

Ethernet Services

3HAC 0954-1
Ethernet Services 3.0



ABB Flexible Automation

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ABB Robotics Products AB
S-721 68 Västerås
Sweden

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1 Overview

This document describes the functionality of the Option *Ethernet Services*.

This option has the following functionality:

- Remote Mounted Disks
Access of the hard drive of an external computer from the controller
- Network booting
Loading the controller software from the hard disk of an external computer

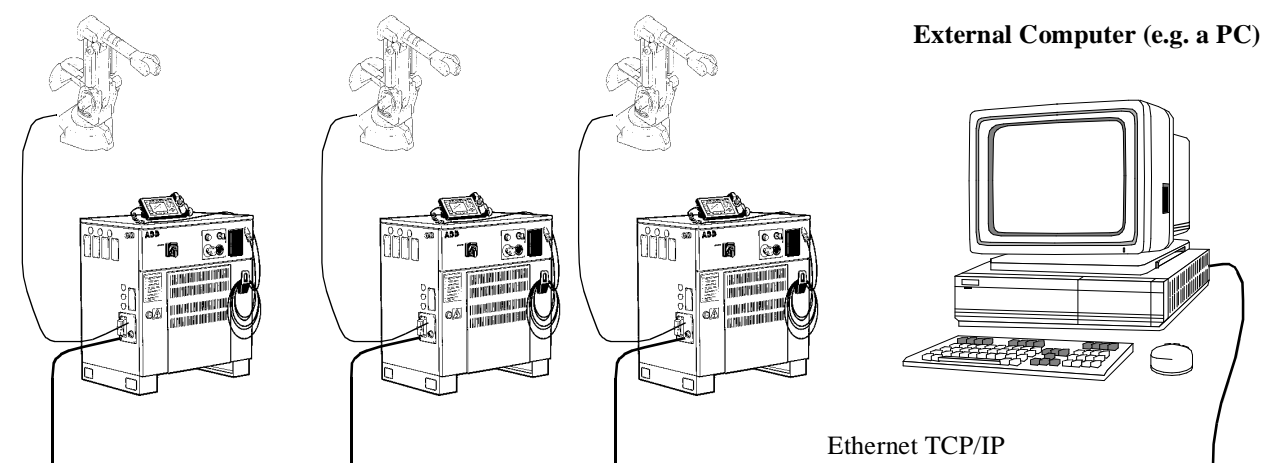


Figure 1 The Ethernet services are all based on controller connected to a external computer. Note that the ethernet cable configuration in the picture are only drawn in a schematic manner. The real configuration varies depending on what type of ethernet is used.

1.1 Requirements for using the Ethernet Services

1.1.1 Controller Hardware

The following Controller Hardware is required for the Ethernet Services:

- DSQC 336, Ethernet Communication board.

1.1.2 Controller Software

- Ethernet Services Option

1.1.3 External Computer (PC) Software

Both services

- TCP/IP stack

Remote Mounted disk

- NFS Server

Network Booting

- Bootp Server
- TFTP Server

2 Remote Mounted disk

2.1 Overview

Remote mounted disks enables the user to access files stored on a disk. It is based on the NFS protocol developed by Sun Microsystems. The external computer has a NFS server software running which will enable the robot to access the files on its disks.

Since several robots can access the disk of the same external computer the PC disk can be used as a backup storage for robot programs, system parameters etc.

2.2 Server and local path

The disk are *exported* by the *NFS server* running on the external computer. They are exported under a name that can be setup on the server. The 'C' drive on a PC can for example be exported under the name '/C'.

This name should be entered in the system parameters in the *Server Address* parameter.

Note that the server does not have to export the whole disk but can export a sub tree of a disk. E.g. *c:\rbt_backup* can be exported as */c/rbt_backup*.

The *Local Path* parameter specifies the name of the *mounted* unit on the robot. This name is displayed on the teach pendant in the list of units together with the "ram1 disk:" and "flp1:" unit. It is also used in the RAPID programming language for accessing files.

See the User's Guide for information about how to change parameters.

Example

Assume that the external computer exports the sub directory *c:\robot* as */c/robot* and that a robot system mounts this disk as *pc:*.

The file *c:\robot\robot.prg* can then be accessed as *pc:/robot.prg* on the robot.

