Video Authentication Manual

Digital Verifier, Signature & Certificate

WebCCTV

Let’s make things safer!

Contents

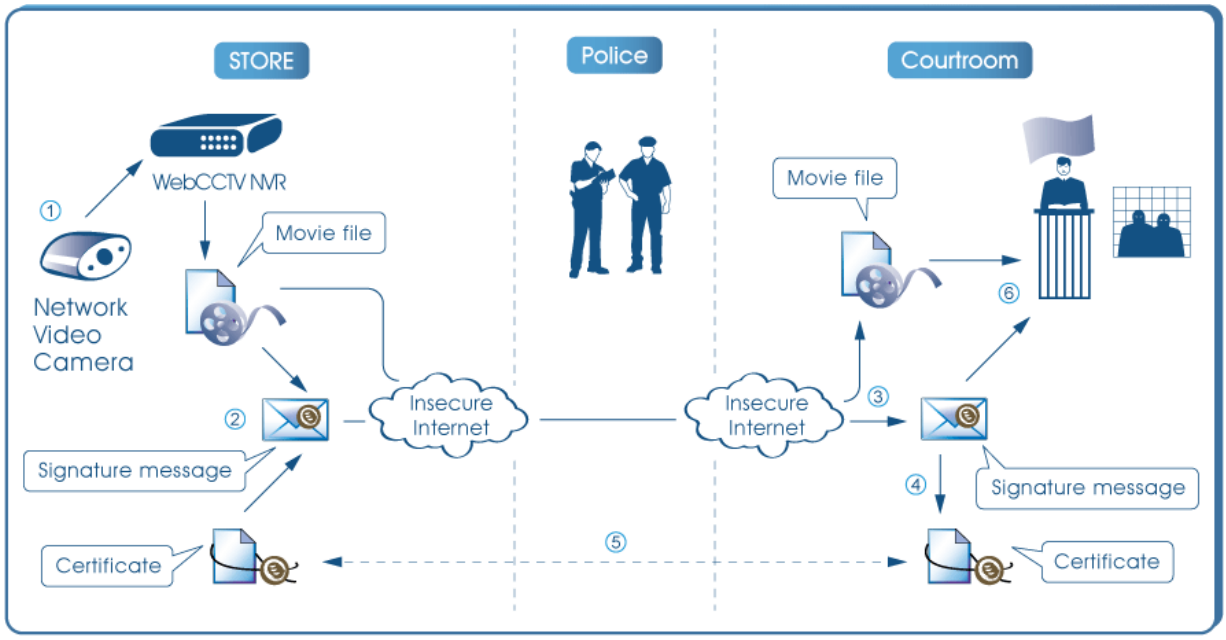
1 Introduction

The latest generation of networked systems promises a much easier and faster way of moving video around (e.g. police, court room…), by simply sending it over the Internet. A public network like the Internet is not exactly the safest when talking about transport. However, digital video can be digitally secured and the possibility to trace the video back to its origin is now a reality. This technology is called **digitally signing** the video.

A **digital signature** is a cryptographically encoded text that contains information about the exported movie file that was signed and about the entity that created the signature. Each export file has its own signature.

A **certificate** is again a cryptographically protected text that contains the electronic key with which the owner of the certificate can sign digital documents or content. This certificate is only valuable if it is trusted by the authorities. (See Chapter **2 Certificate Management**)

The following diagram shows how a digital signature is used in the video authentication process. A full step by step explanation can be found in Chapter **3 Video Authentication Process**.



Video Authentication Process

2 Certificate Management

The Certificate Management section allows you to handle your certificates for exported movie signing. This section can be found in the **Video Manager** application under the menu **Settings → Certificate Management**.

Certificate Management Screen

The **Current Certificate Information** section consists of general information about the certificate which is currently used by WebCCTV for export movie signing, such as:

- Name of your certificate
- Certificate name of an issuer which signed your certificate
- Email you specified for certificates generating
- Complete information that identifies your certificate (including name, email and location)
- Complete information that identifies certificate of an issuer which signed your certificate (including name, email and location)
- Days left to your certificate expiration
- Date of your certificate generation

Subject/Issuer and **Issued to/Issued by** fields are the same if using a self-signed certificate.

2.1 Self-signed certificates

During the WebCCTV installation a self-signed certificate is created which has non-personalized information. It is recommended that you create a new certificate which will include your information as a signer. To do that, follow the steps below:

1. Specify your e-mail in the **E-mail** field.
2. Specify your location in the **Location** screen.
3. Click **Generate** button.

Your new self-signed certificate has been generated. From now on it is used for signing the export movie files.

To export this certificate for transmitting it to a remote location or other purposes, click the **Export** button and define the location to store.

Self-signed certificate have the following advantages and disadvantages:

Advantages:

- Certificate can be renewed at one's choosing
- Custom information (i.e. location of the recorder and contact email, etc.) can be added which is useful in court
- Certificate doesn't expire
- Certificate is free of charge

Disadvantages:

- Certificate is not verified by 3rd party, so it has limited trust.
- Certificate should be explicitly added to the trusted certificates list on each machine for the verification.

2.2 CA signed certificates

In spite of the self-signed certificates advantages, this approach is not the most secure. To improve your security, Quadrox recommends getting a certificate from a trusted certification authority (CA). There are Certification Authorities (CA) which are explicitly trusted worldwide so Microsoft pre-installed theirs certificates in the Windows Operating System. Hence those certificate authorities are trusted by all 3rd parties which use a Windows Operating System. If you get a certificate signed by the CA, you automatically become a trusted signer in the Windows environment.

To import the CA certificate in the WebCCTV system, follow the steps below:

1. Save the certificate on your WebCCTV server.
2. Specify the exact path to the certificate in the **File on server** field.
3. Click **Import** button.

Exported movie files will now be signed by the imported CA certificate. The main advantage is that you don't need to install it on each machine since this certificate is pre-installed there.

A certificate loses its "trust value" over time, because the longer it is in place, the higher chance it has of being compromised. It is recommended that certificates are renewed regularly and that the old certificate is allowed to expire.

