Technical Notes:
One-click Installation &
The AXIS Internet Dynamic DNS Service

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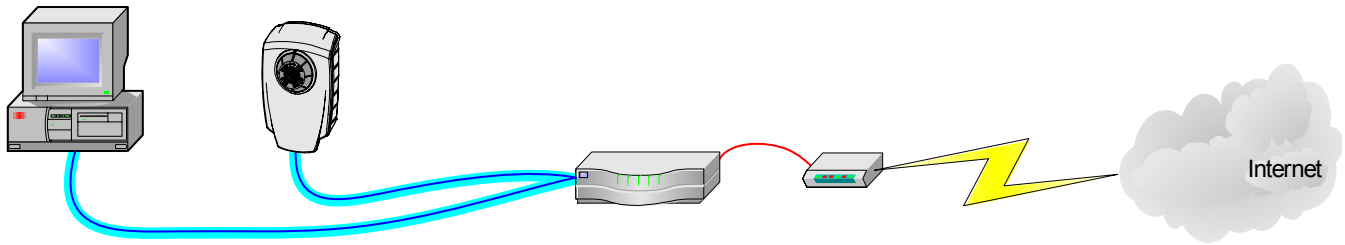
The main objective of the One-click Installation

The objective of the **One-click Installation** is to help users install and access a camera on a local network (LAN).

From a user's perspective, the only steps involved in a **One-click Installation** are the following:

1. Press and release the control button on the back of the camera and wait for the green Status LED to light up.
2. Using a Web browser, go to http://www.axiscam.net and enter the camera's serial number.
3. Access your camera using your Web browser.



Technical description of the one-click installation procedure

More technically, the **One-click Installation** assigns a name to the camera using the domain name system, which is an integrated function of the TCP/IP protocol.

For more information about TCP/IP and the Domain Name System, see the explanations later in this document.

The One-click process can be described as follows:

1. The camera receives an automatically assigned IP address from a DHCP Server.
2. The camera reports its IP address and serial number to the **AXIS Internet Dynamic DNS Service** (this service is free of charge and located on a server hosted by Axis).
3. **The AXIS Internet Dynamic DNS Service** will temporarily register the camera's IP address and assign it a unique name based on the serial number, i.e. axis1a2b3c.axiscam.net - where 1a2b3c are the last six characters in the serial number.
4. **The AXIS Internet Dynamic DNS Service** then sends a confirmation message to the camera that it has been registered by the service.
5. The Status LED on the camera will show steady green when the server confirms the registration.
6. The camera is now temporarily registered in the **AXIS Internet Dynamic DNS Service**.
7. The user must confirm that he/she accepts the camera registration. From a Web browser, go to http://www.axiscam.net and actively accept the camera registration.

8. The final step for the user is to click on the camera link provided on the registration site, and thereby access the camera using the assigned name.

Note: The One-click Installation method does *not* publish your camera on the Internet (outside your LAN). The **AXIS Internet Dynamic DNS Service** offers additional mechanisms for this as an added service after registration. Further details are provided below and at http://www.axiscam.net

The same rules apply as for previous camera models:

- If the camera has a public IP address, other parties that have access to the Internet will have access to your camera.
- If you use a private IP address (e.g. behind a broadband router/firewall), only users on your local network will be able to access your camera.

Publishing a camera on the Internet using the AXIS Internet Dynamic DNS Service

Can the Axis Dynamic DNS service help me publish my camera on the Internet? My network consists of 2 computers and 1 Axis 205 Network Camera, all connected to a broadband router with a built-in switch.

Yes, **The AXIS Internet Dynamic DNS Service** offers an additional service that can help you with this, but it will require some configuration of your broadband router.

To be able to publish your camera on the Internet it's best to be acquainted with the terms below:

Broadband Router

This device has many different names: "NAT-Router", "Internet Gateway", "Broadband sharing device" or "Home firewall" but the essential purpose of the device is the same:

A broadband router allows users on a small network to share a single connection to the Internet.

This is done by forwarding network traffic from inside the private network to the "outside" i.e. the public network, the Internet. The router can be said to "impersonate" a single user out to the Internet and to "impersonate" the Internet towards the inside. As an added bonus, the security on a private network is increased, since most broadband routers are pre-configured to stop any attempts to access the private network from the public network/Internet.

