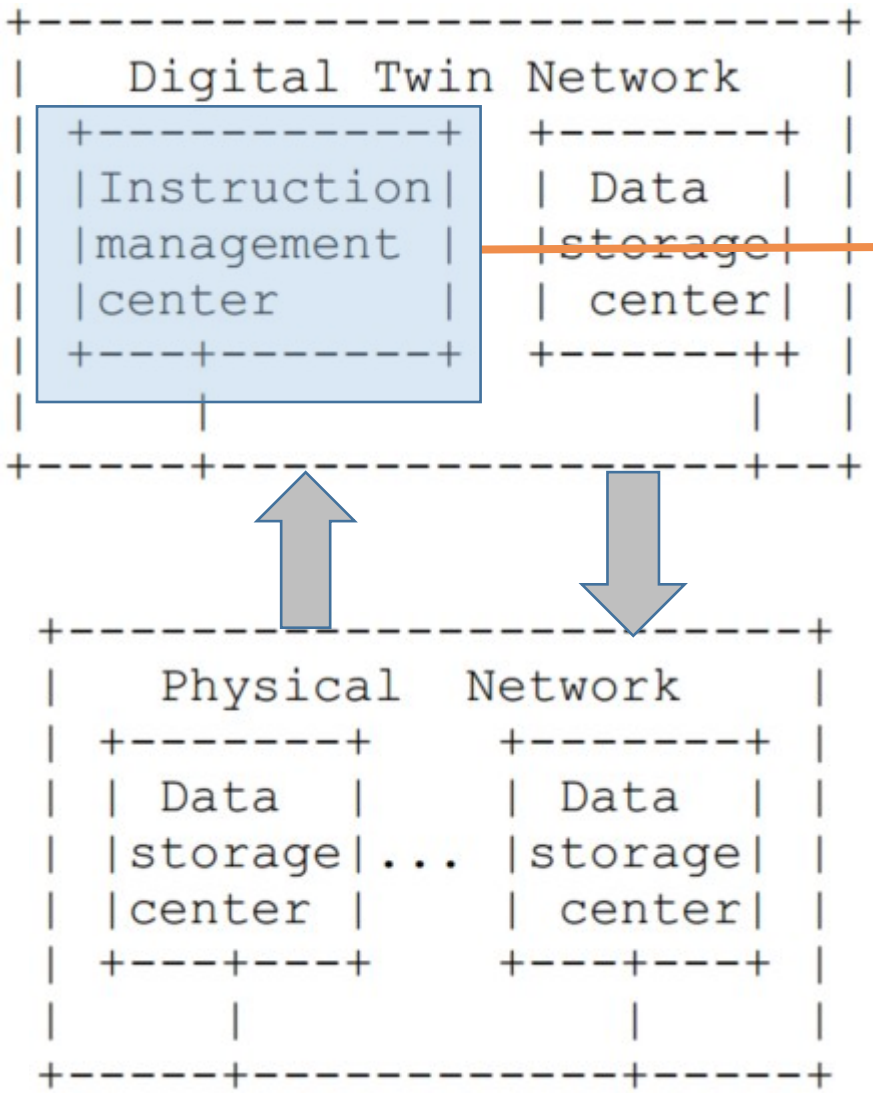
The introduction of Data Storage Center in the PN



Telemetry Streaming Element in the Physical Network has multiply functions：

- data collection;
- Data aggregation;
- Data correlation;
- Data query.