CA certificates have the following advantages and disadvantages:

Advantages:

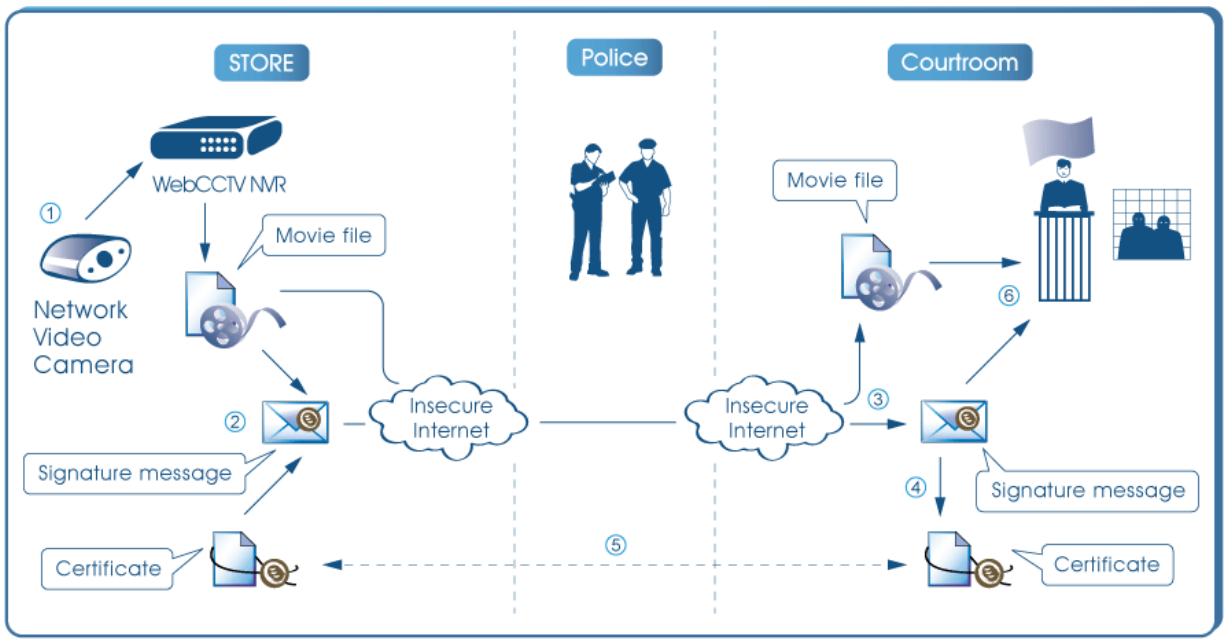
- Certificate is checked by trusted 3rd party for maximal security
- Certificate doesn't need to be explicitly added to trusted certificates list
- Certificate expires

Disadvantages:

- Certificate must be purchased

3 Video Authentication Process

The following diagram shows how a digital signature is used in the video authentication process:



Video Authentication Process

There are six steps in the process:

- **Step 1** – Recording
- **Step 2** – Export
- **Step 3** – Signature & Movie Transportation
- **Step 4 + 5** – Certificate Transportation & Trust
- **Step 6** – Checking Signature

3.1 Recording

Video from the camera is recorded in a standard ASF movie file. During export you can choose to keep it in ASF or convert it to WMV. WMV files can be played on every windows based operating system as the WMV codec is installed by default.

3.2 Export

When a relevant piece of video is exported, information about that video (e.g. the timestamp, camera name, recorder information and the user who performed the export) is gathered in a

signature message. This message is encrypted by the certificate, unique to each recorder, to form a digital signature.

WebCCTV supports two formats of digital signature:

- **.eml** – S/MIME standard message like used in digitally signed emails.
- **.p7m** – true PKCS #7 standard signature message. It can be opened by specialized viewers like Cryptigo's P7MViewer (http://www.cryptigo.com).

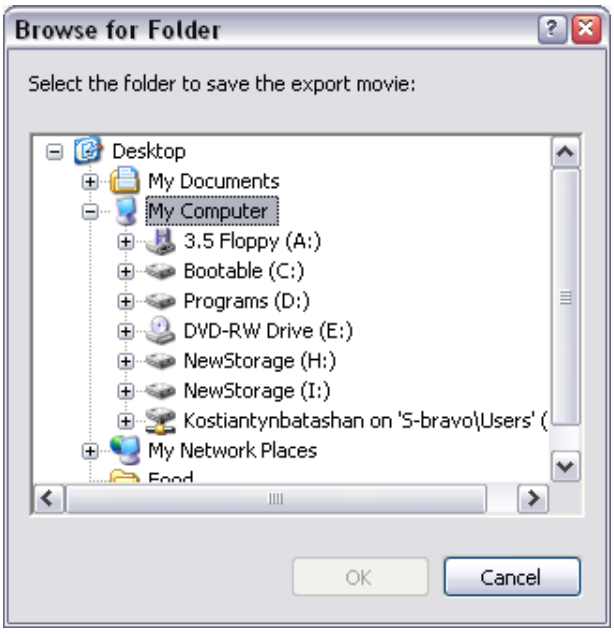
Quadrox has based all of these systems on the open standard technology to prevent any possibility of security holes or "back doors". All algorithms that are used are well known and widely used cryptographic standards, like MD5, SHA-1 and RSA. They cannot be broken if the key is not known, not even by the people that implemented them. The certificate is standard (X.509, PKSC #12), as is the digital signature format (PKCS #7). Apart from the true signature standard that can be viewed by publicly available specialized viewers, we also provide the signature in a standard email format (S/MIME format) so that it can be viewed by common email clients like Outlook Express. Quadrox uses Microsoft's implementations of these formats and algorithms, which are validated and certified by the National Institute of Standards and Technology (NIST).

3.3 Signature & Movie Transportation

The movie file and the signature are transported to the courtroom. They don't necessarily have to travel together and the channel can be unsafe (e.g. they can be sent over the Internet).

To save the signature for further transportation, follow the steps below:

- Click on the signature you want to save.
- Select the save location in the pop up window and click **OK**.



Saving Digital Signature Screen

3.4 Certificate Transportation & Trust

The certificate should be trusted by the court. By trusting the validity of a certificate (by manually checking that it is indeed what it claims to be), the court acknowledges explicitly that the certificate belongs to the machine on which the export was created.

The court expresses this trust by explicitly adding it to the list of trusted root certificates. When doing this, the system will ask to manually verify the certificate, e.g. by comparing the thumbprint of the certificate to the thumbprint of the certificate that is present on the recorder. The latter should be retrieved by physically going to the recorder, it should be done by the authorities and a proven track record should be available. Trusting the certificate has to be done only once per recorder (not for every movie) and doesn't have to necessarily happen at the moment of movie verification.

