

U-70 ACCELERATOR COMPLEX: CENTRALIZED ACCESS TO IP-DEVICES WITH EMBEDDED WEB-SERVER

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Abstract

The paper describes our efforts to organize centralized access to IP-devices of specific types. Each device includes proper embedded web-server and is connected to an accelerator department network. Today there are tens of the devices are used to give pictures online.

A device access is carried out by user understandable device names with the aid of accelerator department web-server. Some arisen problems due to increasing number of device users are pointed. Possible manifold forms of on screen presentation of pictures derived from devices are presented.

NEW DEVICES

At last time an accelerator specialists are using increasing number of various digital devices to solve specific tasks of visual monitoring. At present there are tens of the devices. The devices should be connected to local computer network and they give possibility to user to access them by means of web browser.

The types of devices in use are some models of digital multi-channel oscilloscopes, video recorders, IP-cameras, video encoders. The devices are installed in a control and technical rooms of different buildings.

All devices, mentioned above, provide users with online pictures. Web browser may be used to get the digital picture and set some operational parameters of a device, for example, time of the picture renovation. For U-70 accelerator complex this time usually is set to be equal to 10s.

The pictures from video devices first of all give possibilities to see processes of beam injection from linacs, acceleration and beam transfer from booster to main ring. Some of devices used to observe most significant objects, such as radiation dangerous zones, corridors, technological halls and etc.

As a rule, a multi-channel oscilloscope serves signals of a certain technological system or process. It gives possibility to observe processes of acceleration regimes tuning, the quality of a technological system operation.

NETWORKING OF DEVICES

The first devices were directly connected to the same open network together with an accelerator department office PCs. But fast increase in the number of devices and appearance of certain maintenance problems required some centralization and severe discipline to access and control the devices.

The next problems have appeared after short time of operation:

1. Each PC got access to each device and possibility for tuning it up – led to curious situations.

2. Outsiders of accelerator department had direct access to the all devices by printing IP address.
3. A user should to remember set of IP addresses of all the devices he is interested in.
4. Some devices stopped the web service due to exceeding of simultaneously opened web-sessions limit.
5. Some old models of devices do not support classless IP addressing – possible decisions were discussed with support services of the manufacturers.

To solve the problems a network redesign was necessary [1]. It was decided to organize protocol-based virtual network (VLAN) on top of the accelerator department physical office local area network [2]. It became new internal local domain 192.168.0.0/16 including all devices mentioned above. Except devices VLAN combines only those computers, which are installed in the control or technical rooms and assigned to view images from the devices or tuning up them. The usual computer of the office LAN can't access the devices if it is not a member of the VLAN.

CENTRALIZED ACCESS

The centralized access meant for deriving online pictures only. To set operational parameters of the device is possible if user enters directly to web browser the device IP address as web page address.

To centralize and simplify an access to the distributed devices the accelerator department web-server is used. The server was included in the VLAN to get direct access to the devices. It supports two schemes to organize access to the devices from user computers. In both cases the web-server is used as a reference book – a user selects from the corresponding to the scheme list of devices. Each selection list includes names of all available and accessible devices and some comments.

In the first scheme the user web-browser after device selecting request communicates with selected unit directly, so increasing number of clients of the remote device web-server. This scheme is used to access all devices in scale of VLAN only and is showed in Figure 1.

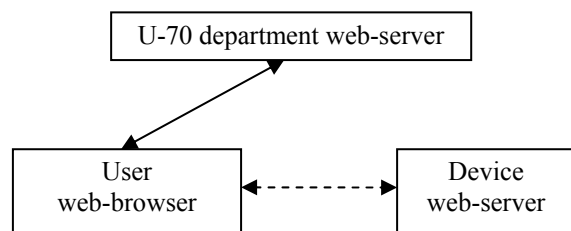


Figure 1: First scheme of device centralized access.

The second scheme is used to view images from oscilloscopes only. In this case after oscilloscope selecting the accelerator department web-server communicates with selected device, derives picture periodically and forwards it to the web-browser of user. Figure 2 shows the scheme of network interrogations.

In this case accelerator department web-server is the only client of each oscilloscope web-server. The picture once received from selected device is sent to all interested users.

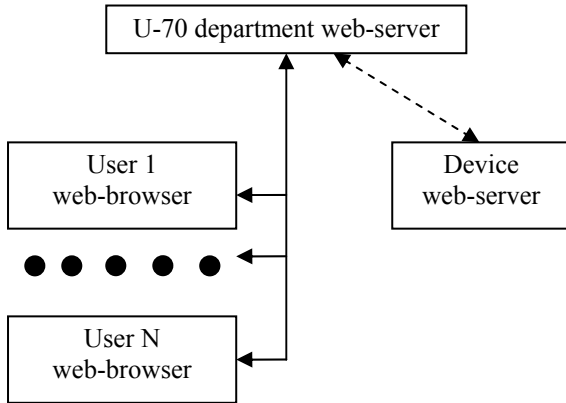


Figure 2: Second scheme of device centralized access.

The second scheme allows access to images created by oscilloscopes from outside of the VLAN, for example from home computers.

SCREENS AND WINDOWS

There is some number of forms to present online pictures on a monitor screen. Usually separate web-browser window is used for each picture (see Figure 3).