2.3 Error handling

The S4 robot controller periodically checks the connection to the server. The behaviour when the connection is lost can be controlled by changing the Trusted flag in the system parameters.

See the User's Guide for information about how to change parameters.

Non-trusted units

If the flag is set to *No* a warning will be generated reporting that the server has gone

down. Accessing the unit after the error message has been given will result in an error.

Trusted units

If the flag is set to Yes an error will be generated, the RAPID program will stop and the controller will switch to motors off mode.

2.4 Authorization

The NFS protocol specifies a way of authorizing the user to access a specific server. These parameters are setup using the *User ID* and *Group ID* parameters.

If these parameters are not used which usually is the case on a PC, set them to the default value 0.

Note that these two parameters must be the same for all mountings on one robot controller.

2.5 Software on external computer

The external computer needs the following software:

- TCP/IP stack
- NFS Server

2.6 Limitations

- In the 3.0 version of controller software maximum 1 disk may be mounted

3 Network Booting

This application allows the controller software to be stored on an external computer. When the controller is switched on the software is automatically loaded from the disk of the external computer.

3.1 Booting Preparations

All configuration of the booting is done at the external computer. The only preparations that has to be done at the controller is to insert the DSQC 336 board and connect it to the network.

The preparations that has to be done are as follows:

- 1 Connect the robot and PC to the ethernet network.
- 2 Make sure the PC is running a TCP/IP stack.
- 3 Install the Setup network boot program (see 3.1.1).
- 4 Load the software to the PC
- 5 Load the Key disk to the PC
- 6 Setup the software
- 7 Setup the TFTP Server
- 8 Setup the Bootp Server

3.1.1 Network Boot Setup program

On the option disk Ethernet Services there is a program for loading and configuring the controller software on a PC for the network boot. It is a Windows 3.1 program but can be run under Windows 95 and Windows NT as well.

Installation

To install the Controller software setup program, follow these steps:

- 1 Insert the disk *Setup network boot S4c 3.0 (3HAB2392-2)* in the floppy drive of the PC.
- 2 Select the RUN... option under File menu in the Program manager (Or under the Start-up button in Windows 95/Windows NT 4.0), and type *a:\install*, then choose the OK button and follow the instructions given by the program. The program will

now installed in the directory `c:\s4boot` or the one you have chosen.

- 3 Add the boot.exe program as a new program item in the Program Manager. (Or to the start-up menu in Windows 95/Windows NT 4.0)

File structure

By default the files are stored on the hard disk of the PC as shown in Figure 2.