When using CA certificates, the trust in the certificate might come from trusting the CA that delivered the certificate. In that case, this procedure might not be necessary.

A copy of the certificate can be extracted from the signature by using the Digital Signature Verifier (available from the Quadrox website). The certificate can also get to the courtroom in a different way (by exporting it from the recorder) or can already be present because it was extracted from previous movies.

3.4.1 Extract & Install certificate from signature using Digital Signature Verifier

Follow the steps below:

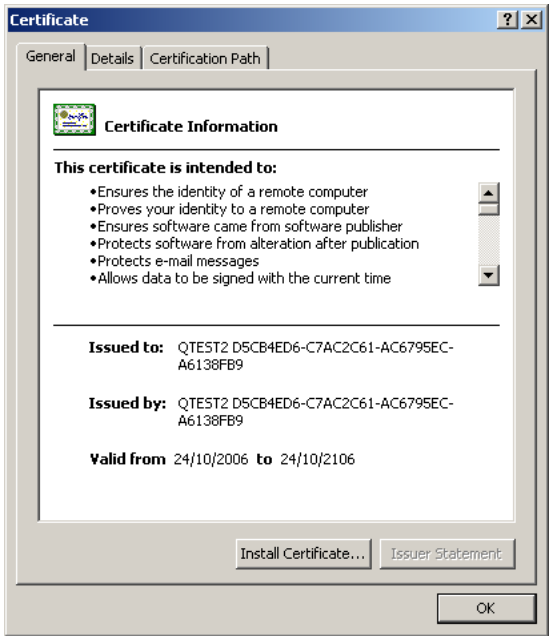
- Open the Digital Signature Verifier tool.

Digital Signature Verifier main screen

- Enter the locations of the movie and signature files and click the **Verify** button. If the certificate is not yet trusted, you will see the following screen.

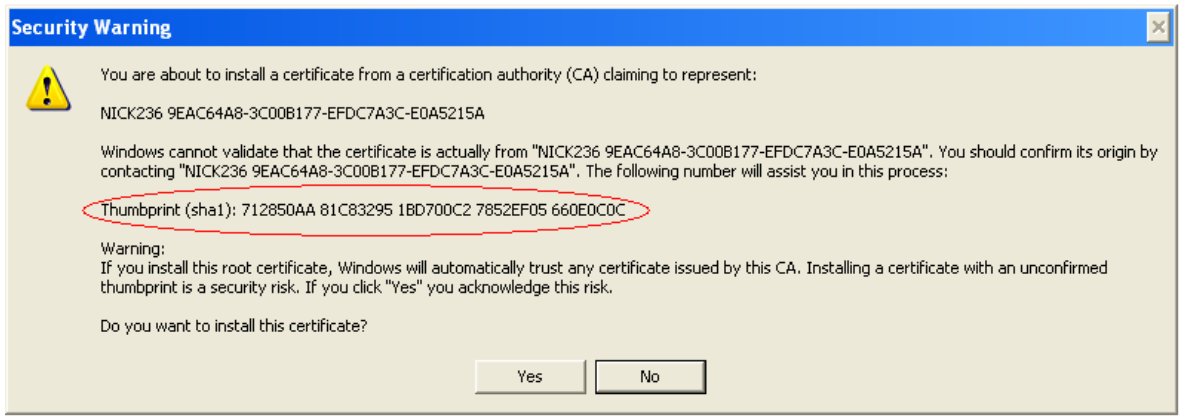
Not trusted certificate warning screen

- Click the **Certificate** button.

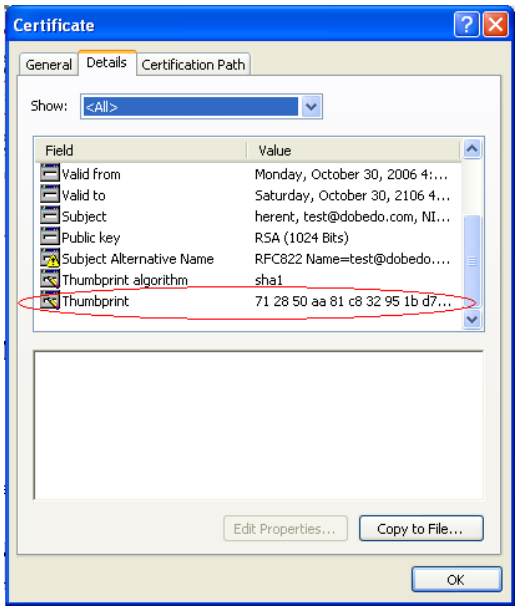


Certificate Information Screen

- Click **Install Certificate** button and follow further instructions leaving all settings by default. A Security Warning window will appear.
- To make sure that you are installing the exact certificate you need, find the **Thumbprint** line in the Security Warning window and compare it with the thumbprint of the original certificate on the recorder. If the thumbprints match, click **Yes**.



Security Warning Screen



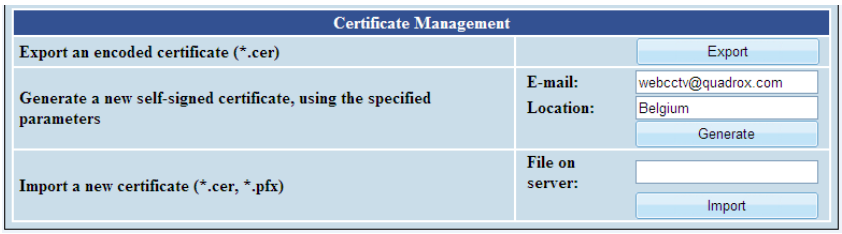
Certificate Information Screen

- Once your certificate is installed, repeat the first two points of this chapter. To verify the signature, see Chapter **3.5 Checking Signature**.

3.4.2 Install Certificate by exporting from Video Server

Follow the steps below:

- Open WebCCTV web-client.
- Go to **System-> Certificate Management** section.
- Click **Export** button and define location to store the certificate.



Certificate Management Screen

- Transport the exported certificate to the target machine and double click on it. The Certificate Information screen will appear.
- Click **Install Certificate** button and follow further instructions leaving all settings by default. A Security Warning window will appear.
- To make sure that you are installing the exact certificate you need, find the **Thumbprint** line in the Security Warning window and compare it with the thumbprint of the original certificate on the recorder. If the thumbprints match, click **Yes**.

