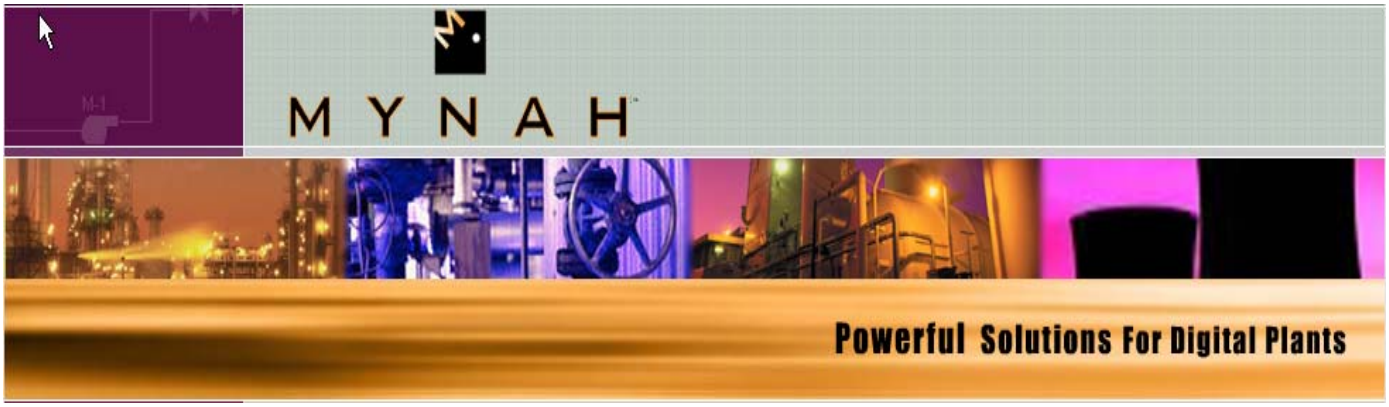
APPLICATION NOTE



Optimizing Speed of Industrial Ethernet Communication with the DeltaV Virtual IO Module Network Gateway

Introduction

The DeltaV Virtual IO Module (VIM) Network Gateway has powerful features that allow optimization of Industrial Ethernet communications with either the Modbus TCP/IP or Ethernet/IP protocol. These features allow the user to either speed up or slow down the control and timing by which the DeltaV system reads or writes data to the field device. The following application note describes several ways to control Industrial Ethernet communications using the VIMNet and DeltaV Explorer applications.

Modbus TCP/IP Optimization

Output Datasets. Output data sent from the DeltaV Module to the VIM Dataset register is written to the filed device immediately upon change of state. In the default configuration, the dataset write is sent to the field device one time only.

Periodic or cyclic writes can be configured for application or devices where it is desirable to periodically send a dataset write. The Special Data 4 parameter as shown below in Figure 1 is used for this. The cyclic write period is set in 5 ms units. This functionality applies only to output datasets configured for block output (output mode=0) and no readback. If configured this way, the VIM will periodically send the data to the field device regardless of changes received from the DeltaV system. A Special Data 4 configured value of 0 implies no cyclic write.

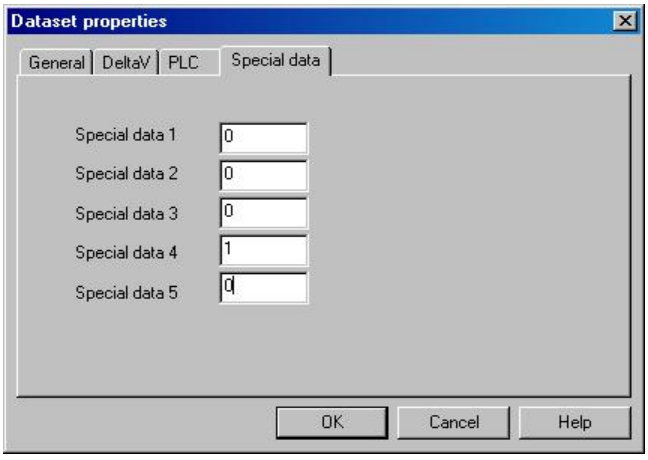


Figure 1: Configuring Special Data Parameters

The cyclic write is done as part of the overall VIM scan. For example, if Special Data 4 parameter is con-

figured as 1, the VIM will start a 5 ms timer. Upon timer expiration, the output dataset is flagged as output pending. All datasets with output pending are then sent to the field first before any reads are performed.