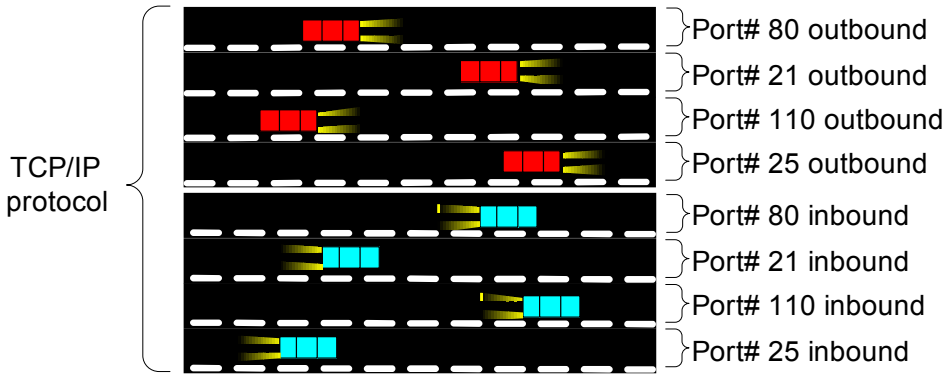
TCP/IP

TCP/IP is the language (protocol) computers use to communicate on the Internet (and on most private networks). If we compare this to the road system used for car traffic, the cabling you use to connect your computer is the physical road and TCP/IP is the set of traffic rules used when driving. Everything you do on the Internet, e-mail or Web browsing, uses TCP/IP for its transportation.

TCP/IP Ports

Each "service" you use on the Internet communicates using one or more specific port numbers; your e-mail program uses port number 25 to send e-mail, and port number 110 to receive e-mail from your e-mail server. When you browse the Internet, port number 80 is used to send and receive Web pages.

To continue the analogy with roads and traffic, ports can be seen as lanes on the freeway where only specific vehicles are permitted to travel.



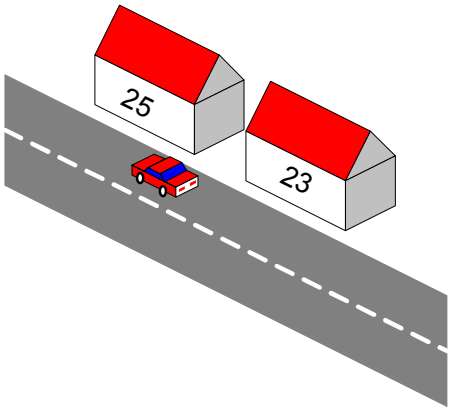
IP Address

Everything that is connected to a TCP/IP network needs a unique address, an IP address. If your own computer needs to get data from another computer, it needs to know the IP address of the other computer, in order to send a request.

This is what happens when you browse the Internet with requests to view Web pages. “Name Resolution” is an important part of this. More information about name resolution below.

An IP address can be compared to the address for a house. All that is needed for your computer to find the requested computer is included in the address itself:

You can use the following analogy when thinking about IP-addresses: *country.city.street.house number*
e.g. 212.247.88.25



There are two main ways of assigning an IP address: manually or automatically.

Automatic (dynamic) addresses are commonly assigned for a limited time using a method called DHCP.

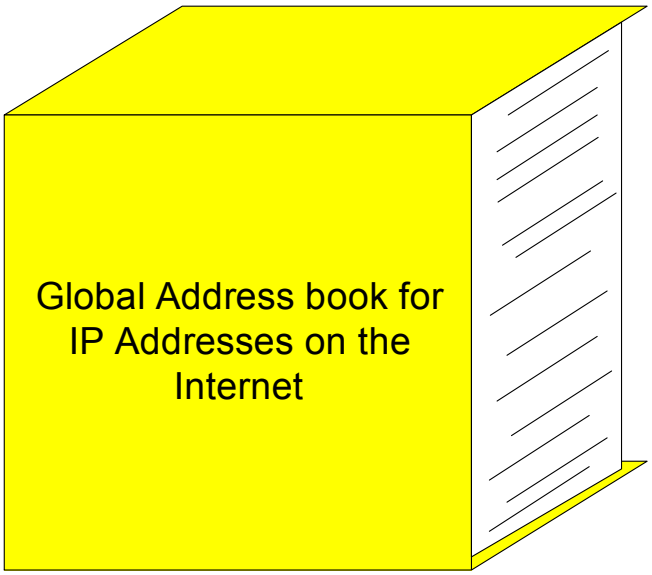
More information about automatic IP addressing can be found later in this document.