To learn advanced ways to make the certificate explicitly trusted, see **Appendix A**.

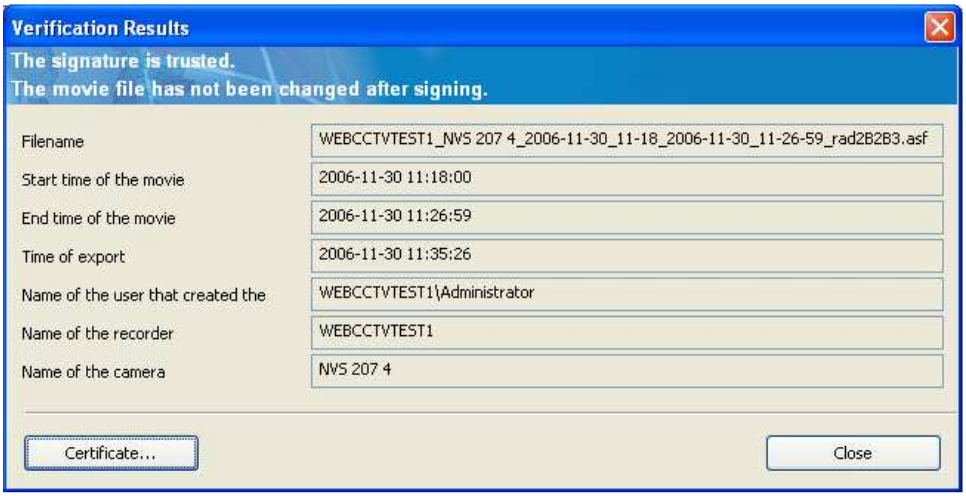
3.5 Checking Signature

Once the certificate is trusted, the signature message can be decoded. Because the certificate is trusted, we know that a) the information in the signature is correct (wasn't changed) and b) the signature was produced on the recorder from which the movie is claimed to have originated. If the signature was forged, the certificate will not decode it.
Inside the signature, a hash value links the certificate uniquely to the movie file. By recalculating the hash in the courtroom, we can be sure that a) this signature belongs to this particular movie and b) the movie hasn't changed since the signature was created. If the movie was forged, the hash value would be different and the signature invalid.

These actions are performed automatically by the Digital Signature Verifier tool.

Digital Signature Verifier main screen

- Open the Digital Signature Verifier tool.
- Enter the locations of the movie and signature files and click the **Verify** button.
- If the signature can be decoded and the hash information matches the movie, the movie authenticity is proven and the following information screen will be shown. The displayed information is part of the digital signature and is likewise proven to be authentic.



Trusted signature information screen

- If the signature cannot be trusted because either the signature or the movie was tampered with, the following screen will be shown.

Not trusted signature information screen

The Digital Signature Verifier was created by Quadrox to make your life easier. However, it is not crucial to verifying the digital signature. You are free to manually check the signature, or by a tool of your own choosing.

The tool is released as an open source tool under the BSD license. To make sure that the tool doesn't display false information, feel free to examine the source code and make your own compilation for maximum trust.

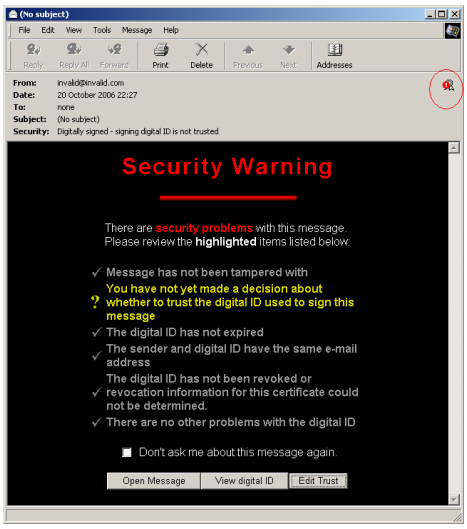
To learn how to manually verify the signature, see **Appendix B**.

Appendix A

Trust certificate explicitly by means of the Outlook Express email client

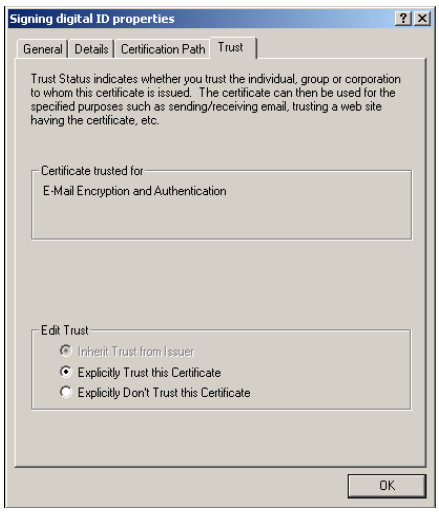
Follow the steps below:

1. Save **.eml** signature on the target machine.
2. Double-click on it to open. You will see the following screen that means your certificate is not trusted on this machine.



MS Outlook Express Untrusted Signature Screen

3. Click **Edit Trust** button.
4. In the screen that appears select **Explicitly Trust this Certificate** and follow further prompts.