Input Datasets. For input datasets, the VIM by default continuously scans inputs datasets as fast as possible. This default scan system will meet the requirements of most applications. Most installations will see approximately 10ms average scan time per dataset. Actual scan times will be dependent upon the response time of the device to the dataset read requests.

There are several options to slow down or control the input dataset communications requests. These options can be used to keep the VIM data requests from affecting the performance of the device.

Periodic or cyclic reads can be configured for application or devices where it is desirable to more tightly control the dataset read requests to the device. This should be used sparingly. In most cases, the VIM default scan speed will provide better results. Read requests can be scheduled through the VIM by placing a time value in the Special Data 4 parameter, in 5 ms units. If configured the VIM starts a timer. Upon timer expiration, the dataset is flagged as ready to read.

Transmit Delays insert a time delay before a dataset request (read or write) is sent. This delay can be configured in one of two ways, at the port level or at the dataset level. At the port level, the delay is configured as shown below in Figure 2, using the Transmit delay parameter. The port level delay affects all datasets configured under the port.

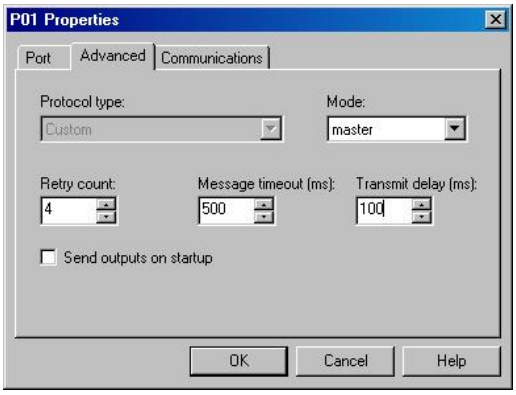


Figure 2: Configuring Transmit Delay

At the dataset level, the delay is configured using the Special Data 3 parameter as shown below in Figure 3.

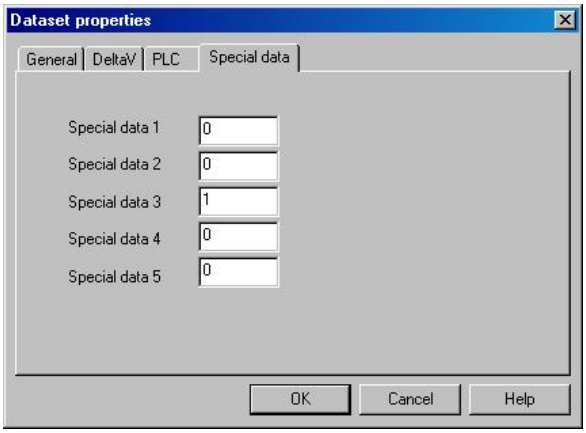


Figure 3: Configuring Special Data Parameters

The Special Data 3 parameter is in 5ms units. To get a 100ms delay, configure this parameter as 20. Note that if the dataset level delay is configured (Special Data 3 is not 0), then the port level delay is ignored.

Simultaneous Messaging allows enhanced communication for devices that support multiple messages. The number of simultaneous messages is set in VIMNet Explorer per device. In the default setting of one multiple message, only one dataset message is requested per device connected. Up to 16 simultaneous messages can be sent per device.

If the target device allows multiple messages, you can use this feature to increase the data transmission and effective data update times. In most cases, multiple simultaneous requests provide significant performance improvement.

Testing has shown that while 10 datasets scanned sequentially (1 simultaneous message) are updated in overall scan time of around 300 msec, changing the number of simultaneous messages to 16 results in an overall scan time of 60 msec.

Modbus TCP/IP devices like Schneider Electric's NOE for the Quantum PLC supports up to 16 simultaneous messages. Other devices that are supported include HIMA and Triconex and Triplex ESD Systems.