Public IP Address

A Public IP address is the only IP address that is recognized on the Internet, where the term **Internet** refers to the global network, the World Wide Web.

Only devices with public addresses can enter the “official road system” and travel the main highways, or traverse the traffic junctions (routers) that the Internet is made up of.

So to simplify; public IP addresses are addresses that are allowed in the “global address book of the Internet” The problem is that the number of public IP addresses available is quickly running out, due to the enormous expansion of the Internet.



This lack of IP addresses is being solved by the IPv6 standard, which will provide plenty of IP addresses. This will, however, involve a massive reconstruction of the Internet infrastructure, requiring time and heavy investment, so we will have to live with the limited number of IP addresses for the foreseeable future.

Core rule: Anything that is published on the Internet needs a public IP address

Companies are handling this lack of public IP addresses mainly by utilizing the fact that the IANA (Internet Assigned Numbers Authority) have defined specific ranges of IP addresses that are unofficial or private, and which can be used freely on local networks. This type of address cannot be accessed from the “official road system” and will be “forced off road” at the first traffic junction (router).

Local IP-Address

Local IP addresses can only be used internally, on a local network. Local IP addresses are commonly used to solve the problem of the lack of public IP addresses (and also to some extent for security purposes).

Why give a computer on a LAN a local IP address? Does this mean that the computer cannot access the Internet?

A computer with a local IP address cannot access the Internet itself. It can, however, access the Internet via another computing device, e.g. a broadband router, equipped with two network cards, one for the inside (local IP address) and one for the outside (public IP address) This computer or device becomes a "gateway" for the local network, providing Internet access to the computers on the inside. The gateway only needs one public IP address, but it can serve thousands of computers on the inside with Internet access.

For reference, it should be mentioned that this method is commonly known as NAT-routing, and was developed by a company named Cisco (the same company that supplied the equipment for most of the Internet infrastructure).

Core rule 1: A private IP address cannot be accessed over the Internet.

Core rule 2: A computer that has a private address needs a gateway accessing the Internet as an "impersonator".

Address ranges defined as "local" by IANA	
10.n.n.n	Class A
172.16.n.n to 172.31.n.n	Class B
192.168.0.n to 192.168.255.n	Class C (this range is commonly used by broadband routers).

DNS (Domain Name System)

Although computers are good at using IP addresses containing only numbers, humans are typically not as good number crunchers as computers, and we prefer to use a person's name instead of his or her social security number. The Domain Name System, **DNS** provides a solution to this problem.

The Domain Name System (DNS) translates IP addresses into names, making it easier for the user to remember the address of a computer device. DNS is used for almost everything on the Internet, i.e. browsing for Web pages or sending/receiving mail.

DNS is a hierarchical database system that resides on Name servers. These servers may be local on your own network, or remote on the Internet, the functionality is the same. We will use a practical example to explain how this is done:

In this example, **Joe's** computer is connected to a broadband router, and has received an automatic IP address from with the DHCP server built in the router. (DHCP is explained below.)

Joe wants to access the Web pages at Axis Communications, so he enters the URL (Web-address): http://www.axis.com in his Web browser and presses **Enter.**

The following happens (simplified and from a DNS perspective):

1. Joe's computer knows the IP address of the closest DNS name server (contained in the "DCHP package" that Joe's computer received when he started it).
2. Joe's computer asks the DNS name server for the IP address of the computer called www.axis.com
3. The DNS name server checks its records to see if they contain any information related to Axis. In this case they do not, so it forwards the request to the next DNS name server up in the DNS hierarchy.
4. The chain of requests continues until a DNS name server that has the requested information is contacted.
5. The server that knows the IP address of www.axis.com responds with the corresponding IP address and this information is then forwarded all the way back to the Joe's computer.
6. Joe's computer receives the IP address for www.axis.com and forwards this to the Web browser
7. The Web browser sends a request for the main Web page to the www.axis.com server.
8. The Web page is displayed on the Joe's screen.
9. DNS in cooperation with TCP/IP has made one more user happy.

It's worth noting that the whole process only takes a fraction of a second, always assuming the traffic flow is smooth and there are no obstacles. There are other ways a name server can "resolve" names, but the description above is sufficient for our purposes.