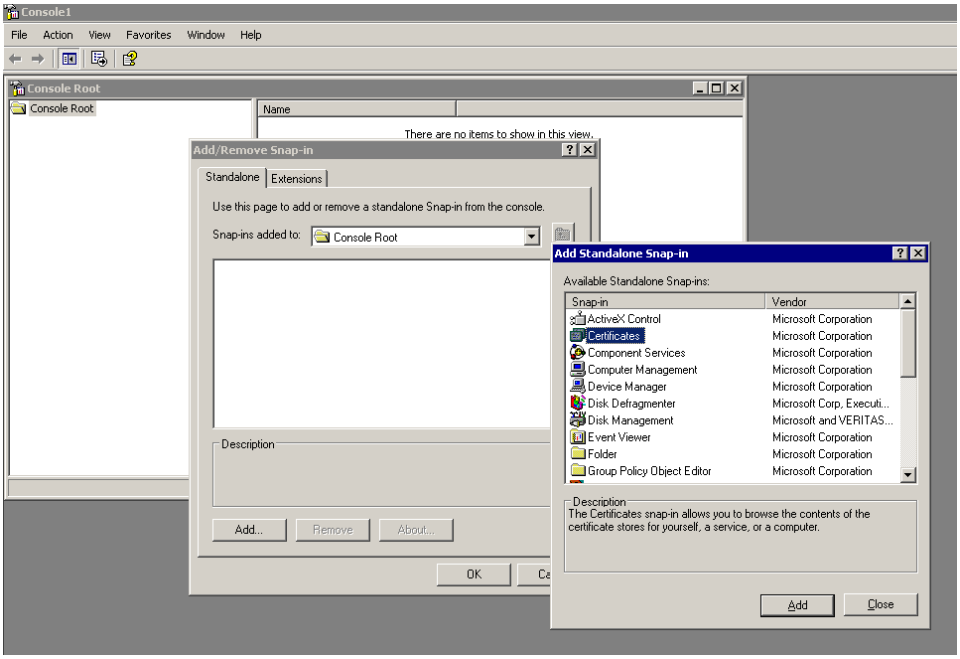


Signing Digital ID Properties Screen

Trust certificate explicitly by means of the Microsoft Management Console

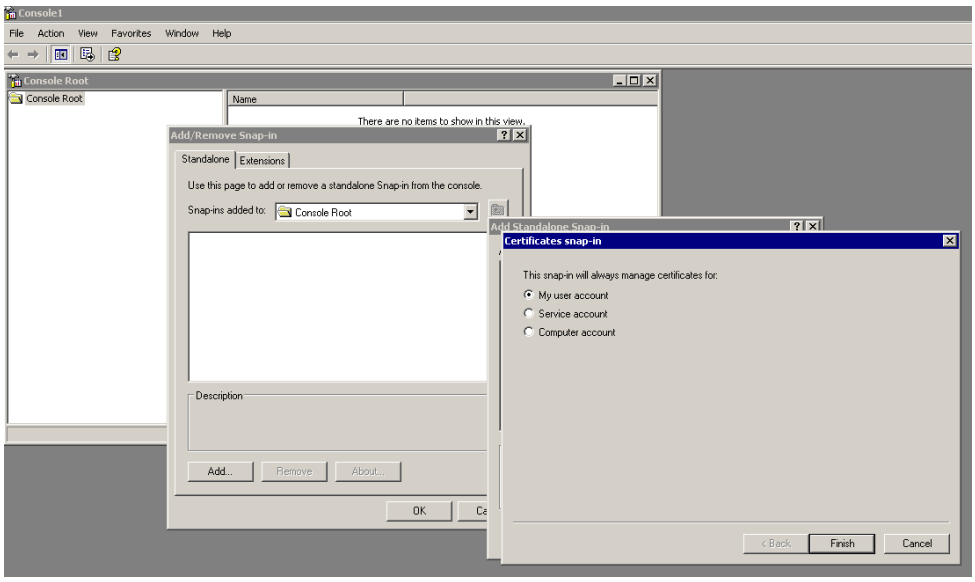
Follow the steps below:

1. Go to **Start->Run** and specify **mmc** command.
2. In the window that appears, click **File** in the window menu and select **Add/Remove Snap-in**.
3. In the window that appears, click **Add** button.
4. In the next appeared window, choose **Certificates** and click **Add** button.



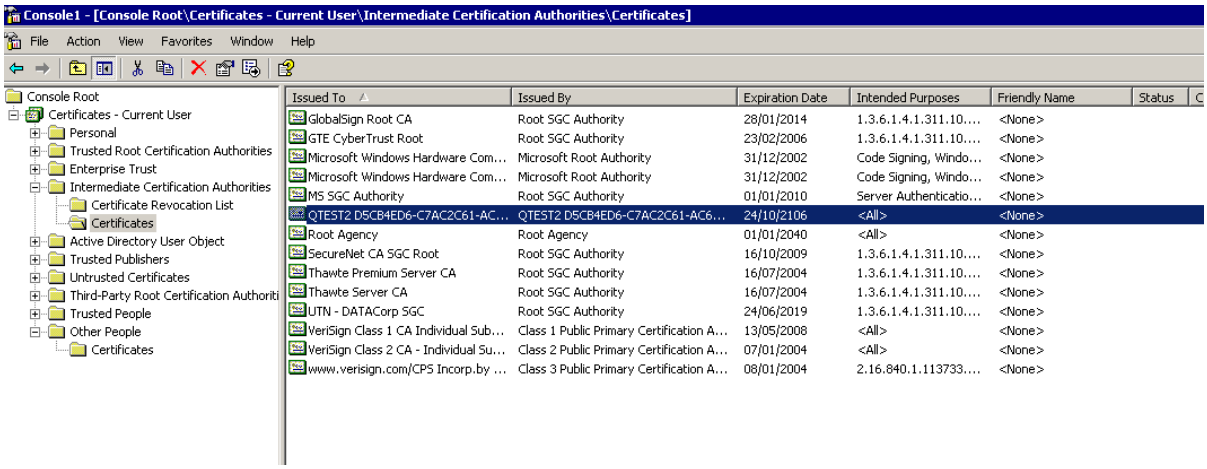
Microsoft Management Console Screen

5. Then select **My User account** item and click **Finish**.



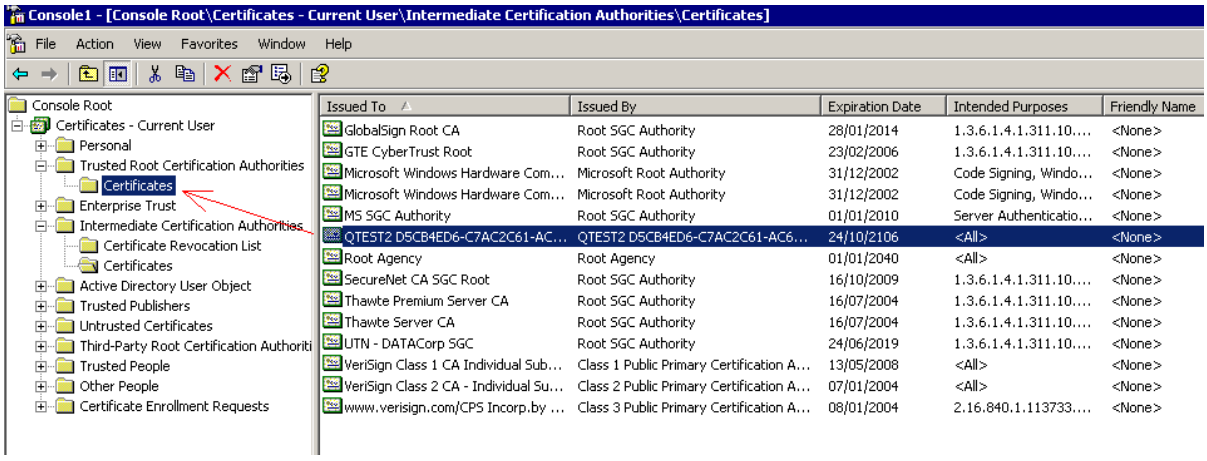
Microsoft Management Console Screen

6. Close all previously opened windows by pressing **Close** and **OK** buttons.
7. Finally you will get the list of all installed certificates.