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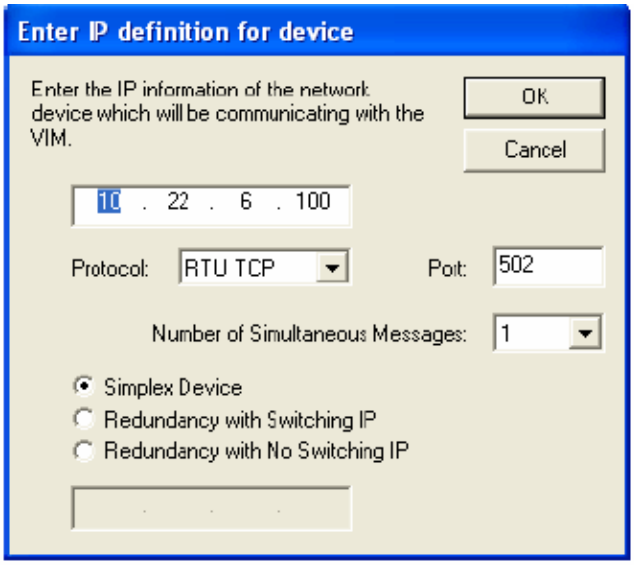

Figure 4: Designating Number of Simultaneous Messages

Ethernet IP Communications Optimization

The same options can be used for application of the Ethernet/IP Driver for the Virtual IO Module as described above for Modbus TCP/IP, with the following exceptions:

1. The Special Data 3 parameter for the dataset level Transmit Delay is in 10ms units.
2. The current Ethernet IP Scanner driver allows you to configure the maximum simultaneous messages in the VIMNet Explorer.
3. There are no periodic reads or writes available for Ethernet/IP VIM datasets.

Simultaneous messaging is a powerful tool for optimizing input dataset reads to Rockwell ControlLogix controllers. The 1756-ENBT card used in Logix racks will support up to 16 simultaneous messages. Other supported devices include Allen Bradley PLC5 and SLC5/05.

Monitoring Industrial Ethernet Performance

The VIMNet Explorer diagnostics application provides powerful tools for monitoring and troubleshooting communications performance over Industrial Ethernet. This application is mostly used to view the network communications statistics. The information is continuously scanned every second and displayed in the diagnostic's window. The diagnostic information is displayed at each level of the VIM architecture, thereby allowing users to drill down to the VIM, port, device, and dataset levels. The following screens show each level starting with the VIM level as shown in Figure 5.

The VIM level diagnostics show the VIM mode, data poll queue, and other parameters. For more detailed descriptions, see *Table 1: Description of Diagnostic Items* on page 5.