The introduction of Instruction Management Center



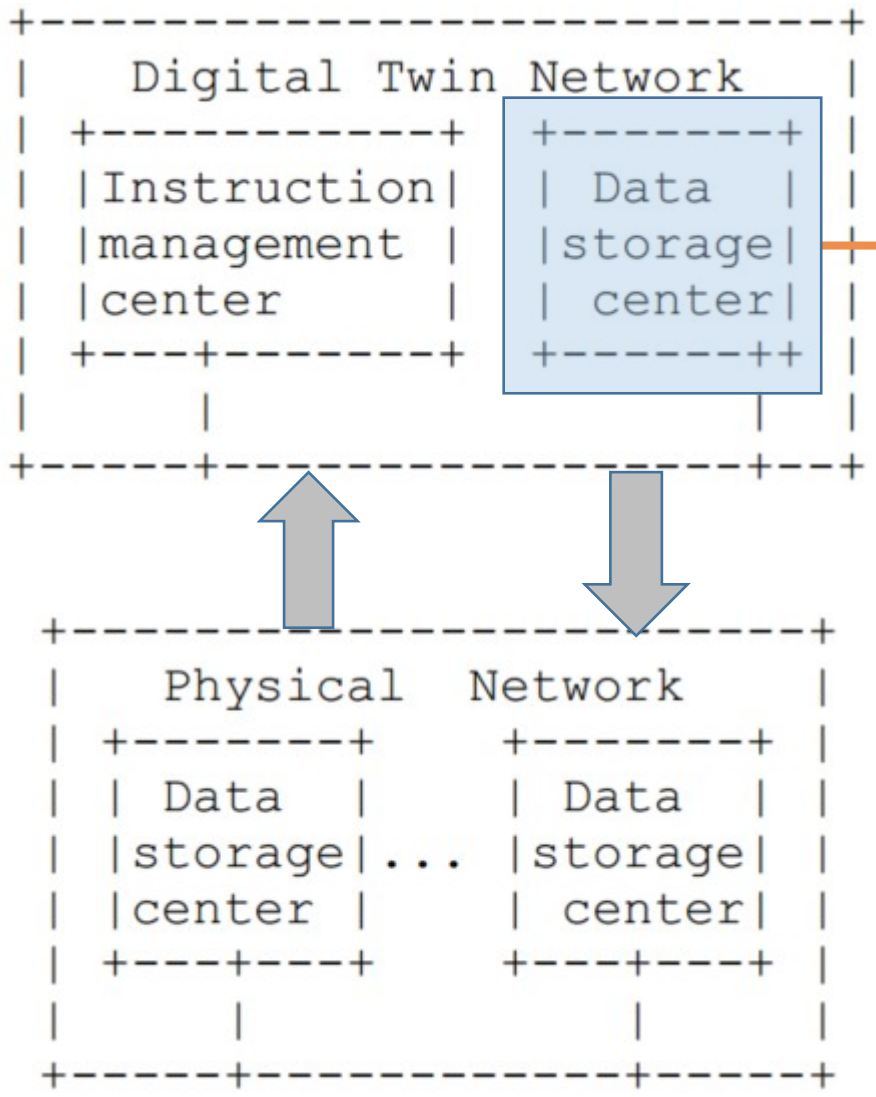
The Twin Network includes the Instruction Management Center and Data Storage Center.

The Instruction Management has two functions.

- It is mainly used to manage the registration of the Telemetry Streaming Element in the Physical Network
- It is mainly used to adaptively configure data collection instructions according to the collection requirements of the Data Storage Center in the Twin Network, and search for IP addresses to send instructions.