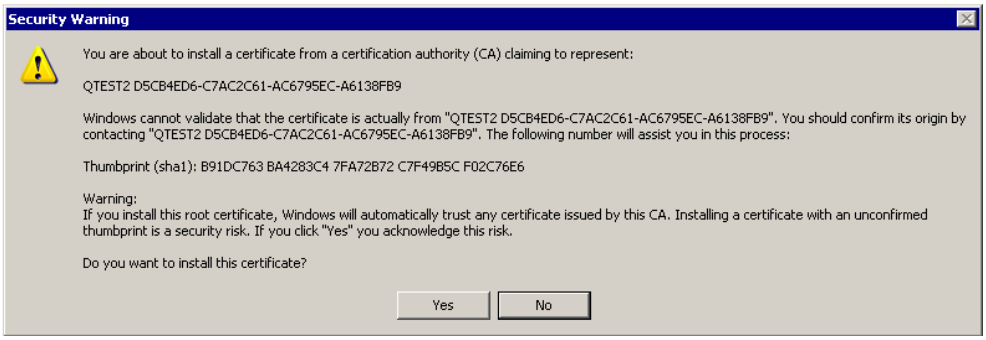
Microsoft Management Console Screen

8. After the certificate installation procedures, which were described above, the certificates are installed to the **Intermediate Certification Authorities** list (when certificate is extracted from the digital signature) or to the **Other People** list (when certificate is installed by exporting it from the recorder). Find your certificate in the corresponding list.
9. To make the certificate fully trusted, drag and drop your certificate to the **Trusted Root Certification Authorities** list.



Microsoft Management Console Screen

10. After verifying the thumbprint, click **Yes** in the screen that appears.

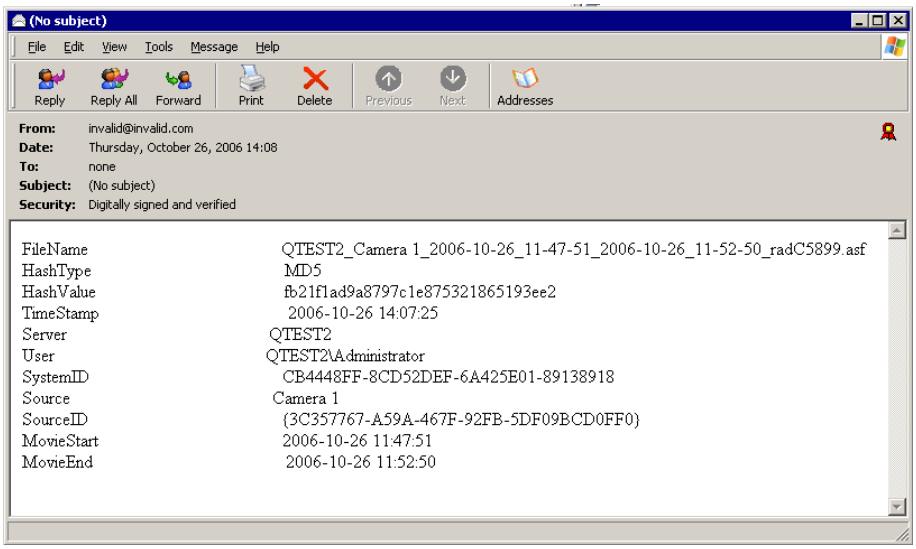


Security Warning Screen

Appendix B

You can manually verify the digital signature by using either the .eml or the .p7m format.

- Signatures in .eml format can be viewed by MS Outlook Express. To do that, double click on the .eml file you just saved, Outlook Express opens the signature and you will see the following screen.



Digital Signature Screen

- Signatures in .p7m format can be viewed by a p7mViewer or another relevant viewer (http://www.cryptigo.com). To do that, install the viewer and double click on the .p7m file you just saved. The p7mViewer opens the signature and you will see a screen, which is similar to the one that is above.

Being able to open a digital signature file and see the information inside it implies that it can be decoded (and thus was generated) by the certificate. This means that the signature file itself cannot have been tampered with.

The digital signature generated by Quadrox software contains the following information:

- The filename of the signed movie.
- Signed movie hash type and value. Together, filename and hash value indisputably link the signature to the movie file.
- The time at which the video was recorded.
- The name of the recorder where video was recorded and exported.
- The system user that created the movie export.
- The identifier of the recorder, which together with the certificate that was used proves that the movie file was originally recorded on that particular system.
- The name of the camera that recorded the exported footage.
- The identifier of the camera that recorded the exported footage.
- The start time of the exported footage
- The end time of the exported footage.

A hash value or a checksum for a file is a short value, something like a fingerprint of the file. This feature can be useful both for comparing the files and their integrity control.

A hash is a mathematically calculated number that uniquely defines the original information. There are always several information strings that have the same hash as a result, but it is infeasible to find a "second original" based only on the hash. If you change a single bit in the original information, the hash will be different. Popular hashes used by the Quadrox software are MD5 and SHA-1.

The Hash value can be checked by using the special tools which are built upon the MD5 checksum algorithm which is used worldwide for checking the integrity of the files, for example FastSum application (http://www.fastsum.com).