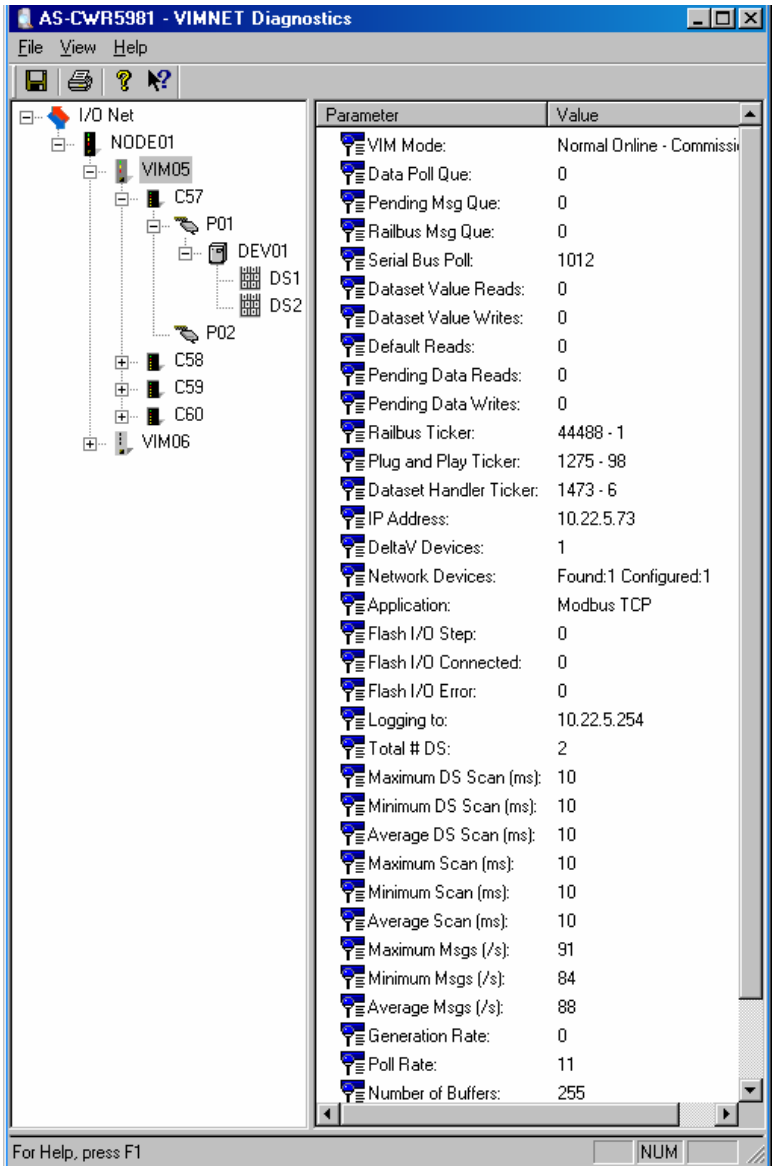

Figure 5: VIM Level Diagnostics

Diagnostic Item	Description
VIM Mode	Shows current mode: Commissioned, Failsafe, etc.
Data Poll Queue	Number of messages waiting to be sent to DeltaV
Pending Message Queue	Number of waiting diagnostics message responses to be sent to DeltaV
Railbus Message Queue	Number of waiting Railbus messages received from DeltaV to be processed
Serial Bus Poll	Counter of poll requests received from Controller
Dataset Value Reads	Counter of dataset value read requests received from Controller
Dataset Value Writes	Counter of dataset value write requests received from Controller
Default Reads	Counter of default read requests received from Controller
Pending Data Reads	Counter of pending data read requests received from Controller
Pending Data Writes	Counter of pending data write requests received from Controller
Railbus Ticker	Ticker of process handling Railbus messages
Plug and Play Ticker	Ticker of process handling Plug/Play messages
Ethernet/IP Ticker	Ticker of process handling Ethernet/IP messages to/from field
Dataset Handler Ticker	Ticker of process handling dataset updates
IP Address	IP address of VIM
DeltaV Devices	Number of DeltaV devices in configuration from Controller
Network Devices	Number of devices configured/found
Application	Application type: Ethernet/IP or ModbusTCP
Flash I/O Step	Reserved for Flash evaluation
Flash I/O Connected	Reserved for Flash evaluation
Flash I/O Error	Reserved for Flash evaluation
Logging to	IP address of PC if message logging is turned on
Total # DS	Total number of datasets in this configuration
Maximum DS Scan (ms)	Maximum scan time (ms) for single dataset based (UCMM and DF1) messages
Minimum DS Scan (ms)	Minimum scan time (ms) for single dataset based (UCMM and DF1) messages
Average DS Scan (ms)	Average scan time (ms) for single dataset based (UCMM and DF1) messages
Maximum Scan (ms)	Maximum scan time (ms) for VIM process thread
Minimum Scan (ms)	Minimum scan time (ms) for VIM process thread
Average Scan (ms)	Average scan time (ms) for VIM process thread
Maximum DF1 Msgs(/s)	Maximum UCMM or DF1 messages per second
Minimum DF1 Msgs (/s)	Minimum UCMM or DF1 messages per second
Average DF1 Msgs (/s)	Average UCMM or DF1 messages per second
ENBT Connects	Counter of ENBT connect requests
ENBT Disconnects	Counter of ENBT disconnect requests
ENBT Invalid path	Counter of ENBT requests with invalid path
ENBT Timeouts	Counter of ENBT requests which timed out
ENBT No Response	Counter of ENBT requests with No Response
ENBT Err Response	Counter of ENBT requests with Error Response
ENBT Connections Exceeded	Counter of ENBT requests terminated because of connection limit
ENBT Pending Req Exceeded	Counter of ENBT requests terminated because of pending req limit
ENBT Writes	Counter of ENBT write requests
ENBT Reads	Counter of ENBT read requests
Poll Rate	Railbus Poll rate
Number of Buffers	
% Available Buffers	
Buffer Resets	

Table 1: Description of Diagnostic Items

The next level down is the Port Level Diagnostics, which shows the port status as well as status of datasets. If the dataset is in error status, it will be displayed as a character string in an error message column. If no error exists, then the status is "Good" as shown in Figure 6.