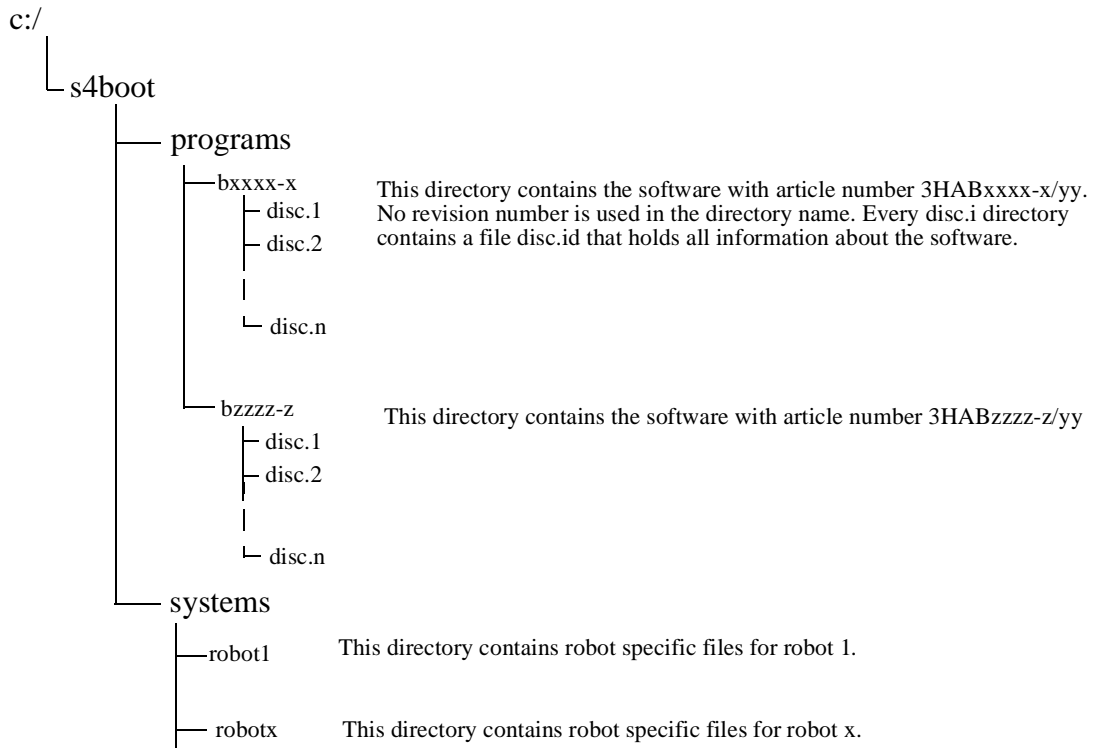
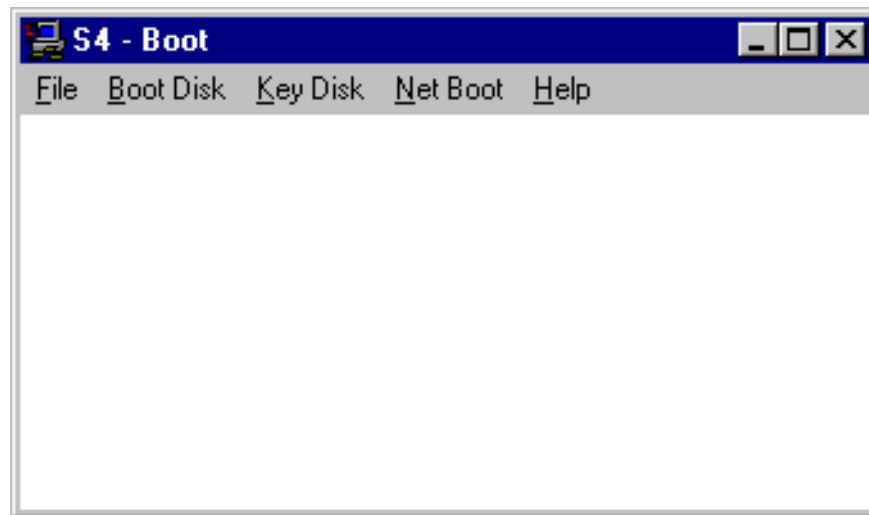


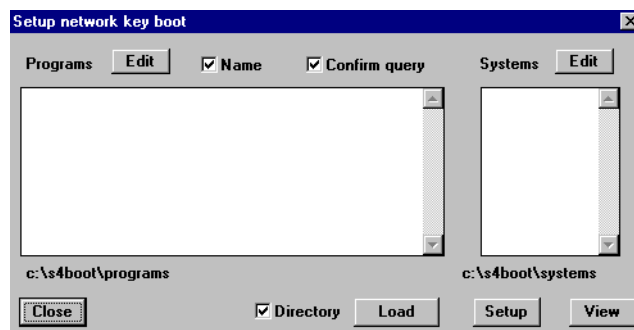
Figure 2 File structure

Start the Setup network boot program

- 1 Start the controller setup program. The following window appears:



- 2 Select the menu **Net boot:Key Setup**. The network boot setup window comes up.



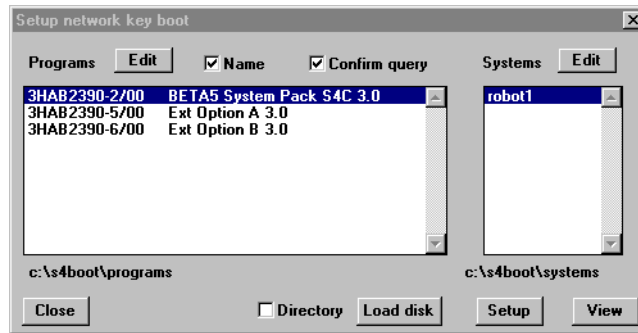
This window is used for configuring the controller software on the PC. The instructions below assumes that this window is visible. The program list shows which programs are in the pool `c:\s4boot\programs`.