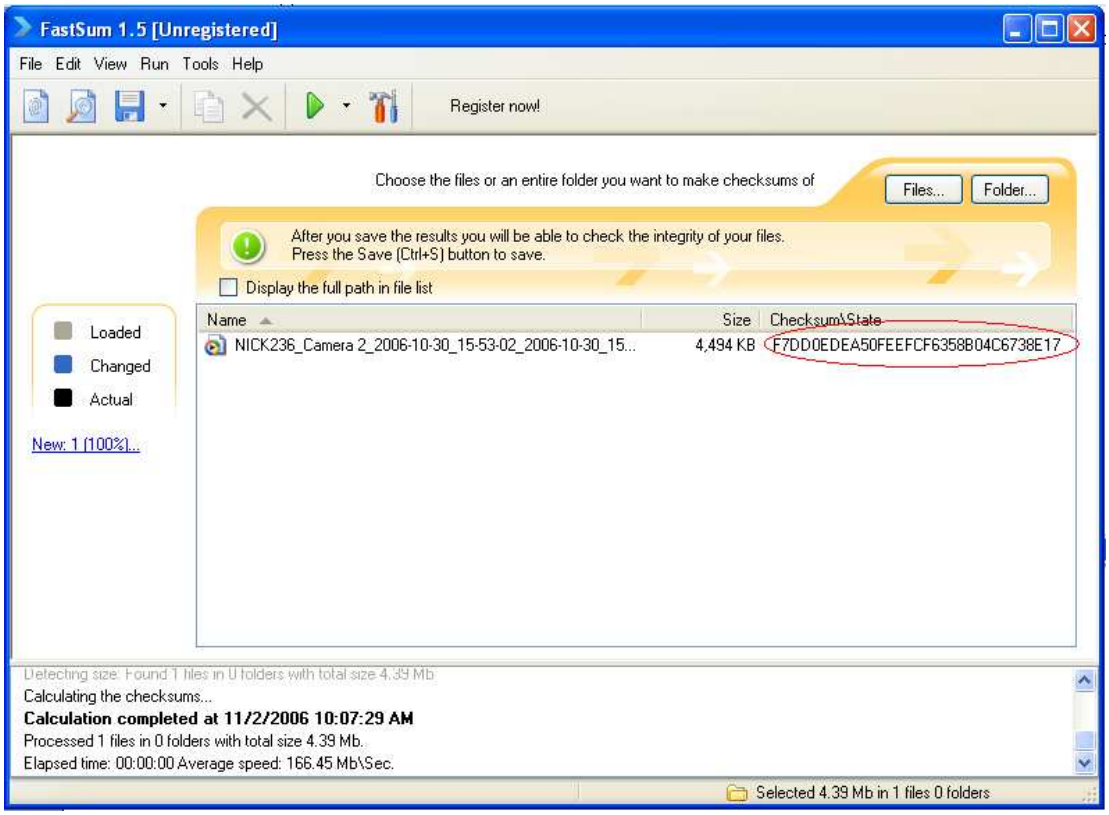
Calculate movie hash value by means of the FastSum application

Follow the steps below:

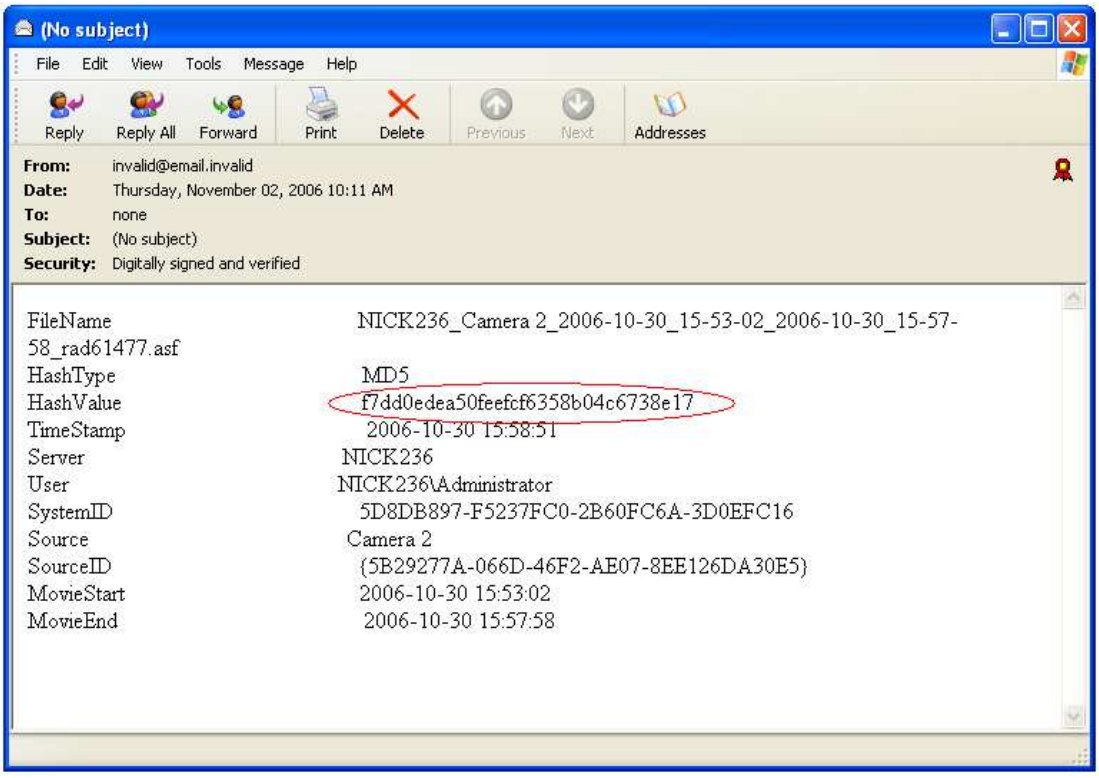
1. Download and install the **FastSum** application by using all the default settings.
2. Right-click on the export file and make the selection as shown on the following screen.

Create Checksum Selection Screen

3. Click **F9** button in the FastSum screen that appears to begin the calculation.
4. When the checksum is calculated by means of FastSum, compare it with the one from the digital signature.



FastSum Screen



Digital Signature Screen

If the checksums don't correspond with each other, this means the movie file is not valid and has been changed.