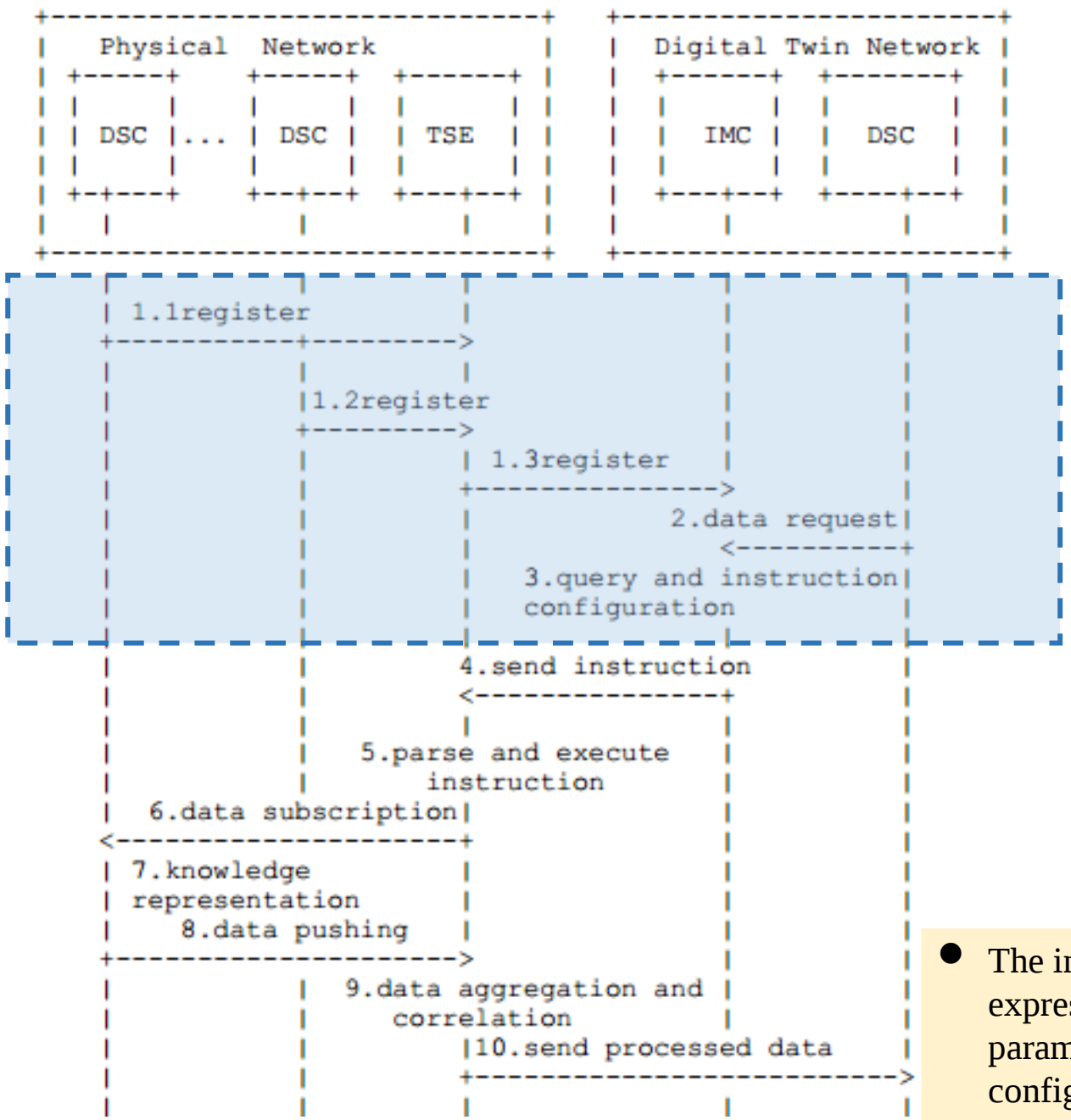
- Registration information include various key information, such as the IP address of the Data Storage Center in the Physical Network, data type, and various index names of the data ,data source name and data size, etc;

The introduction of Data Storage Center in the PN



The function of The Data Storage Center:

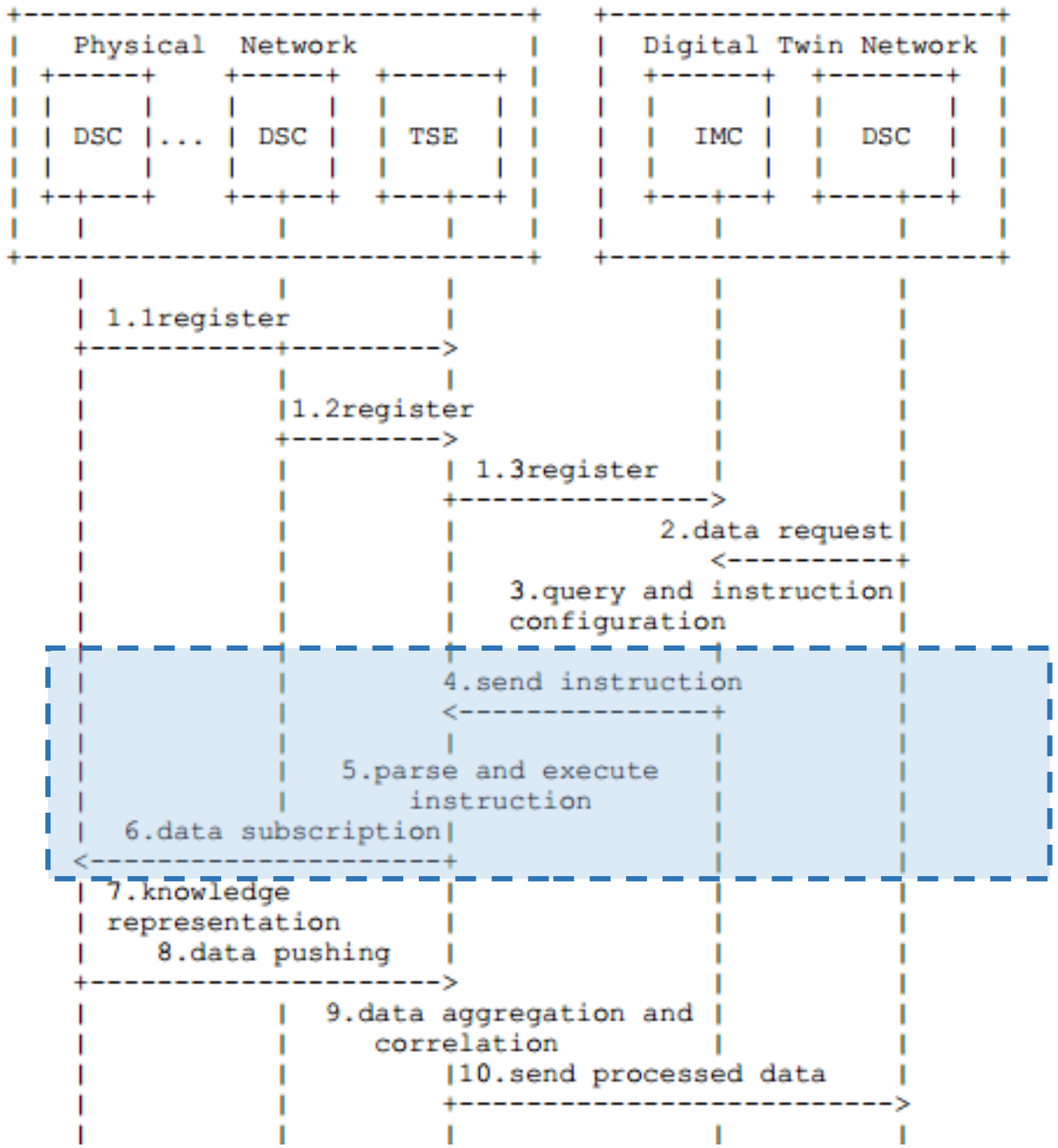
- The Data Storage Center of the Twin Network is mainly used to store the effective information after data processing and knowledge representation returned by the Telemetry Streaming Element in the Physical Network.



The specific process is as follows:

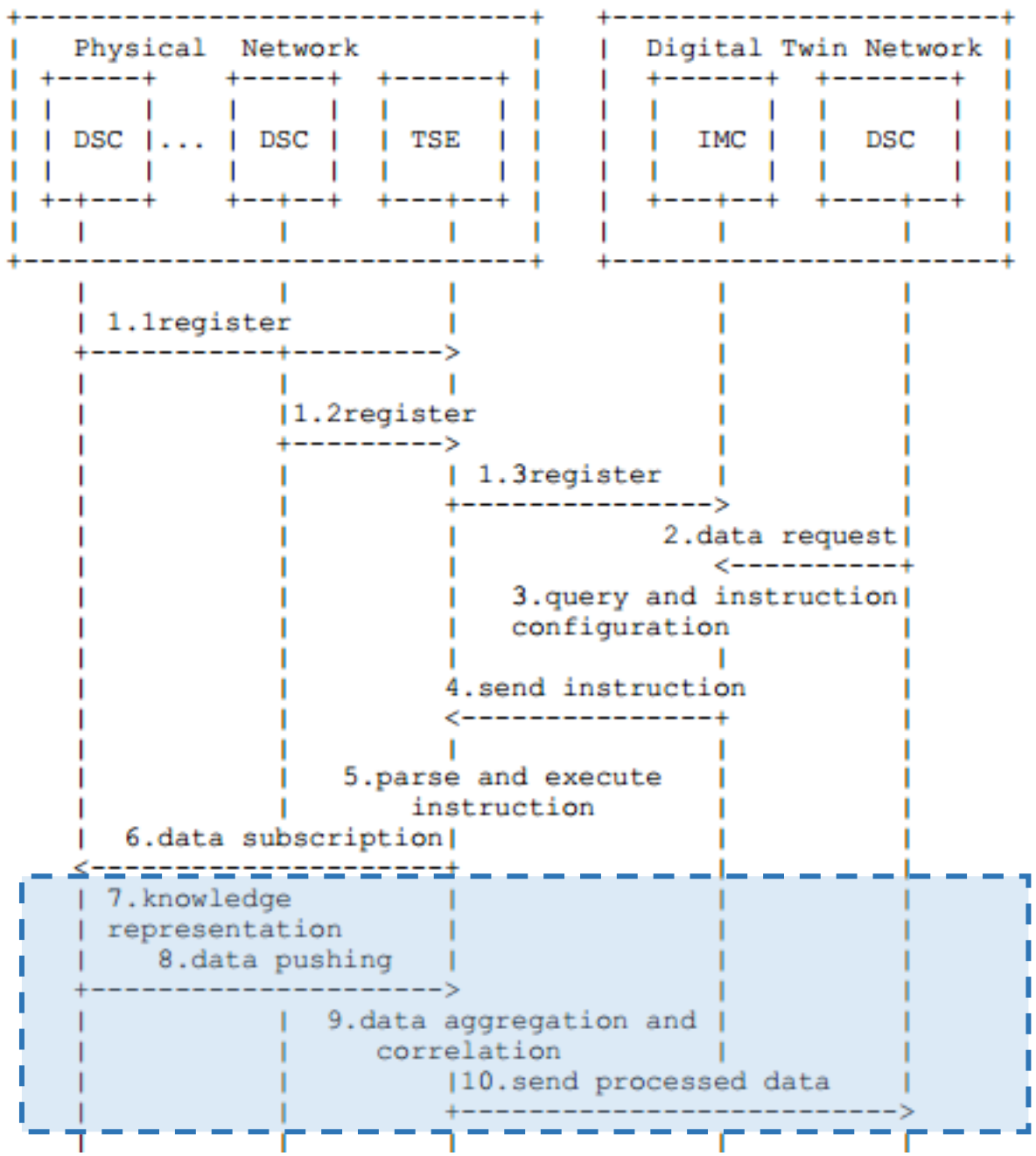
1. the Data Storage Centers in the Physical Network registers with the Telemetry Streaming Element in the Physical Network. The Telemetry Streaming Element registers with the Instruction management center. The registration information includes the IP address of the Data Storage Center, the data type, the data source, or the data size, etc.
2. The Data Storage Center in the Twin Network sends the data collection request to the Instruction Management Center.
3. According to the data collection request, the Instruction Management Center intelligently query the registration information for addressing, and configures the data processing instruction.

- The instruction-carrying information includes rule based mathematical expressions, executable models in .exe format, dynamic collection frequency, parameter lists, program text files in .m format, text files with parameter configuration, and other types of files. And these are created, modified, combined and deleted flexibly according to requirements.



The specific process is as follows:

4. The Instruction Management Center in the Twin Network sends the corresponding instruction according to the query result to the Telemetry Streaming Element in the Physical Network.
5. After receiving the instructions, the Telemetry Streaming Element in the Physical Network will parse them and execute them according to the instructions, and query the location of data stored. The query function can be performed by the Complex Event Processing (CEP) engine, which receives all telemetry data and processes it with all queries provided.
6. The Telemetry Streaming Element sends data subscription to DSC of the Physical Network.



The specific process is as follows:
7. DSC of Physical Network performs knowledge representation of local data, for example, in RDF form, also sends raw data to TSE for knowledge representation.
8. DSC of Physical Network push data or knowledge to TSE.
9. TSE aggregates and correlates the collected data or knowledge. Then according to the actual needs, decide whether to perform knowledge representation.
10. TSE sends the processed data or knowledge to DSC of Twin Network.

Advantages

1. The need for storage resources in the twin network is reduced.
2. The need for computing resources and improve the efficiency of data processing and representation is reduced.
3. The bandwidth resource consumed by data transmission is greatly reduced.
4. Data transmission latency is reduced.

Next Steps

- Detailed analysis on the instruction-carrying information
- To discover more concrete examples of Data collection
- Consider about the extension of the Data Collection method

- **Looking forward to the comments, suggestions and questions**.

Thank you!