



MEDICAL IMAGE DATA COMPRESSION GUIDE

COMPRESSION WITH iQ



Intro

The use of efficient medical image data compression is important for daily clinical operations.

If the chosen compression ratio is too low, a slow transmission might delay clinical diagnosis.
If the chosen compression ratio is too high, artifacts may affect the diagnostic quality of transmitted images.

This guide provides recommendations for clinical settings based on international guidelines and comprehensive testing performed by IMAGE Information Systems (IMAGE).

In all scenarios, the diagnostic quality of applied data compression should be validated by an appropriate medical doctor, e.g. a radiologist, for each installation before being used for any diagnostic purpose.

Please contact us at support@image-systems.biz for any issues, comments or recommendations.

<i>COMPRESSIONS</i>			
ALGORITHM	ADVANTAGES	DISADVANTAGES	RECOMMENDED FOR
JPEG Lossless	Standard, fast	Low compression ratio	Any images
JPEG Baseline	Standard, fast	Lossy compression Low compression ratio	Any images (8 bit)
JPEG Extended	Standard, fast	Lossy compression Low compression ratio	Any images (12 bit or 16 bit)
JPEG-LS Lossless	Fast and high compression ratio	Not supported by all modalities (Newer!)	Any, if all modalities are compatible!
JPEG-LS Near-Lossless	Fast and high compression ratio	Not supported by all modalities, Lossy compression	Any, if all modalities are compatible!
JPEG 2000 Lossless	Standard, high compression ratio	Very slow, particularly for large images	Not recommended
JPEG 2000 Lossy	Standard, high compression ratio	Lossy compression Very slow, particularly for large images	Not recommended
RLE	Standard	Low compression ratio	-

Warnings & Notes

Read all warnings and notes carefully before applying any rules to a production environment.

⚠WARNING

- Medical image data compression codecs may become unsupported in the future, e.g. in more than 20 years. We, therefore, do not recommend using data compression for image archives as images may become unreadable many years from now. This could cause legal or health issues.
- The image entropy (content of information) can decrease if irreversible ("lossy") compression schemes are applied multiple times to the same image data, e.g. multiple compressions applied by iQ-ROUTER. We, therefore, recommend that systems be configured in such a way that multiple image compressions are avoided.
- No compression is recommended for SPECT nuclear medical images (NM modality) due to the low resolution.
- 8 bit grayscale CR, DX or MG images require special compression settings. We recommend that 8 bit grayscale images not be used in a production environment. Instead switch modalities to create 8 or 9 bit images at a higher bit depth, e.g. 12 bit. This can apply e.g. to AGFA CR images.
- We do not recommend using JPEG 2000 Lossy post-receive image compression in iQ-WEBX for any diagnostic purposes.

NOTICE

- The resources needed for image data compression usually exceed the advantage in performance for uncompressed image transfer if the available network bandwidth is higher than 30 MBit/s. We, therefore, recommend that data compression options be used for any medical image transfer if the network bandwidth is less than 30 Mbit/s in general, and to not use it if the available network bandwidth is >30 MBit/s.
- Thumbnails may not appear in iQ-X when using JPEG 2000 Lossy or JPEG Lossy transfer syntaxes for storing compressed images in iQ-WEBX.
- iQ-WEBX supports JPEG Lossy post-receive image compression for 8 to 12 bit grayscale images only. Change the modality to a different level of stored bits ("bits stored"), e.g. 12 bit, or the compression to JPEG Lossless generic compression for this modality.
- JPEG 2000 offers the highest compression rates but consumes very high CPU and memory resources. This applies mainly to high-resolution images.

Disclaimer:

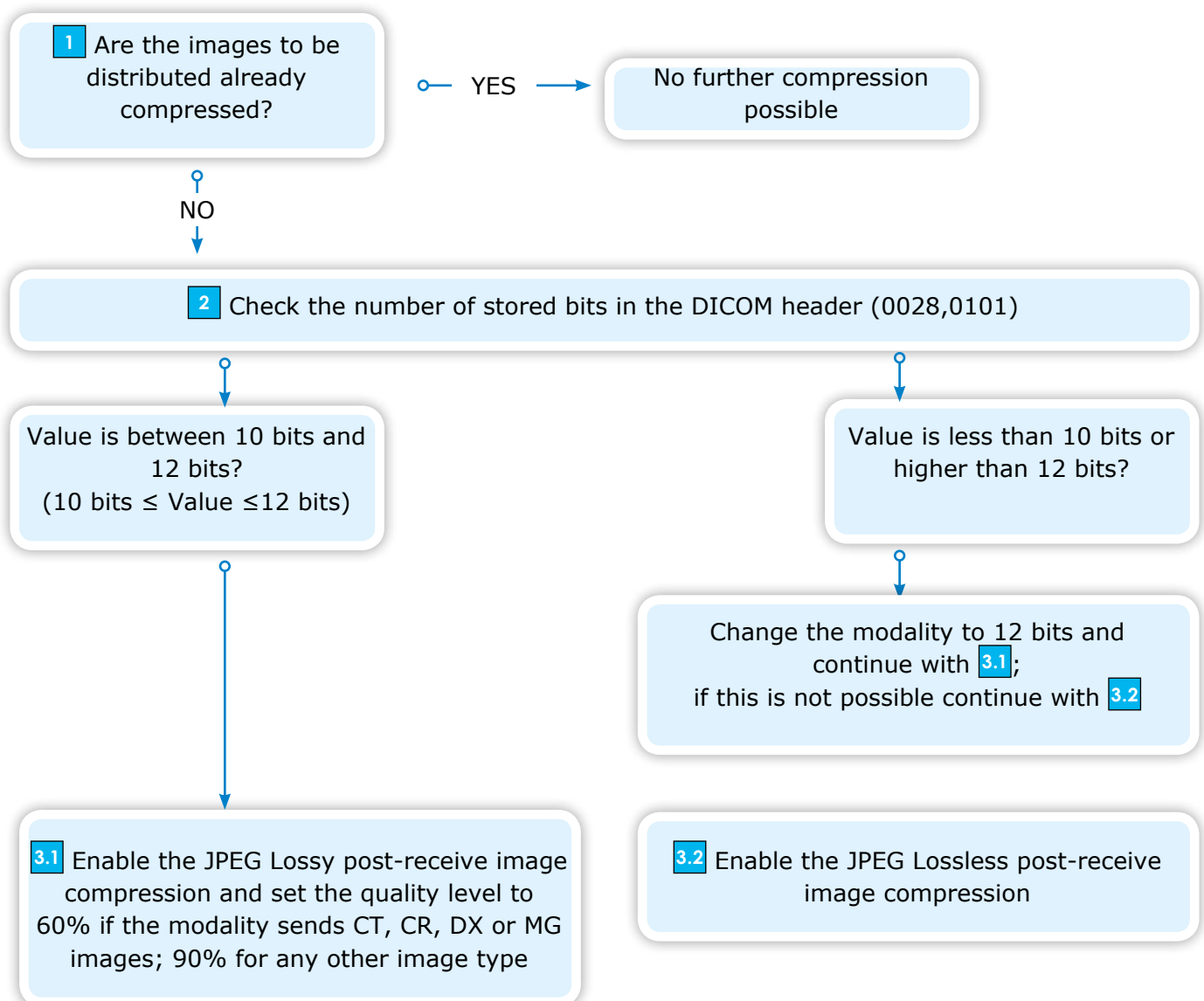
IMAGE Information Systems Ltd. assumes no responsibility for the information contained in this guide.

Data Compression Guide

Web based image distribution using iQ-WEBX 6.x



The compression settings must be adjusted for each sending DICOM device (remote AE) separately.



Data Compression Guide

Lossless Compression for VPN or DICOM SSL/TLS based image distribution using iQ-ROUTER 1.x or 2.x



1 Are the images to be transmitted already compressed?

YES

No further compression recommended*

NO

2 Use JPEG-LS Lossless image transfer syntax

* The image entropy (content of information) can decrease if irreversible ("lossy") compression schemes are applied multiple times to the same image data, e.g. multiple compressions applied by iQ-ROUTER. We therefore recommend that multiple image compressions be avoided.