Check hash value of an exported movie file by means of the FastSum application

Follow the steps below:

1. Download and install the **FastSum** application (http://www.fastsum.com).
2. Create an empty text file with **.md5** extension.
3. Edit the file in the following way:

fb21f1ad9a8797c1e875321865193ee2 *QTEST2_Camera 1_2006-10-26_11-47-51_2006-10-26_11-52-50_radC5899.asf

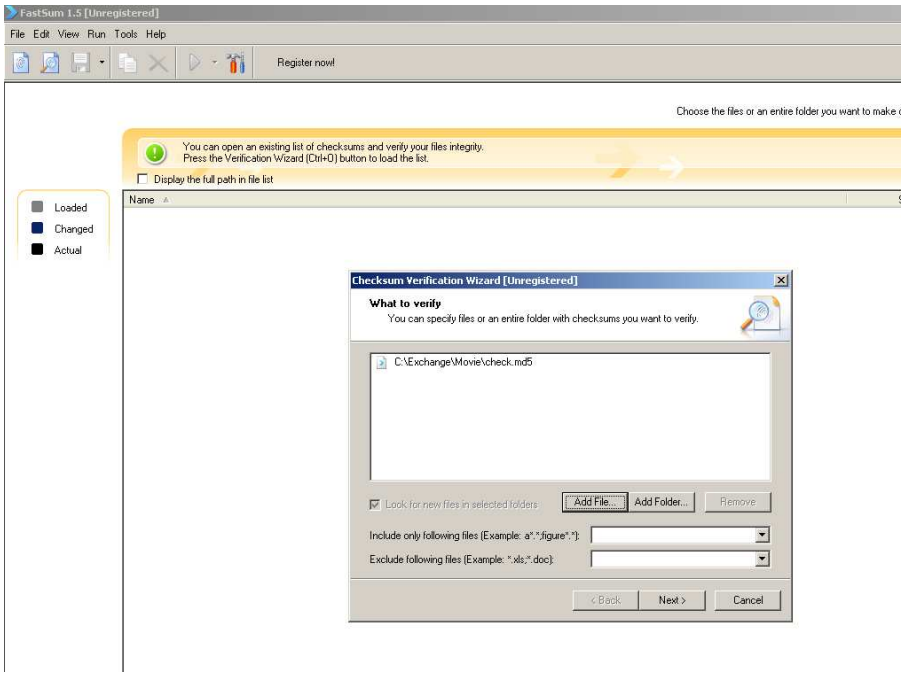
The string above is an example.

Assuming that

fb21f1ad9a8797c1e875321865193ee2 – is the hash value/checksum, which is taken from the digital signature of the exported movie file you want to validate.

QTEST2_Camera 1_2006-10-26_11-47-51_2006-10-26_11-52-50_radC5899.asf – is the name of the exported movie file you want to validate.

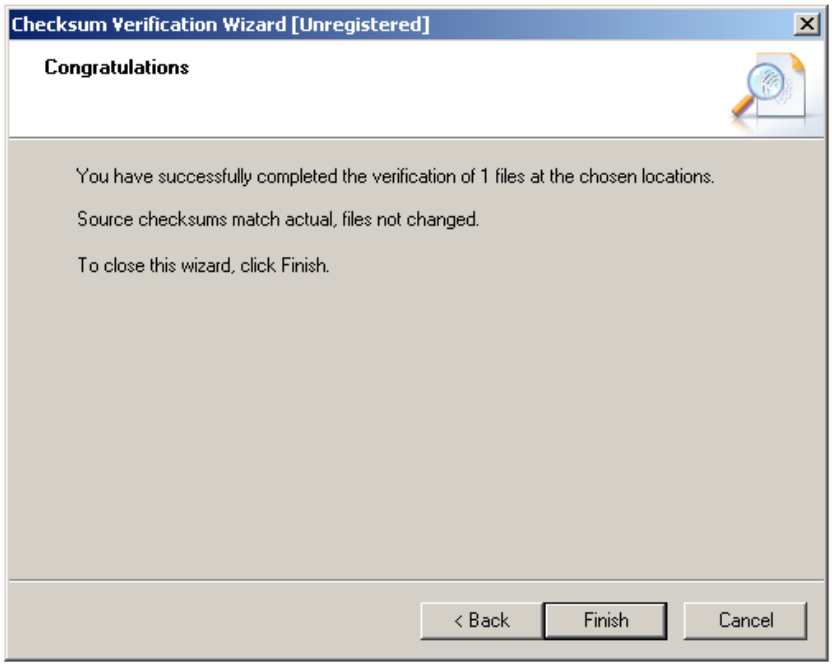
4. Save the edited **.md5** file.
5. Put saved **.md5** file and export movie file to a one folder.
6. Launch **FastSum** application and go to **File -> Verification Wizard**.
7. Click **Add File** in the screen that appears and select **.md5** file you created.



FastSum Application Screen

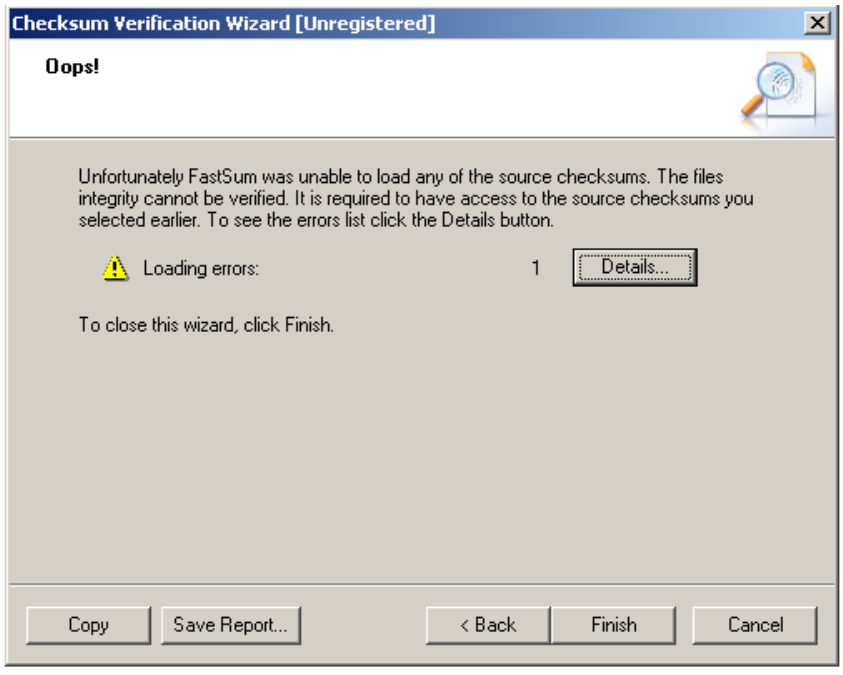
8. Click **Next**.

9. If the movie file wasn't changed and the checksum corresponds to the movie file, you will see the following screen:



Checksum Verification Wizard Screen

10. If checksum doesn't correspond to the movie file, this means that the movie file is not valid and has been changed. You will see a screen denoting such an error:



Checksum Verification Wizard Screen