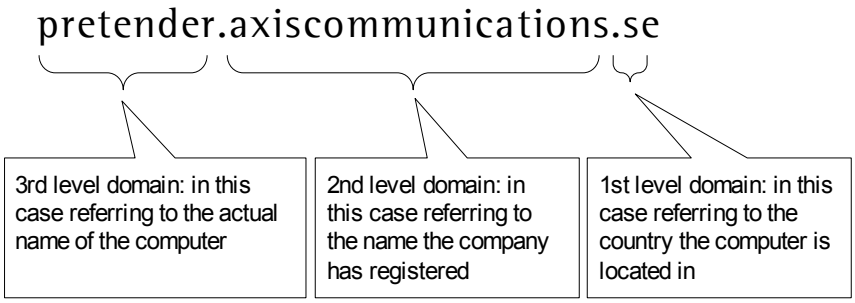
Core rule: DNS is needed for translating IP addresses into understandable names

Domain name

A Domain name is a computer name or device name. A name is regarded as more user friendly than the average IP address. As an example, you probably recognize the domain names below, but perhaps not the IP addresses they correspond to?

- www.axis.com - a typical name
- www.google.com – a search site
- www.oxford.edu - a popular EDU (educational) name
- encarta.msn.com - a Web server that does not start with www
- www.axis.se - a server located in Sweden
- ftp.axis.com – a server that is used more for File Transfer Protocol (FTP) than Web pages.

The example below shows the different parts a typical domain name consists of:



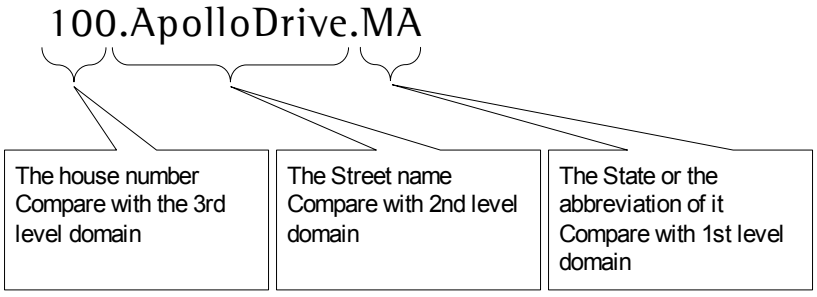
First-level Domain - The COM, EDU and SE portions of these domain names are called the top-level domain or first-level domain. There are several hundred top-level domain names, including COM, EDU, GOV, MIL, NET, ORG and INT, as well as unique two-letter combinations for every country (www.axis.se).

Second-level Domain - The second-level domain is often a reference to a company name, product name or a service offered.

Third level Domain - The third level domain often refers to the actual name of the computer or to the services it offers; for example a server that is called **www** is probably a Web server, a server with **mail** as third level domain is most likely occupied with e-mail handling.

There's nothing stopping additional levels of domain names, 4th, 5th and so on, but the "level of detail" or precision increases with each added level.

To return to the analogy of a street address as an IP address, a typical street address can be written using the same notation:

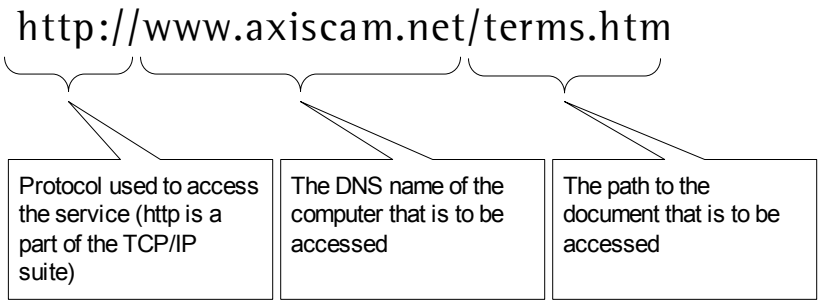


URL

URL (Uniform Resource locator) is an address that your application knows how to handle. It contains the protocol to use, the DNS name or the IP address of the computer to contact, and the path to the requested document or file.

The most common type of URL is used for addressing a specific Web site on the Internet.

See below for a typical example of a URL:



DHCP

The Dynamic Host Configuration Protocol (DHCP) is a method for automatically assigning IP addresses to devices on a network.

The DHCP procedure (simplified):

A computer that is configured for automatic IP addressing receives an invitation to lease an IP address as soon as it is connected to a local network.