Data Compression Guide

*Lossless compressed image archive using iQ-ROUTER 1.x or 2.x and iQ-WEBX 6.x ***



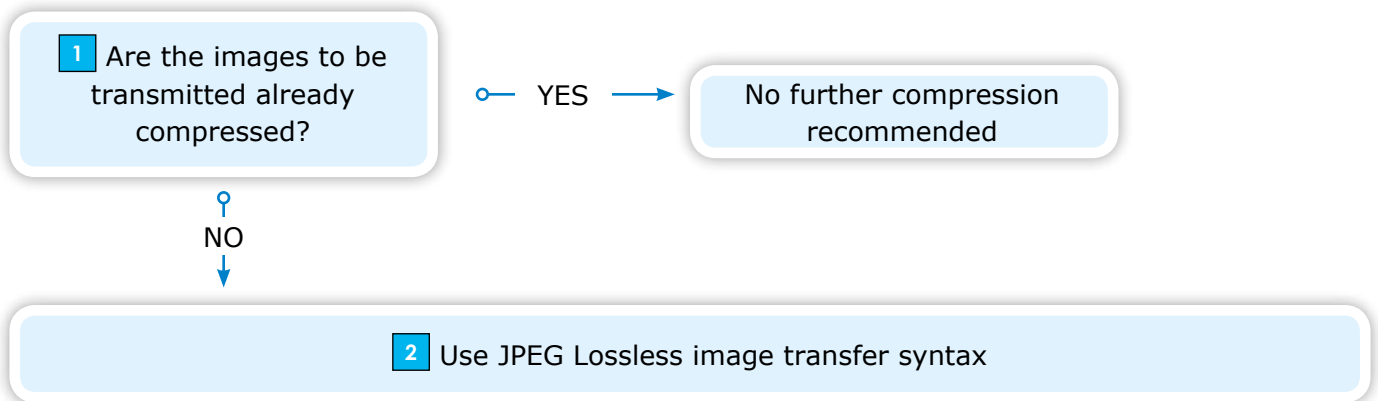
Modalities



iQ-ROUTER



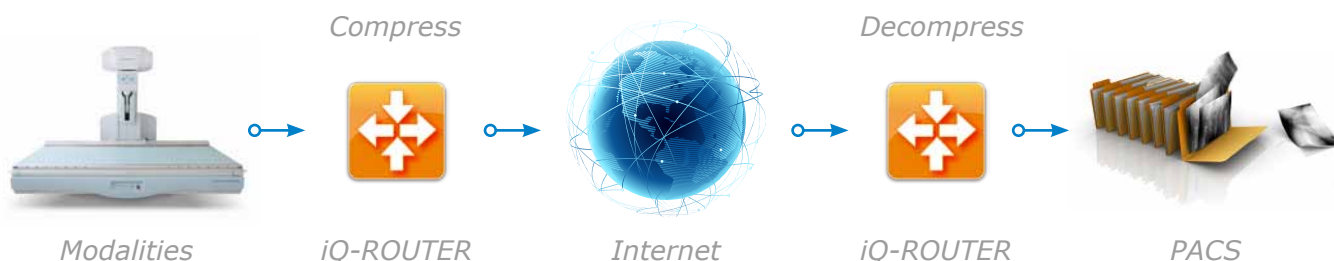
PACS



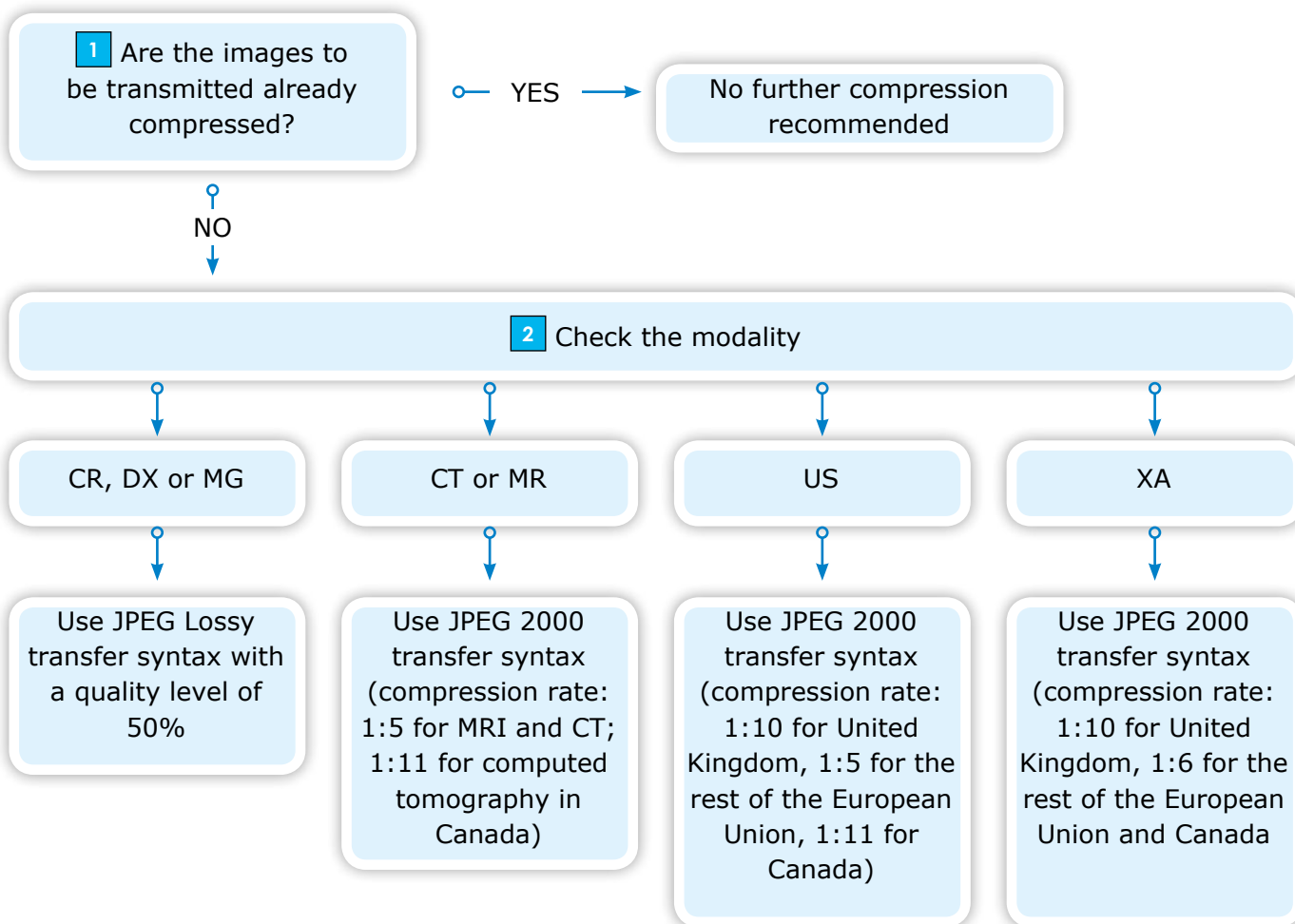
**Warning: Medical image data compression codecs might become unavailable in the future, e.g. in more than 20 years. We therefore do not recommend using data compression for image archives as images might become unreadable many years from now. This could cause legal or health issues. If the archiving of compressed images is desired anyway, we recommend JPEG Lossless image compression as this codec offers the highest reading probability in the far future.

Data Compression Guide

Lossy Compression for VPN or DICOM SSL/TLS based image distribution using iQ-ROUTER 1.x or 2.x



The compression quality settings should be adjusted globally in iQ-ROUTER. The compression type must be adjusted for each DICOM connection separately. If different compression ratios apply, use the lowest compression ratio (e.g. 1:5 if you transmit CT and XA images in Europe).



References & Links

Recommendations on the use of irreversible or lossy compression have been published by the radiological societies of Europe, Canada, Germany and the United Kingdom:

[1] European Society of Radiology (ESR, Austria)

“Usability of irreversible image compression in radiological imaging. A position paper by the European Society of Radiology (ESR)” (Insights Imaging (2011) 2:103–115)
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3259360/>

[2] Canadian Association of Radiologists (CAR, Canada)

“Pan-Canadian evaluation of irreversible compression ratios (“lossy” compression) for the development of national guidelines” (J Digit Imaging, 2009)
http://www.car.ca/uploads/standards%20guidelines/Standard_Lossy_Compression_EN.pdf

[3] German Röntgen Society (DRG, Germany)

“Compression of digital images in radiology—results of a consensus conference” (Rofo 2009)
<http://www.ncbi.nlm.nih.gov/pubmed/19115165>

[4] Royal College of Radiologists (RCR, UK)

“The adoption of lossy data compression for the purpose of clinical interpretation” (April 2008)
https://www.rcr.ac.uk/docs/radiology/pdf/IT_guidance_LossyApr08.pdf

