

# Improving a Traditional SCADA System with DCS – ABB Freelance 800F

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## Abstract

*The increase of the availability and speed performance of the digital communications used today tends to reduce the traditional boundary between the SCADA systems and the Distributed Control Systems (DCS). This paper tries to conclude that using hybrid applications, which mix together both types of systems is the future of this domain. The paper describes, as an alternative example of a traditional SCADA system, the functionality offered by the Freelance 800F system, produced by ABB – which can be considered a mixed system (SCADA/DCS), although it is labeled as a DCS system.*

**Key words:** SCADA, DCS, monitoring, control.

## Introduction

This paper presents a new trend of control and monitoring processes designed for fluid transport via pipelines – the increase of performance in the digital communications area (computer networks, point-to-point data communications) which tends to reduce the differences between SCADA (Supervisory Control And Data Acquisition) and DCS (Distributed Control Systems) and to make disappear the usual limitations between the individual uses of the two concepts. The future seems to be a place for hybrid applications, which are providing the features of both types of system. Taking into consideration the existing example of a traditional SCADA system, the one used in a Romanian company which is transporting petroleum products by pipelines, the question which raises is to what degree the features provided by a system which can be considered as SCADA/DCS hybrid (although it is labeled as a DCS system) – ABB Freelance 800F – will improve the monitoring and control activity, by the advantages given by flexibility, added options and better reaction timing.

## The relation between SCADA and DCS

There are several points of view on the similarities and differences between a SCADA system and DCS and the way to use them together. Some of these points of views are described in the following:

1. At the SCADA systems, the operator/supervisor is collecting data, events and alarms from the remote units (RTU or PLC). The operator is analyzing data and is taking measures, if necessary. RTU/PLC is a local control system which is working according to the commands received from the supervisory system, except for specific control decisions (fire fight, emergency stops),

which are taken locally by the RTU/PLC. In DCS, the controller is the one which is controlling the process, the control loops being incorporated. ([3])

2. In many cases the SCADA solutions have DCS components, by using smart RTU's or PLC's, which are capable of autonomous execution of simple logic processes without involving a master computer. ([1]).

3. In general terms, SCADA system refers to a system which is coordinating but not controlling the real time processes. This discussion over the real time control is becoming more confused because of the communication technologies which are permitting high speed, low latency communications over great distances. Most differences between SCADA and DCS are provided by the technical culture of the company and can be usually ignored. As the high speed communication infrastructures will become available, the differences between SCADA and DCS will disappear entirely ([4]).

4. In [5], the following differences between a DCS and a SCADA system are given:

- |        |   |
|--------|---|
| DCS:   | <ul style="list-style-type: none"> <li>- typical for a sub-process control (for example, a pumping station);</li> <li>- high availability of the power supply;</li> <li>- fast and resilient communications;</li> <li>- the control system can be installed in a controlled environment.</li> </ul> |
| SCADA: | <ul style="list-style-type: none"> <li>- distributed over large areas (thousands of kilometers);</li> <li>- the power supply can be unreliable or even absent;</li> <li>- communications can be slower;</li> <li>- the equipments can be installed in a hostile environment.</li> </ul>             |

5. According to [1], a monitoring solution implemented at an oil company from Kazakhstan (KazMunaiGas), which is established more than 40 oil and gas fields, is consisting of:

- each field is controlled by its own dedicated DCS;
- all the fields, with the pipeline network, are controlled by a central SCADA system.

## ABB Freelance 800F

Freelance 800F is a DCS solution proposed by the company ABB, the global leader in power and automation technologies [www.abb.com]. The basic idea for developing Freelance 800F was increasing cost efficiency by reducing the sum spent on software engineering, at the same time with keeping the hardware prices at the level of the Programmable Logic Controllers ([2]). The spending on software engineering can be reduced by the following measures:

- usage of a single software engineering tool (Control Builder F) for configuring the entire system, which is composed from the automation functions and the operator interface – with displays and logs, and also for configuring the fieldbus lines (PROFIBUS, FOUNDATION Fieldbus, HART, etc.) and setting up field devices;
- automatic generation of the entire code for communications between controllers and operation stations;
- lowering the financial and time investments for data introduction, based on common format database for both field devices and process and operation stations, giving data consistency on the entire system;
- uniform plausibility check over the entire system on the user programs of all process and operation stations and of the smart field devices, including formal check for completeness and consistency of the user programs;
- visual configuration, using high performance PLC programming language editors, following the IEC 61131-3 standard: Function block diagram (FBD), Instruction List (IL), Ladder diagram (LD), Sequential function chart (SFC), Structured text (ST);

- extensive library for function blocks to which user defined function blocks can be added; macro and graphic symbols library for creating graphic and interface elements for user defined function blocks;
- it is possible to integrate any PROFIBUS-DP or PA slave devices by using a concept of generic subordination (through GSD files) – these components can be configured by user defined dialogs.

## System architecture

Freelance 800F system architecture is divided in operator level and process level, levels which are communicating by the system bus, based on Ethernet, with the TCP/IP protocol.