A DHCP server that is assigned to handle the automatic IP addressing on the network sends out this offer. On a corporate network, the DHCP server is typically a computer server; in a smaller network it is typically a broadband router.

The computer accepts the offer and is thereby accepted as a member of the TCP/IP network and can start sending and receiving information.

The local computer not only receives an IP address, it also receives additional data, for example about the nearest available name server and the default gateway for Internet access (on small networks this is the broadband router).

Examples of typical usage for DHCP:

- A company with many users that travel has automatic (DHCP) IP addressing configured on all laptop computers to simplify IP addressing when they switch between networks. The user does not need to change any parameters when connecting the laptop to a new network.
- An Internet Service Provider (ISP) implements DHCP with a short lease time to limit the number of IP addresses needed. This is possible since not all subscribers are connected to the Internet all the time.
- A broadband router has a DHCP server to simplify IP addressing for users on the local network and a DHCP client accepting automatic IP addresses on the public network (Internet).

Port Forwarding

This explanation is intentionally limited to explaining the typical usage of port forwarding in the broadband sharing context.

Port forwarding is essentially a method for a broadband router to forward data traffic aimed for one port on its public network interface to a computer or network camera on the local network interface.

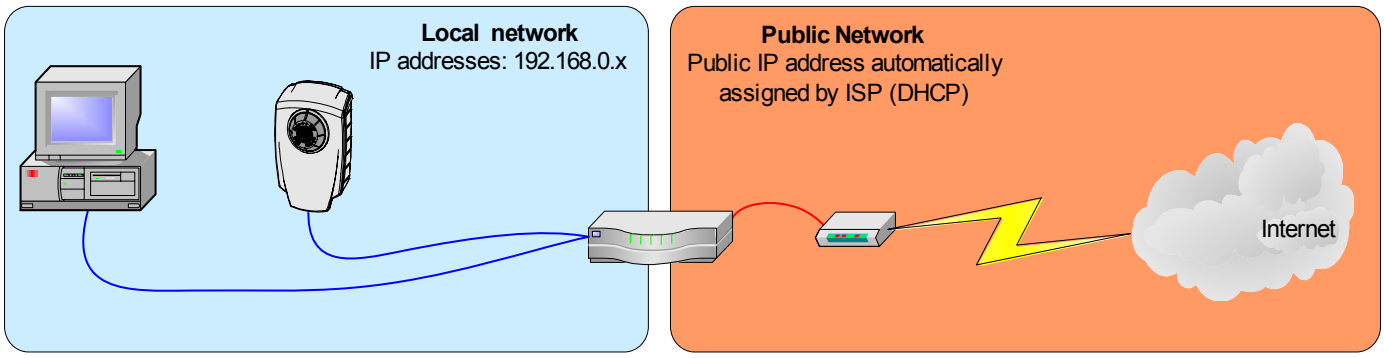
To use a practical example, we have a user with a network camera who wants to publish it on the Internet. Our user has the following equipment:

1 AXIS 205 Network camera

1 PC running Windows

1 Broadband router (with built-in network switch)

The user also has an xDSL connection to the Internet with an ISP that has implemented DHCP for its subscribers; which gives us the following network:



Typically, the broadband router blocks incoming traffic, but allows access to the Internet (outgoing traffic from the local network). This is a typical default configuration for broadband routers.

We need to direct all incoming requests that reach port 80 the public network interface of the broadband router, so that these are forwarded to the camera's IP address on the local network.

1. All addresses on the local network have been assigned using the broadband router's built-in DHCP server. Although practical for IP address assignment, this is not good for our purposes, since this means that the camera's IP address might change and we would lose contact with it (the port forwarding would point to the wrong address). We need to set a **fixed (static) IP address** for the camera.
2. We start by checking the broadband router's documentation, to find which IP address we can use for the camera. The documentation says the router uses the IP address range192.168.0.2 through 192.168.0.35 for DHCP, so we conclude that if we use an IP address above that range we won't be risking conflicts with other devices that receive automatic addresses from the DHCP server.
3. We choose192.168.0.**100** as a fixed IP address for the camera.
4. We set the IP address of the camera to **192.168.0.100** using AXIS IP Utility software (for more information on how to obtain and use this application, see the quick installation guide).
5. Set other IP parameters in the camera using its built-in administration pages (DNS and default router are very important).