Load Controller software

The controller software has to be stored into the file structure shown above. This should be done for both the system pack and for any external options. This is done as follows:

- 1 Click on the *Directory* check box. The *Load* button changes to *Load disk*.
- 1 Press the ***Load disk*** button.
- 2 A message box comes up asking for the first disk.
- 3 Insert the first disk and press ***OK***
- 4 If this program consist of more than one disk you will be asked to insert the next disk. If not you will back on 2 above.

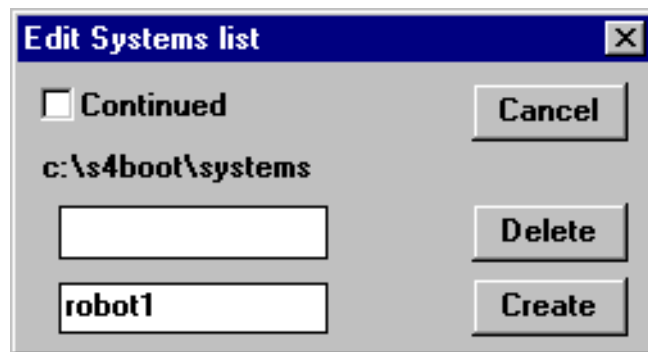
5 The loaded programs can now be found in the **program list**, as shown below



Add a robot to the system list

On the right in the **system list**, the configured robots are listed. To add a robot to the list do as follows:

1 Press the **Edit** button above the systems list. The following dialog is displayed:



2 Type the name of the new robot in the text field to the left of the **Create** button

3 Press the **Create** button.

4 The robot can now be seen in the list of systems.

Load the Key disk

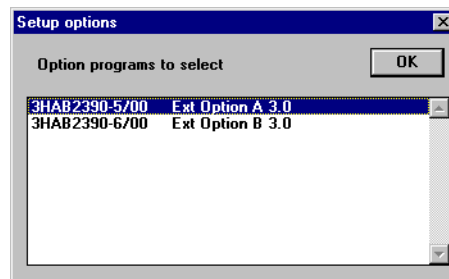
Every robot has a unique key disk. This disk must be loaded in the PC for each robot system. This is done by selecting a robot system in the list and then follow the instructions in the section *Load controller software* above. A key disk is recognized by containing a key.id file besides the disc.id file.

Setting up the controller software

The robot must be tied to the software that we want to load. Do as follows:

1 Select the robot that you want to setup and the *System Pack* that you want to use for this robot.

- 2 Press the *Setup* button.
- 3 If there are any external options loaded in the PC program pool and they are specified in the selected system pack file “\disc.1\relprog.txt” you will get a list of them. Select the options you want to use for this robot and press OK.

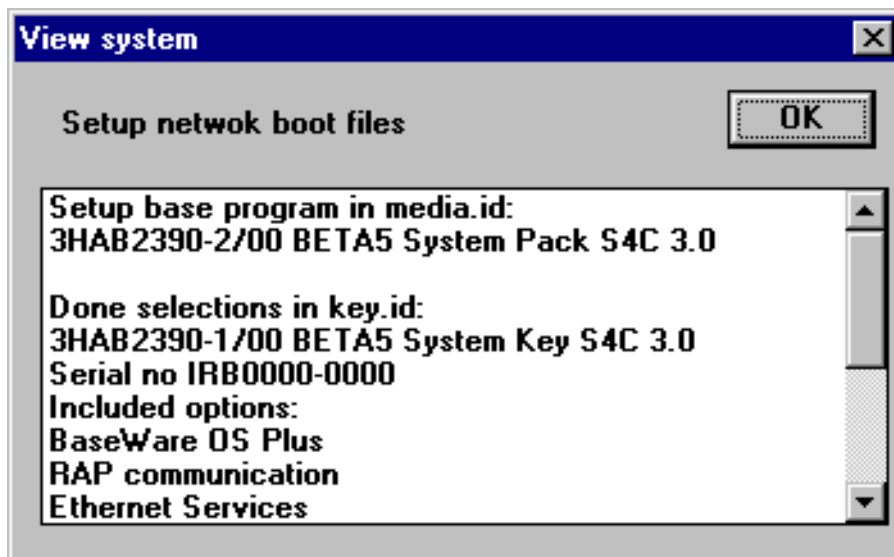


- 4 A short beep can be heard and the setup is finished. The robot system directory will now contain three files: key.id (loaded at start), media.id and install.cmd (created by the setup program).