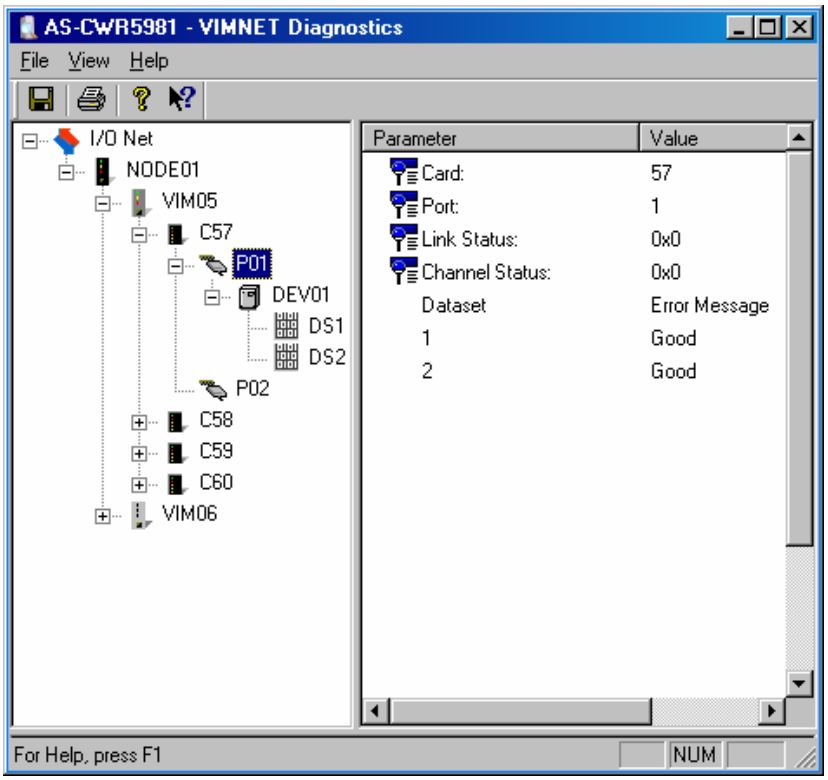

Figure 6: Port Level Diagnostics

The device level diagnostics show the statistics for the selected device providing information such as IP address, connection status, and number of retries as shown in Figure 7. It also shows valuable data such as the number of good and error responses. At this level, users can see the maximum, minimum, and average response times. The minimum time (ms) represents the minimum time it takes the VIM to scan all of the datasets under that particular device.