In the operator level can be installed an engineering station and one or more operator stations. The engineering station is used for configuring and starting the system using the software package Control Builder F. The operator stations are used for operating and monitoring the system via the software package DigiVis.

At the process level, Freelancer 800F can be composed of several process stations which are connected with I/O units. As an option, these process stations can run as redundant systems (CPU redundancy and/or fieldbus modules redundancy) or as simple systems. The input/output modules are used taking into consideration the quantity and the type of the process signals. Any other fieldbus compatible components, as remote I/O modules or field devices, can be connected to AC 800F.

As it is shown in Figure 1 ([2]), Freelance 800F has an hierarchical architecture: on the inferior level, there are field devices (transducers and actuators) which are connected to the AC 800F Controllers using different types of intelligent link devices (LD 800P, LD800HSE). On the superior level (the operator level) there are installed an engineering station and one or more operator stations.

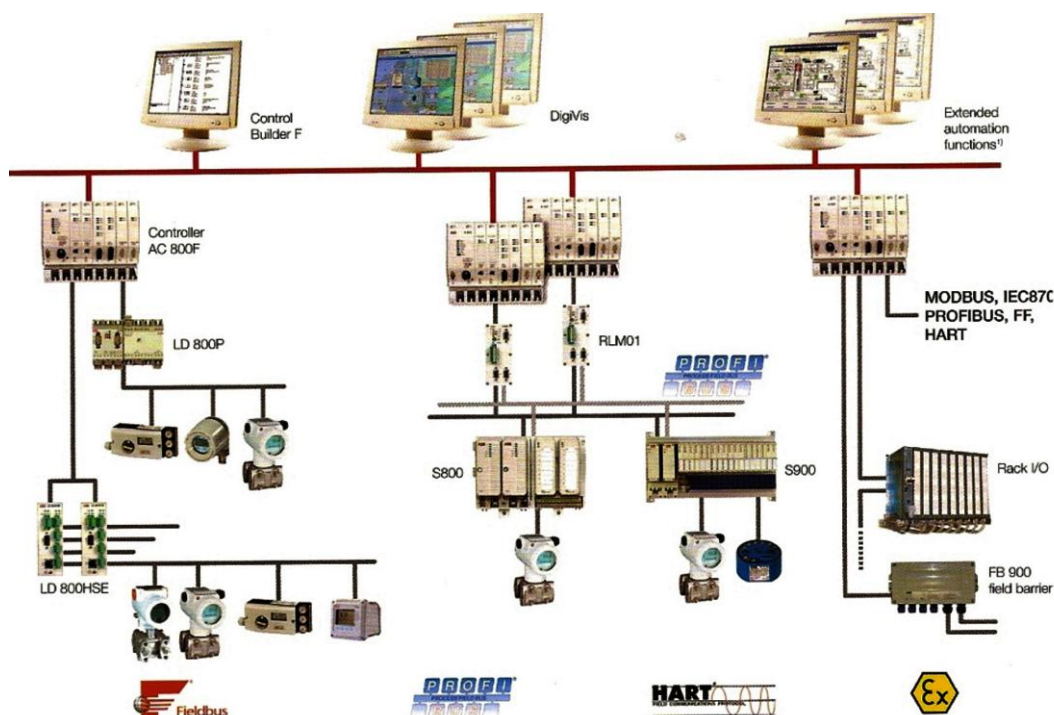


Fig. 1. The system architecture of Freelance 800F.

## Process level automation

The AC 800F controller has a modular structure. The central processing unit (CPU) is designed as a printed board onto which various modules – power supply units, Ethernet or fieldbus modules – can be connected inline with the application.

Referring to fieldbus, several modules for PROFIBUS-DP-V1, FOUNDATION Fieldbus HSE, HART, MODBUS, IEC 60870-5-101 and CAN are available. The fieldbus line and PROFIBUS slave lines connected to it are entirely configured and set up by Control Builder F, without any use for other external applications for configuring.

The PROFIBUS slave lines can be integrated into the system using GSD files (Device Master Data, abbreviation of the German term Geräte-StammDaten) or FDT/DTM (Field Device Tool / Device Type Manager). GSD files are containing information about the equipment (they are also called device datasheets).

For FOUNDATION Fieldbus, configuration is made by CFF Files (Capabilities File) DD files (Device Description). These permit setting up of the system even without connected field devices.

Also we can connect a rack containing I/O units to AC800F, using a CAN module for this case. The CAN module permits the operation of five I/O racks, with up to almost 1000 I/O channels for each AC 800F. The I/O racks are equipped with a module for linking up to nine I/O modules and can be placed separately at a distance of maximum 400 meters by AC800F.

The main characteristics of the AC800F controller are presented in the following table.

