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APPLICATION OF DATA DIODES IN PROTECTED NETWORK SEGMENTS

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Abstract

This article covers how diodes can benefit our business processes and perform tasks such as quality storage and transmission of our data. It is written that some of their types can not work directly with IP, FTP, HTTP and other common standards.

The problem of storing confidential data and preventing their leakage sooner or later arises in any organization engaged in information processing. The degree of relevance and importance of this issue for the company is determined by the amount of damage that will be caused to it in the event of the realization of such a risk. The higher the potential losses of an organization from data leakage, the more stringent measures have to be applied for their safety. The range of possible actions varies from the development of organizational regulations and the installation of leak prevention systems (DLP, Data Leak Prevention) to the adoption of the concept of "Zero Trust" and the creation of an "air gap" – the physical disconnection of critical network segments from the outside world.

Isolation of protected networks from data exchange with other segments is especially relevant for the production infrastructure of automated process control systems, state-owned companies working with data subject to state regulation, commercial organizations engaged in innovative developments. However, the "air gap" does not work efficiently enough, if only because even a completely isolated infrastructure needs to exchange data with the outside world. Controller firmware requires periodic updates, data constituting a commercial or state secret is replenished, the results of product design must be presented to the public. The problem can be solved by transferring data on physical media — USB drives, memory cards or hard drives, but this approach is fraught with a number of serious problems, the main of which is the lack of a guarantee of the reverse movement of information. Indeed, the "flash drive" with which the data was delivered to an isolated segment of the network can become a repository for confidential information leaving the company. The problems with efficiency and the insecurity of this method of data movement cannot even be mentioned. Meanwhile, for about a decade there has been a much more elegant and high—tech solution to the problem of one-way transmission of information - the Data Diode. This term refers to a device designed to transmit packets of raw data in one direction. Unlike other methods of unidirectional information movement, most data diodes are physically unable to transmit packets in two directions. Of course, Data Diode is not without certain drawbacks, but in a number of indicators they definitely surpass other ways of organizing such connections.

A data diode can be either a separate network device or a hardware and software complex that provides advanced functionality for one-way data transmission. The hardware diode is implemented by removing the transmitting component on one side and the receiving component on the other side of the bidirectional communication system. Most often, technically, a data diode is a device where one of the two fiber optic cables, as well as receivers or transmitters for it are missing. Less common are devices based on the RS-232 interface. The main disadvantage of the RS-232 implementation is that, in addition to data transmission lines, the standard defines control lines through which data can potentially flow back to the source network.

Fig 1. Fiber system data diode

In a minimal design, the data diode housing contains interfaces for connection to the receiving and transmitting networks, as well as a power connector. Manufacturers can equip data diodes with additional service add – ones - for example, an indication of transmitted packets or the ability to configure the device via a file with a list of allowed IP addresses.

The hardware data diode is capable of unidirectional transmission of streaming, raw data – for example, signals from video cameras using specialized protocols (RTP / UDP and others). However, most commonly used transport protocols used to transfer files and other (processed) data packets require bidirectional communication. Therefore, the data diode cannot work directly with TCP, FTP, HTTP and other common standards: they all use a return channel to receive packet delivery information and other information. File transfer using transport protocols requires the creation of a hardware and software complex based on a data diode and a pair of proxy servers that perform packet conversion, emulating the operation of TCP, SMB or other information transmission standards. A unidirectional gateway using proxy servers on both sides of the data diode allows you to implement much more service functions than exclusively hardware systems. Here we can talk not only about data transmission, but also about their protection, monitoring and filtering – with the help of antivirus systems and other tools.

The main disadvantage of hardware data diodes and unidirectional gateways based on them is the relatively low information transfer rate. Most manufacturers declare parameters from 10 to 100 Mbit/s in the characteristics of their devices, which in some cases can become a “bottleneck” for a secure network infrastructure. Software data diodes – network devices in which restrictions on the transmission of information are determined by the logic of the firmware, and not by hardware limitations, allow to increase the bandwidth of a unidirectional channel. As a rule, such systems are implemented on the basis of a secure microkernel of the operating system responsible for the logical separation of networks without a return channel. Such systems can have a bandwidth of up to 10 Gbit/s, support standard transport protocols and offer additional service capabilities, such as support for HTTP status codes. The disadvantages of software data diodes are obvious: the theoretical possibility of information leakage through the reverse channel and the complexity of certification of such systems.

As noted above, data diodes are most often used when transmitting data from an unprotected (low, low)

network to a protected (high, high) one. As a rule, a secure network contains higher – level data – secret or confidential information, the leakage of which is prevented by the diode. Typical scenarios for using unidirectional network devices include receiving security updates, database replication, and broadcasting a video or audio signal from the outside.

Fig 2. The simplest data diode application scheme.

It is important to remember that in general, the data diode does not protect the “high” network from cyber attacks, but only prevents information from leaking from it. If the data packets transmitted from outside contain a malicious load, it will be delivered to the target system. As in the case of a bidirectional channel, the traffic passing through the data diode must be checked and, if necessary, cleaned. The reverse movement of data is also possible – from a "high" network to a less secure one. Such a scheme involves collecting a strictly limited set of information from a closed system without the possibility of controlling it. The most common example of such an application of data diodes is the transmission of parameters from automated process control devices – logic controllers, sensors and other monitoring tools. There is also a hybrid scheme for using data diodes. In this case, two independent unidirectional channels are organized: the first is responsible for transmitting information to the protected system, and the second is from it. This approach allows you to organize a full – fledged data exchange – for example, the transmission of mail messages, updates, work logs - and significantly reduces the possibility of an attack using feedback. In fact, the attacker will need to gain access to two separate channels, bypassing the means of protection of each of them.

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