2 An overview of FDI

This chapter provides an overview of the FDI technology. Taking as a starting point the basic architecture of FDI, the various versions and their usage scenarios are explained. The consideration of the FDI server, FDI information model and FDI client provide an insight into the function of an FDI host. Finally, the benefits of FDI for device manufacturers, system manufacturers and users are discussed.

2.1 The FDI specification

The FDI specification is consists of seven parts.
Part 1: Overview [IEC13a]: This part of the specification provides an overview of the function of FDI and is thus a good starting point for those reading the specification. It also contains the life-cycle concept (see Section 2.8).
Part 2: FDI Client [IEC13b]: This part of the specification defines the client-sided functions of FDI. In particular, the interfaces between the User Interface Plugin and the FDI host are defined here independent of technology.
Part 3: FDI Server [IEC13c]: This part defines the functions of the FDI server. This relates particularly to the interaction between the FDI server and the content of FDI packages.
Part 4: FDI Packages [IEC13d]: The structure of FDI packages is described here. The various types of FDI packages and their content are defined.
Part 5: FDI Information Model [IEC13e]: This part specifies the structure of the OPC UA information model as well as the mapping between FDI package content and their representation in the Information model.
Part 6: Technology Mapping [IEC13f]: Here, the concrete implementation of the interfaces between the FDI host and the User Interface Plugin based on Microsoft.NET is described.
Part 7: Communication Devices [IEC13g]: This part of the specification describes the handling of communication devices. Communication devices provide access to networks (e.g. a PROFIBUS interface card) or, in the form of a gateway, allow the transition between networks (e.g. from PROFIBUS to HART).

In addition, there are communication profiles. These respond to protocol-specific mechanisms, such as the assignment of FDI packages to field devices via protocol-specific version information. There are currently five communication profiles. More profiles will be added by including FDI supported communication protocols such as ISA100 Wireless.
Part 101-1: Foundation Fieldbus H1 Profile [IEC13h]
Part 101-2: Foundation Fieldbus HSE Profile [IEC13i]
Part 103-1: PROFIBUS Profile [IEC13j]
Part 103-4: PROFINET Profile [IEC13k]
Part 109-1: HART Profile [IEC13l]

FDI also references a number of further specifications. The following are of particular significance:
Electronic Device Description Language (EDDL) [IEC14a][IEC14b][IEC14c]: Specification of the EDDL description language that is used in FDI.
OPC Unified Architecture (OPC UA) [IEC10a][IEC10b][IEC11a][IEC11b] [IEC12a][IEC12b]: Specification of the middleware technology OPC UA used by FDI and on which the FDI information model is based.

This list makes it clear that a whole series of specifications are relevant for FDI in their entirety. However, the respective specification parts focus on specific parts of FDI in accordance with their normative task.

In contrast to the specification the following chapters look at the functional correlations between the components of the FDI technology. The respective underlying parts of the FDI specification are referenced.

2.2 The FDI architecture

2.2.1 Basic architecture

The FDI basic architecture consists of three components: the *FDI Package*, *FDI Server* and *FDI Client* (figure 2.1) [IEC13a].

FDI packages represent the field devices that are to be integrated into the automation system. For this purpose, FDI packages contain all the necessary information regarding the data, functions of the field device as well as the user interfaces that the user uses to configure and set parameters for the field device. In addition, further data can be included, such as user manuals, certificates or similar.

The FDI server represents all field devices of the automation system and provides access to the user interfaces via which the field devices can be configured and the parameters set. In addition, it provides access to the data, functions and further information (e.g. user manuals). In order for the FDI server to be able to work with the field devices, it needs to know their type. For this, it imports the FDI packages, which contain knowledge regarding the field devices, into its device catalog. The FDI server then knows a field device's type. The FDI server maps the individual field devices of the automation system as instances of the field device type in question. The FDI server then provides all