Viewing the Software that is selected or a certain robot

If you want to view the software that a robot is setup to use do as follows:

- 1 Select the robot to view
- 2 Press the View button
- 3 A list of the programs will be displayed:



Storing programs in more than one pool

By storing the software in program pools more than one set of Controller software can be stored in the controller simultaneously. New program pools can be created by typing the name of the new pool in the text field above the program list and pressing New.

3.1.2 TFTP Server

The TFTP Server is used for transferring the software from the external computer to the S4C Controller

The TFTP server must be setup to have its home path at c:\.

3.1.3 BootP Server

The BOOTP server is used for answering the requests from the S4 Controllers. The server holds a list with one entry per S4 system. When a request comes, the BOOTP server sends a reply to the controller with information about from what host and what directory it can find the robot-specific information (the directories under *systems* in Figure 2). The BOOTP server uses the unique ethernet address to identify which controller is requesting the boot information.

The following information must be put into the bootp database (with an example):

- Host name robot1
Any name identifying this robot controller.
- Ethernet address (Physical address) 00:00:c4:20:00:4e
The ethernet address of the DSQC 336 Ethernet board
- IP address 192.168.1.1
The IP address of the main computer.
- Subnet mask 255.255.255.0
The subnet mask of the IP network.
- Boot file name s4boot/systems/robot1
This variable should point to the robot-specific directory.
(See page 8)

Note: The BOOTP and TFTP servers must be located on the same computer

3.2 Booting Sequence

- 1 The Robot is switched on
- 2 The Robot requests information on the network using the bootp protocol. The ethernet address is used as an identifier.
- 3 Using the information the robot starts transferring the system dependant information. In the system dependant files the robot finds information about what software to load. The controller uses the TFTP protocol for transferring the files.
- 4 The software is loaded into the controller using TFTP.
- 5 The controller starts.

4 Protocols

RAP, remote mounted disk and booting via network are all based on the TCP/IP protocol suite. TCP/IP is not vendor-specific and is widely used both for Wide and Local Area Networks.

