Migrate To A Safer Plant

Greater Control With A PC
DCS: Integration
O&G: Intelligent Software
In recent years, the advanced functionality embedded in field instruments and the evolution of the field network require DCS controllers (Figure 1) to have the capability to process a wide variety of information at higher speeds. As field instruments advance, there is a need to exchange large amount of process data and parameters among various diagnostic devices for stability of plant operation. The modern Field Control Station (FCS) is expected to have quicker processing speed to handle the increasing amounts of data from the field.

Processing Method Of Process Data
Let us take a closer look at the architecture of a newly developed FCS that enhances the processing performance of process data and field instrument data.

Asynchronous Parallel Access Method
The Asynchronous Parallel Access method was adopted in older generation of DCS. As shown in Figure 2, FCS has an I/O communication module separately from a CPU module. The I/O communication module inputs and outputs process data at its own periodic intervals, and maps the data in the memory storage, which can be accessed from the CPU module.

The main processor of the CPU module accesses the I/O data mapped on the memory to update the I/O data for control computation, giving this method an advantage of reducing the load of the main processor for I/O access. However, since the I/O access cycle of the I/O communication processor is not synchronised with the control scan of the main processor, the reaction time tends to be longer: the time from the detection of a process data value by sensor devices to its use in the main processor for control computation.
Direct Access Method
Researchers later introduced the Direct Access Data Processing Method as shown in Figure 3. The main processor of the CPU module directly communicates with I/O Modules (IOMs) to exchange process data with IOMs.

Since the main processor can directly access the data in the IOMs, the reaction time can be much shorter and the controllability is better than those when the Asynchronous Parallel Access method is adopted. However, the load of the main processor becomes higher because the main processor must wait to receive the data from IOMs.

Particularly when IOMs are distributed in wide area network via optical fibre, the required I/O access time for the main processor to communicate with IOMs becomes longer, creating non-negligible load for the main processor as well.

Latest Synchronous Parallel Access Method
The latest Synchronous Parallel Access method combines the advantage of the Asynchronous Parallel Access method and that of the Direct Access method. As shown in Figure 4, it shortens the reaction time and provides excellent controllability as well as keeps the load of the main processor low.

In order to synchronise the control scan of the main processor with the I/O access, both the I/O communication processor and main processor are mounted on the CPU module.

In the case of the synchronous Parallel Access method, the I/O communication processor completes the collection of process data just before the start of the control scan cycle in the main processor. In order to achieve this, the mechanism that periodic interrupt events along with assumed I/O processing time based on the amount of input process data that is sent to the I/O communication processor has been developed.

The main processor clocks the time based on periodic interrupt events, and the time for starting the control scan cycle is determined by these periodic events. As such, the I/O communication processor starts inputting process data at the timing ahead of the I/O processing time by counting backward from the periodic interrupt event at which the next control scan cycle starts. Therefore, the collection of process data can be completed just before the main processor starts the control scan cycle.

Improvement In Processing Performance
The use of the Synchronous Parallel Access method has improved the processing performance of not only process data for control loops, but also field instrument data.

Current Concerns
As mentioned earlier, FCS is required to process a large amount of various types of process data from field instruments. In the case of the Direct Access method, the main processor accesses device diagnosis parameters and then sends them to the plant asset management software as shown in Figure 6.

The main processor needs to perform control computation using process data and to execute processing related to the device diagnosis parameters, which is required for the plant asset management. For
this reason, in the case of the Direct Access method, the amount of control computation needs to be limited to preserve sufficient processor power to handle device diagnosis parameters as well.

I/O Communication Processor Solution
Since device diagnosis parameters are not needed for control computation, the main processor does not handle those parameters. In terms of improving performance of control computation as mentioned in the earlier section, it is desirable to process massive device diagnosis parameters without increasing the load of the main processor.

In the new mechanism, the I/O communication processor performs both the sending and receiving of field instrument data, including communication with IOMs and the plant asset management software, which the main processor used to be performing.

Consequently, this mechanism provides parallel processing as shown in Figure 7: control computation performed by the main processor and communication of device diagnosis parameters performed by the I/O communication processor, efficiently obtaining a larger amount of field instrument data.

When adopting this new mechanism, instead of the main processor, the I/O communication processor needs to generate the communication frames to be sent to IOMs. In order to ensure the same level of reliability as before, a new mechanism to collate the frames repeatedly by hardware and software has been adopted.

By adopting the Synchronous Parallel Access method in which the I/O communication processor is equipped in the CPU module, the FCS is capable of improving processing performance of process data and processing performance of device diagnosis parameters.

Since this architecture achieves field instrument data processing without any increase in the load of the main processor that performs control computation, it provides an easy functional improvement environment for the larger amount of field instrument data.

For example, if some of the functions performed in the asset management software are executed in the I/O communication processor in the FCS, responsive usability of the field instrument data will be improved. Future functional enhancement and increased field instrument data processing speed are expected owing to this architecture.