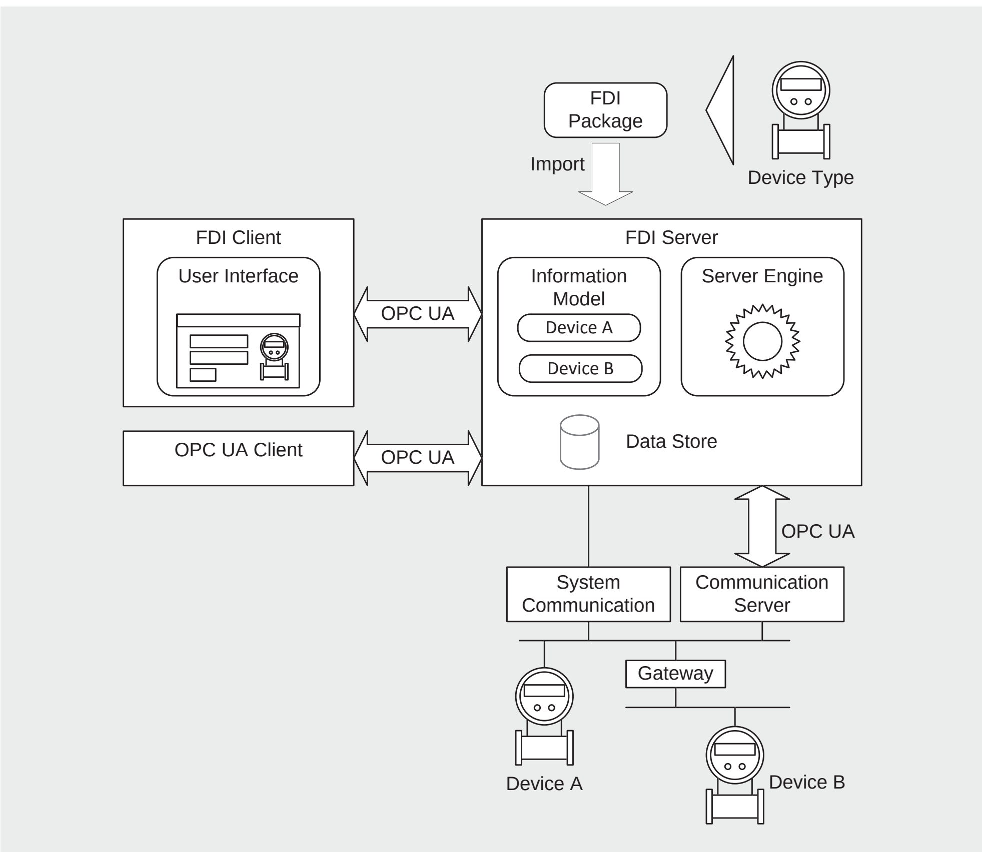

Figure 2.1 FDI base architecture [IEC13a]

of this information via what is known as an information model. The information model defines the manner in which data and its structure is mapped. In the case of FDI, it defines in particular how the topology of the automation system and the field devices contained in it are represented. The field device data that can be accessed in the information model either comes from persistent data storage (e.g. a database) or via communication directly from the field device itself. For this, the FDI server either uses its own, system-specific communication routes or communication servers. Communication servers are also specified in FDI and provide the access to a communication medium. If the field device that the FDI server wants to communicate with is in an underlying network in the topology, gateways take charge of the translation between networks ("nested communication").

FDI clients provide the interface to the user. They provide the possibility to configure and parameterize field devices. To do this, they load the respective device-specific user interface from servers and present it – in a similar manner to a Web browser. The data that is shown on the user interfaces comes from the FDI server. Data that the user changes via the user interface is also transmitted via the FDI server to the field device.

The technological basis for the communication between the FDI server and the client and between the FDI server and the communication server is OPC Unified Architecture (OPC UA).

With the FDI basic architecture as a foundation, it is now possible to implement the scenarios *FDI Standalone Tool* (section 2.2.2), *FDI hand-held and mobile client* (section 2.2.3) and *FDI Client Server* (section 2.2.4). These are explained in more detail below.

2.2.2 FDI Standalone Tool

In most cases, a standalone tool is used by commissioning or maintenance personnel. This is a mobile computer, such as a laptop or desktop PC. However, in both cases the main feature is that the FDI client and the service functionality are on one computer. This can be realized by either having the FDI client and server available locally or by implementing the FDI client and server in a monolithic application. In this case, the client server communication does not need to be Implemented explicitly (figure 2.2). However, in both cases there is the option to use communication servers.