6. Consult the broadband router's manual for information on how to configure **port forwarding**, e.g. **DMZ port mapping** or **Internet publishing**.
7. Start a Web browser and go to the router's built-in Web pages. Log in to the router's configuration pages.
8. Find the menu item "port forwarding" (or similar), with a table as illustrated below:

Service Name	Start port	End port	Server IP Address
FTP	21	21	Not configured
HTTP (Web)	80	80	Not configured
			Not configured

9. We need to configure the **HTTP** service, as the camera sends its video over HTTP. We change the configuration to the following:

Service Name	Start port	End port	Server IP Address
FTP	21	21	Not configured
HTTP (Web)	80	80	192.168.0.100
			Not configured

10. Save the configuration in the router and exit the configuration pages
11. The configuration is complete.
12. Any requests reaching the router's external IP Address on port 80 will now be forwarded to the camera's IP address: 192.168.0.100 – This means that anyone on the Internet can view the video sent by the Axis 205 Network Camera; as long as they know the external IP address of the router.

> **Note:**
>
> This method requires that a user accessing the camera over the Internet knows the public IP address for the router. However, the router's public IP address will probably change at some point and not much can be done about this.
>
> The AXIS Internet Dynamic DNS service has a solution for this, which is presented later in this document

Links to port forwarding information for common broadband routers

There are as many configuration methods for broadband routers as there are brands & models. Consult the router's documentation for information on how to enable port forwarding. See below for links to port forwarding information for a few of the more common brands.

Note: The location of these documents is subject to change without notice. Axis Communications provides these links as a service only. The inclusion of these links does not imply that Axis Communications endorses, recommends, or accepts any responsibility for the information presented by these sites

Port forwarding on the Linksys Cable/DSL Router
http://www.dslwebserver.com/main/sbs-linksys-port-forwarding.html

Port forwarding on various Netgear routers
http://kbserver.netgear.com/kb_web_files/n101145.asp

Port forwarding on various D-Link Routers
http://support.dlink.com/faq/search.asp?question=port%20forwarding

Port forwarding on an Asante FR3000 DSL/Cable Router
http://www.dslwebserver.com/main/sbs-port-forward-asante-fr3000.html

The AXIS Internet Dynamic DNS service

How can AXIS Dynamic DNS service help me publish my camera on the Internet?

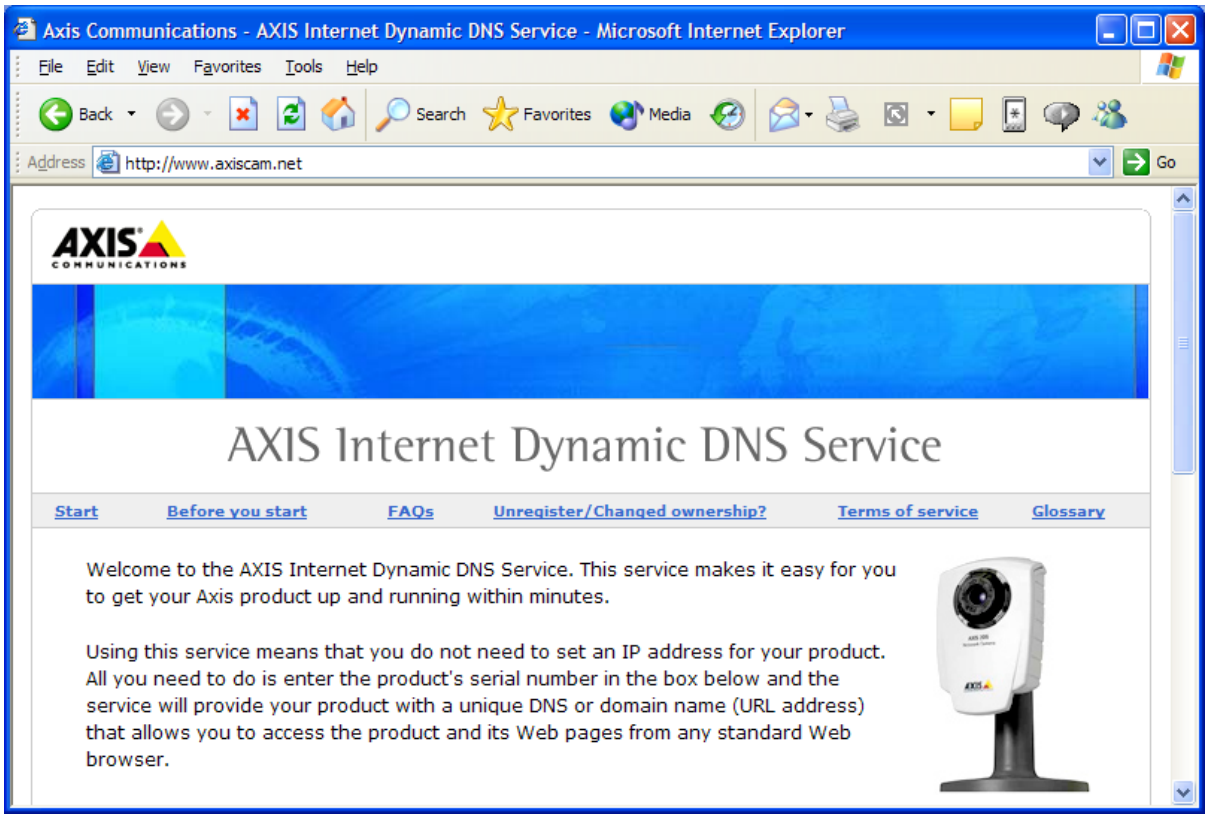
Port forwarding must be properly set up before attempting to use this extended feature of the AXIS Internet Dynamic DNS Service (unless you already have the camera set up with a public IP address).