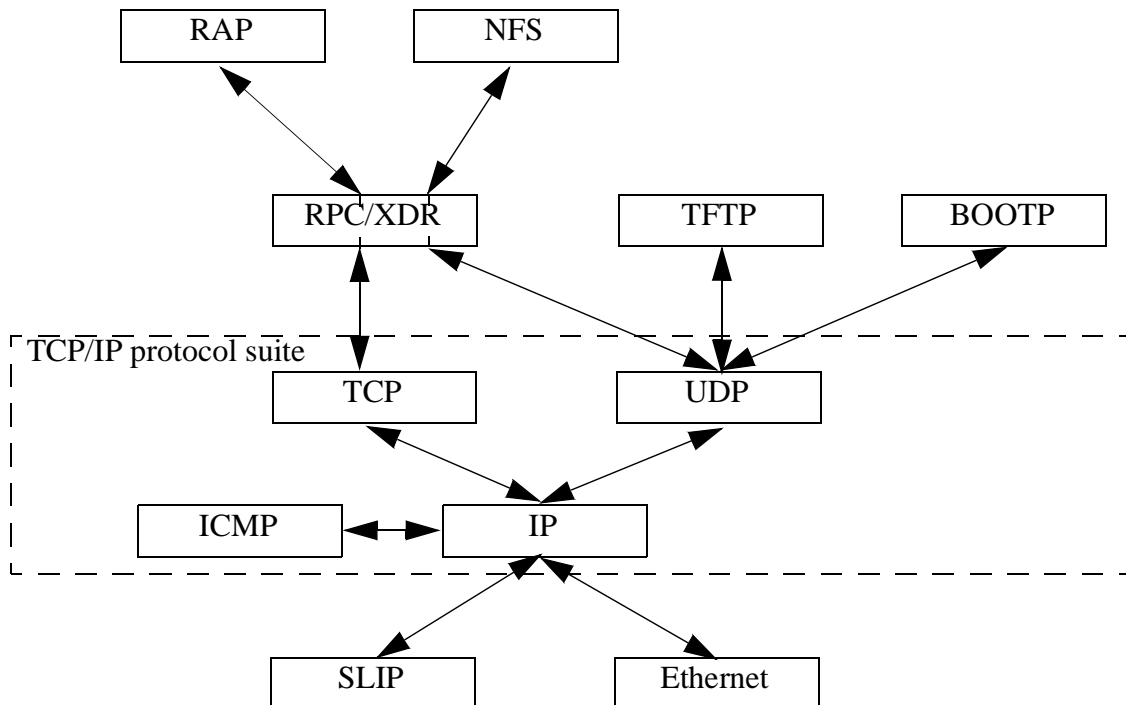


Figure 3 The protocols used for the Communication in the S4C controller

Figure 3 shows the protocols used in the S4C controller. All protocols except the Robot Application Protocol (RAP) are standard protocols. The list below briefly explains the function of each protocol and includes references for further information.

- **SLIP**
SLIP, Serial Line IP is a de-facto standard for point-to-point serial connections running TCP/IP. It is used in the controller for RAP-communications via a serial line.
- **Ethernet**
Ethernet is a common standard for communication in networks. It was developed by Xerox Corporation 1976. The standard IEEE802.3 was developed from the original ethernet.
Information is transferred in packets on the cable. When a node wants to send a packet, it first checks that there is no traffic on the line. In that case it waits a while. This technique for collision detection is called CSMA/CD, Carrier Sense Multiple Access with Collision Detection.
The transmission rate is 10Mbit/s and there are four different cabling systems Thick (standard ethernet) with thick (10mm) coaxial cables, thin ethernet with thinner (5mm) coaxial cables, fibre optic ethernet and Twisted pair cables.

References: Nemzov, The Ethernet management guide: keeping the link.

- IP
Internet Protocol, IP provides a packet delivery service for TCP, UDP and ICMP.
- ICMP
Internet Control Message Protocol handles errors and control information between gateways and hosts in the network. This messages are normally generated and handled within the TCP/IP networking software.
- TCP
Transmission Control Protocol is a connection-oriented protocol that provides a reliable full-duplex stream. TCP guarantees that the messages reach their intended destination.
- UDP
A connectionless protocol. UDP does not guarantee that the messages reach the indented destination. This has instead to be handled by the overlaying protocols
- TFTP
Trivial file transfer protocol
A simple protocol for file transfer.
- BOOTP
Bootstrap Protocol for determining the IP address and some other information at start-up.
- RPC/XDR
Remote Procedure Call/eXternal Data Representation.
RPC is a protocol for invoking a procedure on an remote machine. For the user of the RPC calls it appears like they are executed on the local machine, i.e. the network is transparent.
XDR provides a standardized form for transmission of data between different computers.
The controller uses Sun/RPC Version 4.0r
- NFS
Network File System
NFS is a protocol developed by Microsystems that uses IP to allow a computer to access the file system of another computer.
- RAP
See RAP Service Specification and RAP Protocol Specification.

5 References

- 1 RAP Protocol Specification (ABB Flexible Automation)
- 2 RAP Service Specification (ABB Flexible Automation)
- 3 User's Guide (ABB Flexible Automation)
- 4 RobComm User's Guide (ABB Flexible Automation)
- 5 Nemzow, Martin A. W., The Ethernet management guide: keeping the link. 2nd ed., McGraw-Hill, 1992. ISBN 0-07-046320.
- 6 Power Programming with RPC by John Bloomer, O'Reilly & Associates, Inc. ISBN 0-937175-77-3
- 7 Comer, Douglas E., Internetworking with TCP/IP, Prentice-Hall International, Inc. Vol I-III.
- 8 A number of RFCs. These are the standard document for the Internet protocols. They can be downloaded from the internet from several sites.:
 - RFC 760 IP
 - RFC 761 and 793 TCP
 - RFC 768 UDP
 - RFC 783 TFTP
 - RFC 951 Bootstrap Protocol (BOOTP)
 - RFC 1542 Bootstrap Protocol (BOOTP)
 - RFC 1050 RPC
 - RFC 1094 NFS
 - RFC 1055 SLIP