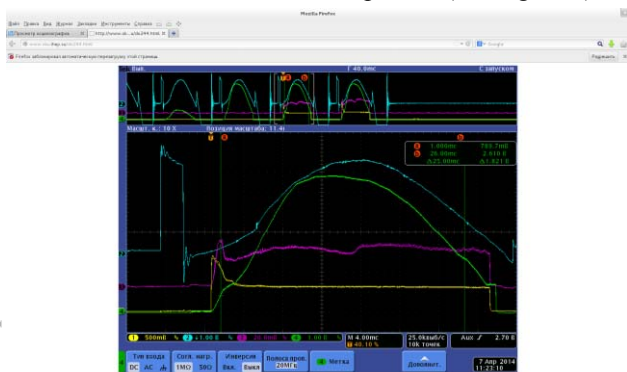


Figure 3: Web-browser window with one picture.

As a rule this form is used by users from their office personal computers taking an opportunity of second scheme of device centralized access.

The first scheme of device access supports possibility to visualize up to four pictures from different source devices inside one window simultaneously. The possibility was realized by framing HTML content [3]. Figure 4 is the example of this form.



Figure 4: Web-browser window with four pictures.

Now a typical control room maintains computer monitors with a large screen. Depending on current task to solve a user may layout all necessary windows with corresponding pictures on the screen. He can use any of device access schemes. The Figure 5 shows a screen with five online pictures from remote oscilloscopes.

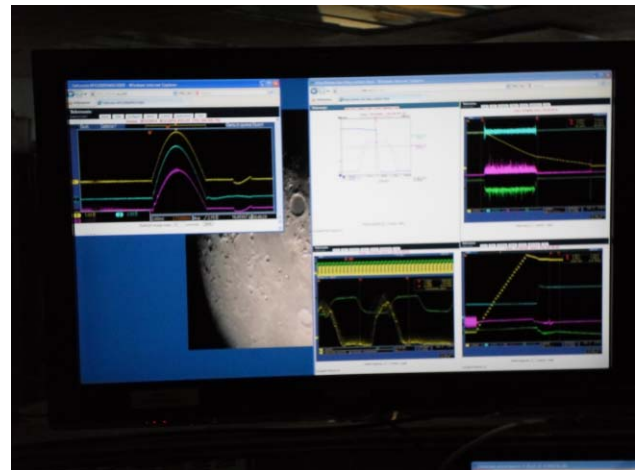


Figure 5: Screen with web-browser windows.

In control room user may see a set of significant signals on screens of local real oscilloscopes and on computer monitors with pictures from remote devices. The corresponding devices may be installed in other building of any accelerator of the U-70 complex.

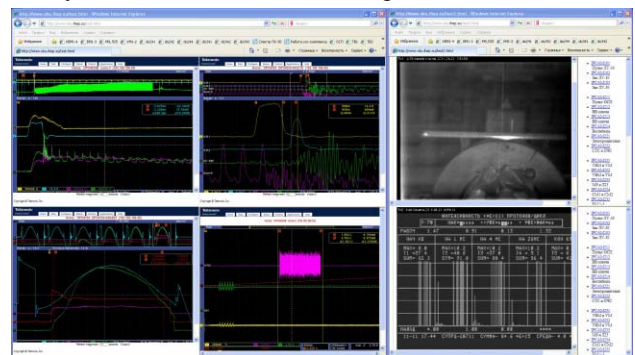


Figure 6: Two web-browser windows on one screen with four frames each.

The Figure 6 shows screen with two web-browser windows. The left window contains images received from

four different oscilloscopes. The right one presents two images from cameras and two lists of device selection.

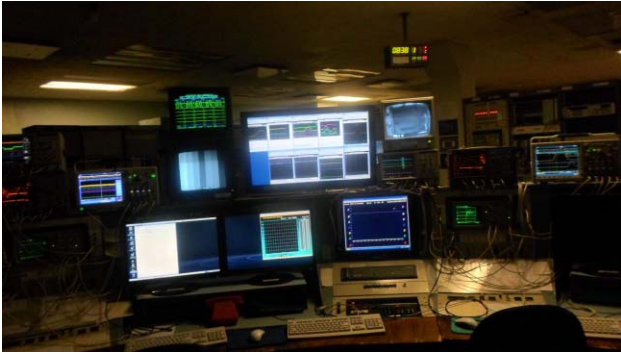


Figure 7: Overview of the booster control room console.

General view of booster control room console is presented in Figure 7.

CONCLUSIONS

Engineers are responsible for technological instrumentation may to form their current screens to detect malfunctions of hardware in use.

An operator solving tasks of technological system parameters adjustment, control physical processes related to beam dynamics, creates set of windows with pictures are good for making decisions on optimization of current accelerators regimes.

For example, tuning of beam ejection from booster and beam transfer to main ring require to form at least two windows with digital multi-channel oscilloscopes pictures.

The first one to observe:

- Forms of changes of the magnetic field of booster circular electromagnet.
- Forms of changes of the RF field of accelerating cavities.
- Signal of orbit middle radius change.
- Intensity signal of accelerating beam.

The second one is necessary to view mutual synchronization of accelerating beam and timing of pulse and bump systems to eject beam from booster and inject it to main ring.

So, the centralized access to distributed IP-devices is a new tool, giving a user possibility to select the most significant for current moment information in form of pictures. User may use the computer monitor space in a most efficient way to solve his tasks. He can do selections and screen forming on-the fly.

Historically there are control rooms distributed over accelerators and beam lines of the U-70 accelerator complex. One can see current state of the significant parameters over the whole accelerator complex from any control rooms console.

Today this facility became integral part of whole toolset to control the beam quality during the U-70 accelerator complex run.

REFERENCES

- [1] N. Olifer, V. Olifer "Computer Networks: Principles, Technologies and Protocols for Network Design", Wiley & Sons, England, 2005.
- [2] G. A. Donahue "Network Warrior", O'Reilly Media Inc., 2007.
<http://www.safaribooksonline.com>
- [3] Frames in HTML Documents; <http://www.w3.org>.