The AXIS Internet Dynamic DNS Service lets you use an external domain name associated with the outside interface of your router, in addition to the name you have obtained for use on your internal network.

Dual names are necessary, as some broadband routers cannot handle outbound traffic from the local network to the public interface and then back again.

From a user perspective the steps involved in publishing an Axis 205 Network Camera on the Internet are as follows:

1. Complete the one-click installation procedure as described in the beginning of this document, or set a fixed IP address and the necessary network parameters in the camera, as described in the port mapping example above (note that you need to press the Control button if you change the port number for the camera).
2. Set up **port forwarding** correctly in the broadband router/firewall, as described in the example on port mapping above.
3. Log in to The AXIS Internet Dynamic DNS service (http//www.axiscam.net), perform your registration and accept that the router's external address can be used for access from the Internet using a name.



Technical description of the name publishing function provided by the AXIS Internet Dynamic DNS service

The publishing function is closely linked to the **One-click Installation** method, but does not use the camera's IP address. The broadband router's external IP address is used instead.

As described earlier in the technical description of the **One-click Installation,** the network camera sends information to the AXIS Internet Dynamic DNS service when the Control button on the camera is pressed. This information is sent over HTTP (the protocol used by Web servers and Web browsers). The information contained in the package is:

- The camera's IP address
- The camera's firmware version
- The camera's serial number
- The camera's port number

This information allows the service to assign a domain name linked to the IP address, to the camera. It does not make it possible to assign a public IP address to the camera if it is located on a private network, e.g. behind a firewall or broadband router.

The AXIS Internet Dynamic DNS service utilizes the fact that each data packet sent over TCP/IP contains the sender's IP address at the start the packet. Compare this with a physical parcel sent using the regular postal service where the recipient's address as well as sender's address is written on the parcel itself.

As only public addresses are accepted as senders on the Internet, the sender of the **One-click Installation package** will be the public address of the broadband router or firewall that put the package on the Internet.

The procedure can be described as follows:

1. The AXIS Internet Dynamic DNS service receives the **One-click Information package** when the control button on the camera is pressed.
2. The AXIS Internet Dynamic DNS service temporarily registers the contents of this package (IP address, firmware version and serial number) and assigns a name for the camera based on the serial number.
3. As a parallel process, the AXIS Internet Dynamic DNS server analyzes the sender of the package (broadband router/firewall) thus discovering the sender's public IP address.
4. The AXIS Internet Dynamic DNS service registers this additional information under a separate domain name for the camera. This name becomes the public domain name for the camera and allows other users on the Internet to browse to it (provided that port forwarding is correctly set up).

Note that even if the camera contacts the AXIS Internet Dynamic DNS service at regular intervals, your ISP may frequently change the IP address of your broadband router. This might prevent the external naming part of the service from working properly; there is no way for the camera to know how often the external IP address of the router is changing.

> **Note:**
>
> If you find that your Internet Service Provider has a very aggressive approach as regards the changir of IP addresses, consult your manual and see if your broadband router has native support for any Dynamic DNS services and use this as an alternative solution.