2.2.3 FDI hand-held and mobile client

An FDI handheld is a specialization of an FDI standalone tool. It contains both FDI client and FDI server functionality and is therefore a complete FDI host. In comparison to the FDI standalone tool, an FDI handheld is more robustly designed, is smaller and, depending on the design, can be used in hazardous areas. Communication interfaces are often implemented in the hardware of an FDI handheld and are thus a direct component of this. However, as well as these complete FDI hosts, an FDI handheld can also be designed as a pure FDI client. This means it has an OPC UA client–server interface via which it is connected to an FDI server (figure 2.3). This naturally requires a communication connection to the FDI server (e.g. via WIFI).

2.2.4 FDI Client Server

An FDI client–server structure has all the aspects of the FDI architecture. An FDI server provides access to field device data, functions and their user interfaces. FDI clients access the FDI server, for example in order to configure field devices during the engineering phase or to observe them during

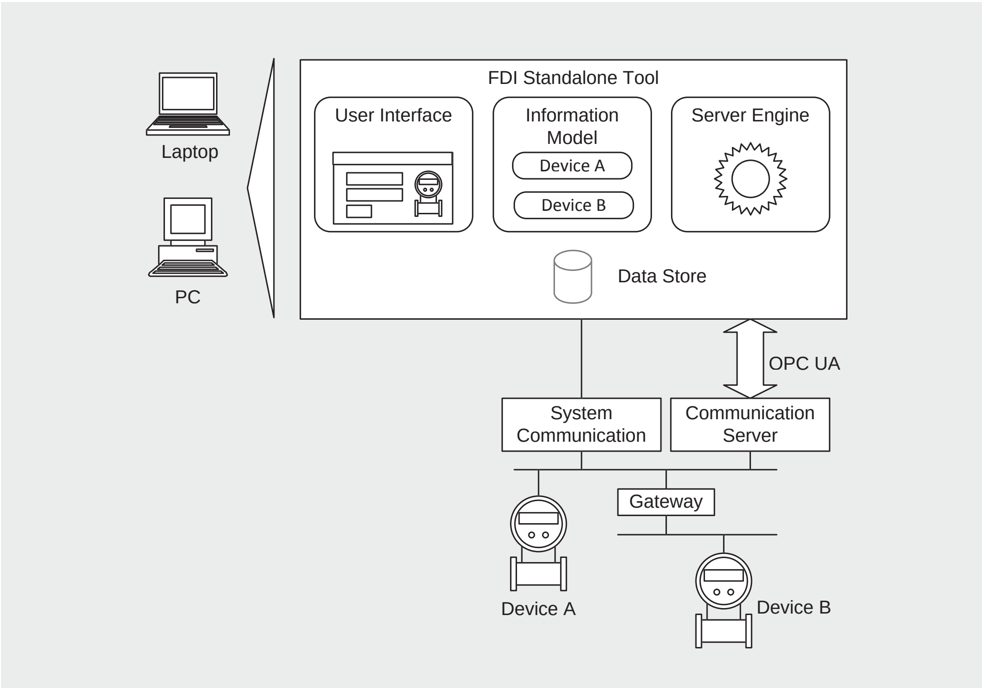

Figure 2.2 FDI Standalone Tool

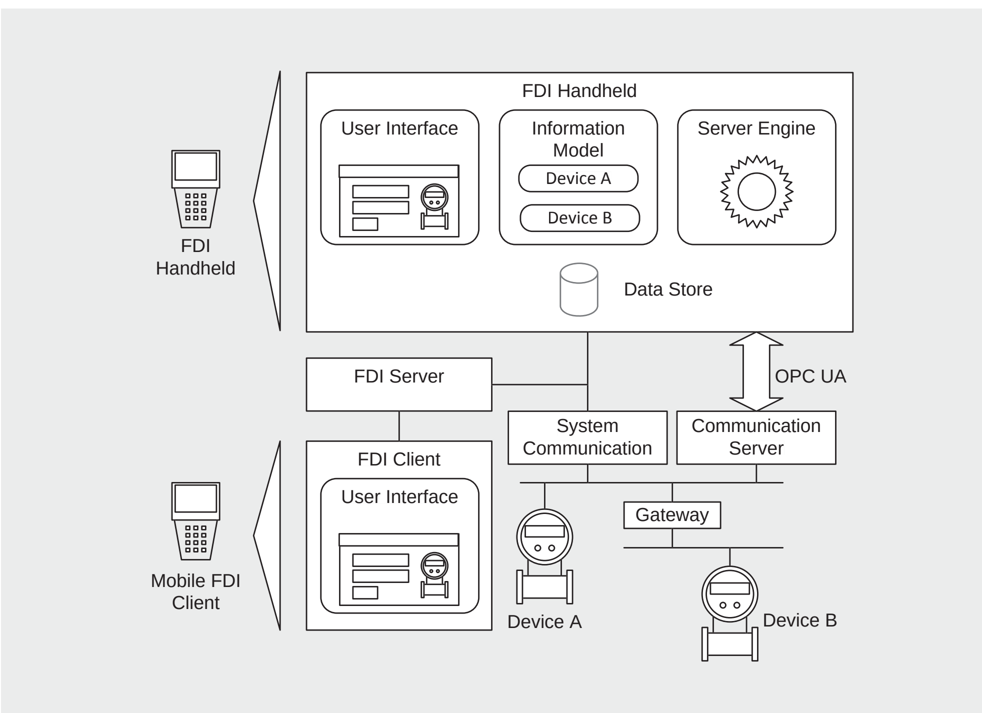

Figure 2.3 FDI handheld and mobile client

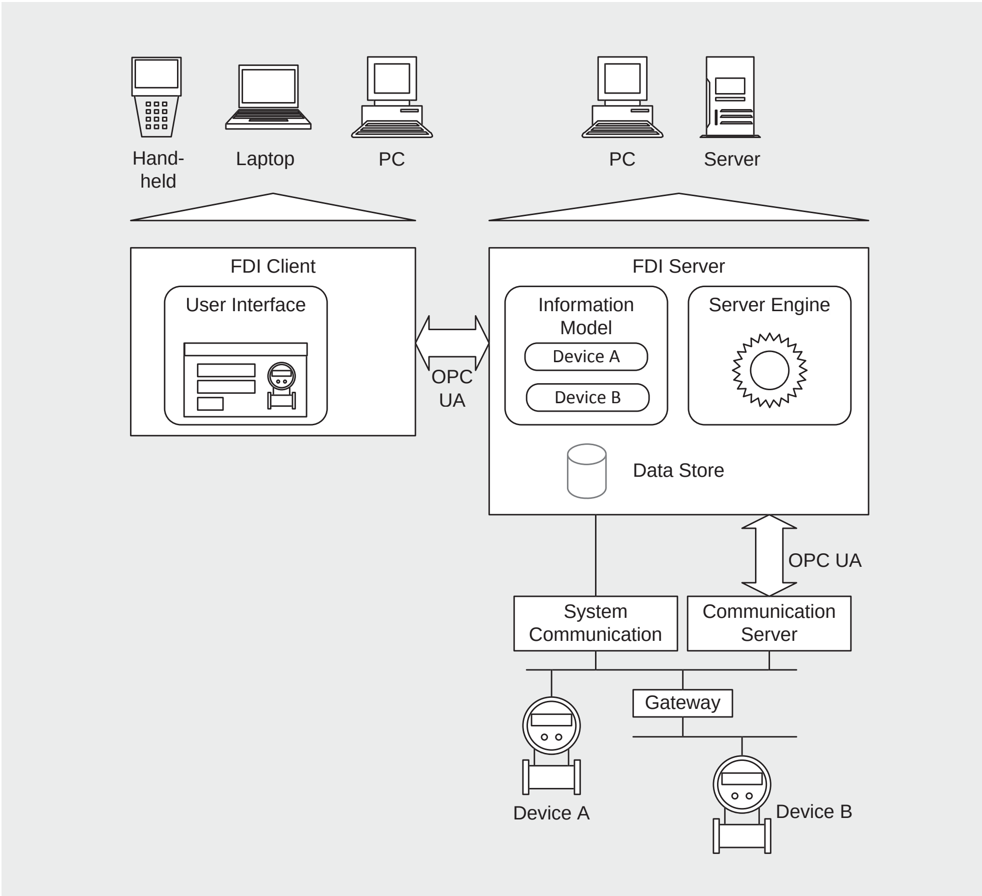

Figure 2.4 FDI Client Server

the operating phase. FDI clients can also be implemented on the basis of mobile devices – for example, as mobile FDI clients based on a laptop or as FDI handheld clients (figure 2.4).