**Table 1.** Characteristics of the AC800F controller

CPU	RISC superscalar processor, working on 32 bits, with fast bits processing
RAM	4 MB S-RAM or 16 MB SD-RAM for working on backup power supply
Tasks execution	Cyclic (with configurable timing, starting from 5 ms per cycle) Event driven (predefined events) As fast as possible (PLC mode)
Interfaces	Ethernet PROFIBUS FOUNDATION Fieldbus Station bus (CAN bus) Serial: RS485/422/232 Modbus protocol(master or slave, RTU or ASCII) Tele control protocol according to IEC 60870-5-101
Working environment	0...60°C (32...140°F) temperatures, it does not require forced cooling

## Functions

The functions offered by the Freelance system are designed according to IEC 61131-3 standard, but they are also following some other high performance functions and function blocks which proved to be highly useful in industrial applications. These functions can be found in a function block library and can be supplemented by user defined functions and function blocks. By using these functions, the processing capacity and the speed of the process station can be easily adapted to the automation requirements while designing and configuring the station.

## Using DigiVis to obtain the operator level

The operator stations of the Freelance 800F system are working on common PCs or, for special cases, on industrial ruggedized PCs.

The DigiVis software package, based on a Microsoft Windows graphic interface, is blending together the advantage of user friendliness with the one of obtaining performance for process operation. Any peripheral devices existent on the market (displays, printers, mice, keyboards) can be used. To make things even easier the operation and monitoring functions (based on DigiVis) and the set-up functions (made by Control Builder F) can be implemented together, on the same PC.

The DigiVis operation and monitoring software package provides the following features:

- Fast and transparent operation due to a clear hierarchy of the information;
- The possibility to assign shortcuts specialized for fast display selection;
- A large number of predefined displays;
- A control schema which is providing access to interlocking displays for the selected equipment;
- An external access schema which is providing supplementary information such as PDF documentation, live images from the installation, standard operational procedures;
- Fast selection of correct measuring points for the eventuality of a process alarm;
- Message displays based on a uniform and clearly arranged concept;
- The possibility to configure up to 16 profiles for group access, with a maximum of 1000 users, each of them with specific password (based on an optional Security Lock software);
- Displays for trends with archiving options;
- Events list for all operator actions, each event having a time label;
- System diagnostics, including field devices;
- Various language localizations: German, English, French, Spanish, Swedish, Polish, Russian, Chinese, Japanese;

Process visual monitoring is accomplished by:

- Graphic displays specific for each installation;
- Control panels for process parameters;
- Text labeling for up to 15 regions on the installation.

Figure 2 is presenting a sample control panel for process parameters ([2]).

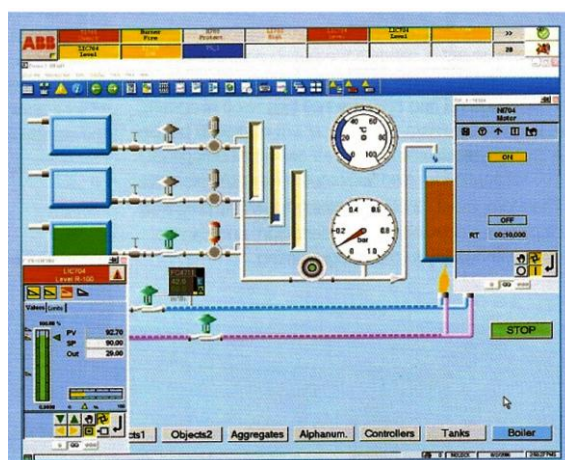


Fig 2. A sample control panel for process parameters.

The provided predefined displays are adapted to process control engineering needs, both for structure and content of the information. The following predefined displays are available: general display, group displays, front panel, SFC displays (Structured Function Chart), time table display, trends display, Web display, messages list and hints list, logs and system display.

## Conclusions

Trying to answer if a possible use of the Freelance 800F system is profitable, the following conclusions (positive and negative) can be drawn:

- Freelance 800F is really offering a large set of functions which can be useful in the activity of any company specialized in petroleum products transport;
- Taking as granted a fast and reliable enough communication system, we can use a DCS or a hybrid system instead of a traditional SCADA system;
- Freelance 800F is not yet adapted for use in a Romanian company – it's lacking the Romanian language localization. This feature can be possibly provided at the request of a Romanian client or as a joint work;
- Passing from a traditional SCADA system to a new system can require extensive efforts for upgrading the existing communication infrastructure. Such a massive modification is justified by the fact that the SCADA systems are usually working on low speed communication links, most of the times of a serial type;
- Freelance 800F takes over and enlarges the capabilities of DCS systems, on a satisfactory performance/cost value;
- The usage of Freelance 800F satisfies requirements such as real-time, security in transmission and easiness in informing the operator.

## References

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## Îmbunătățirea unui sistem SCADA tradițional cu DCS – ABB Freelance 800F

## Rezumat

*Creșterea performanțelor privind mijloacele de comunicație digitală tinde să reducă demarcația între sistemele tradiționale SCADA și sistemele de control distribuit (DCS). Lucrarea încearcă să ducă la concluzia că viitorul este destinat aplicațiilor hibride, ce îndeplinesc funcțiile ambelor tipuri de sisteme. Vor fi examinate, ca o alternativă a unui sistem tradițional SCADA (cel al unei companii de transport produse petroliere din România), funcțiile pe care le-ar putea pune la dispoziție sistemul ABB Freelance 800F - sistem ce poate fi considerat mixt (SCADA/DCS), deși este etichetat ca fiind DCS.*