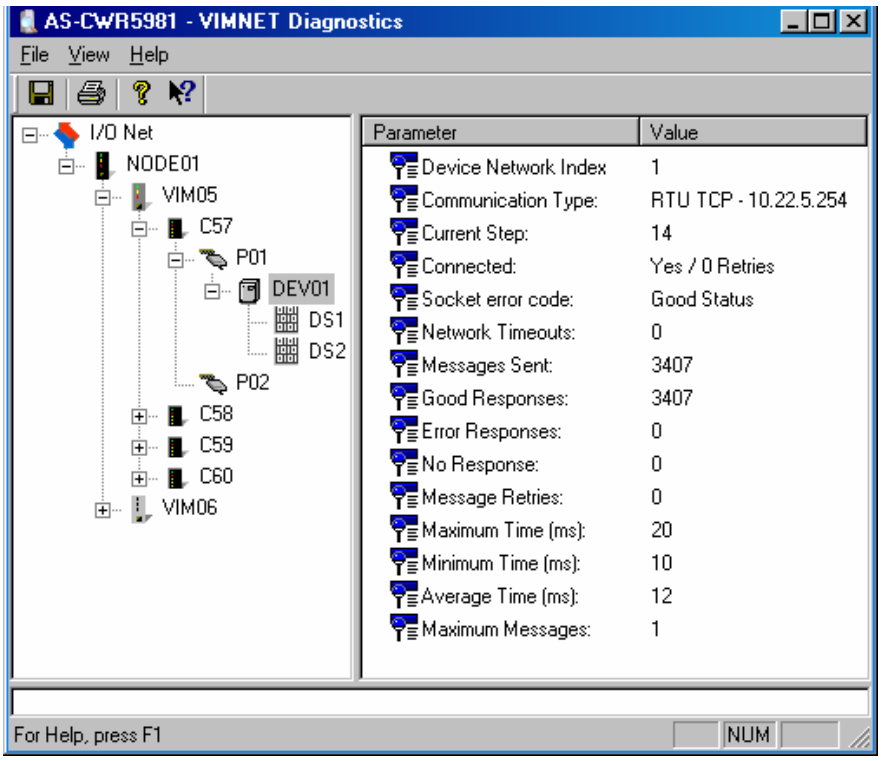

Figure 7: Device Level Diagnostics

The lowest level of statistics provides the dataset specific diagnostics information as shown in Figure 8. At the dataset level, users can view the Dataset Scan and the Time Between Scans. By looking at these two statistics, users can determine what is the scan time for that particular dataset and how much time elapses between two consecutive scans.

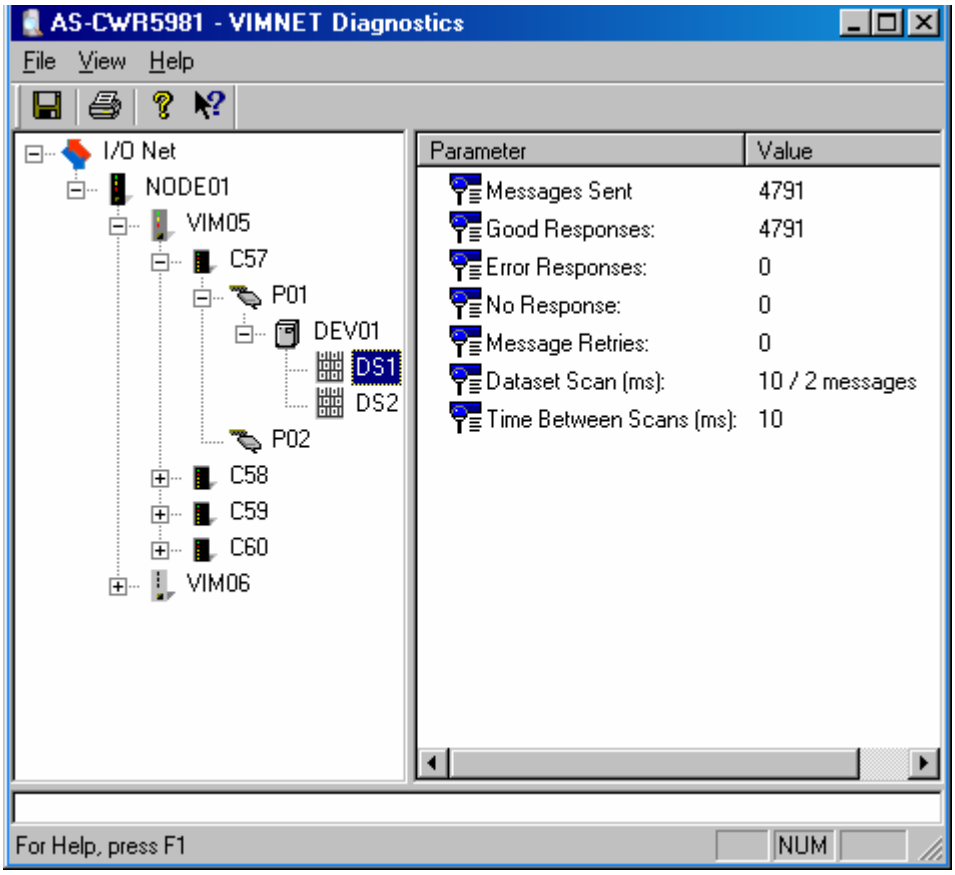

Figure 8:Dataset Level Diagnostics

Summary

The DeltaV Virtual IO Module Network Gateway has powerful features that allow optimization of Industrial Ethernet communications within both protocols. There are several features that allow the user to control the timing and manner in which the DeltaV system reads or writes data to the field device.

Some of the features help slow down the read/write request such as transmit delays, while others speed up the updates and increase the data transmission such as periodic/cyclic reads and simultaneous messaging.

The VIMNet Explorer Diagnostics provides many diagnostic tools for monitoring and troubleshooting the communication between the DeltaV system, the VIM, and field devices.

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