2.2.5 FDI in the automation system

With the FDI versions *Standalone Tool*, *Handheld* and *Client Server*, multiple scenarios can be realized in the automation system (figure 2.5): a central FDI server at system level represents the plant topology and the field devices contained within it. FDI clients access this server in various application cases: engineering stations, for example, can change the configuration and parameter settings of the field devices. To do this, they display the user interface of the field device and transmit the user's changes to the FDI server, which then either sends these directly to the field device or saves them in a database. If the plant is extended or converted (see section 1.2), the engineering stations can be used to make the necessary changes to the structure of the plant, i.e. its topology. In the FDI sense, this means that new device types are imported and new device instances created or existing device instances deleted or moved within the topology. Maintenance stations monitor the status of the field devices. To do so, they read the field device status in accordance with NE107 from the information model of the FDI server.

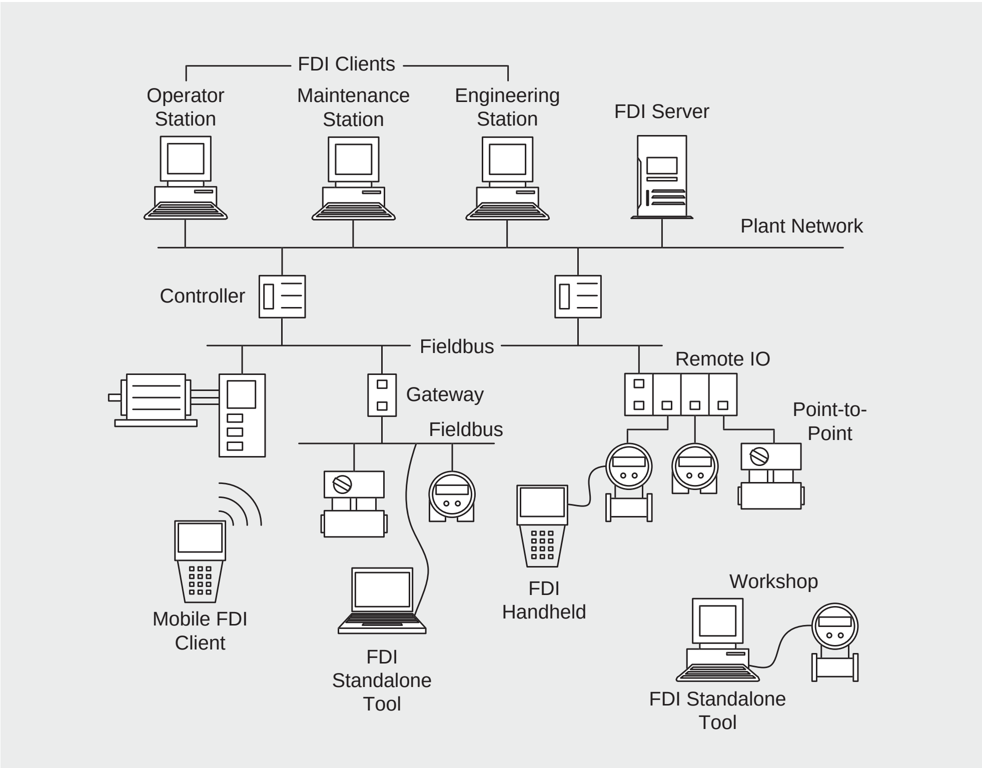

Figure 2.5 FDI within the automation system

In the case that a fault is recorded, the device-specific diagnosis provides information on detailed fault statuses and options for maintenance or fault resolution. Information can also be passed on to a CMMS[1] so that a relevant maintenance job can be dispatched there. An operating or observation station can also access the FDI server as an FDI client and use and display device data such as status information in the plant visualization.

FDI standalone tools can also be in use, for example in the workshop where configuration or parameter data are set before a device exchange or where the detailed diagnosis of a faulty field device is performed. However, FDI standalone tools can also be used in mobile form on a laptop to perform on-site checks of a device, for example in order to record a valve signature.
FDI handhelds enable the operation of field devices (e.g. for configuration and parameter setting or for diagnosis) in hazardous areas as well, depending on the version. An FDI handheld client uses the central FDI server for communicating with the devices.

In this way, with its versions client server, standalone and handheld, FDI supports the extensive application cases and scenarios in the phases of the plant lifecycle.

1 Computerized Maintenance Management System: a computer system for automated management of maintenance jobs.