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Improve DICOM Network Transfer Times

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Improve DICOM Network Transfer Times

- Introduction
- How does DICOM Network Transfer work
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  - A-Synchronous DICOM Transfer
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Introduction

Trend:

- Faster Hardware
- More Storage
- Increased Network Bandwidth

Result / Observation:

- Number of Images / Exam is growing.
- However you see that transfer speed is not improving

You will even see that acquiring the data is faster then transferring the data.

How does DICOM Network Transfer work?

What's the problem?

Not the network because you will typically see that it's hardly used.

Further inspection learns that the synchronous DICOM handshaking is causing the delay:

```
          C-STORE-RQ    A    =>
<=        C-STORE-RSP   A
          C-STORE-RQ    B    =>
<=        C-STORE-RSP   B
          C-STORE-RQ    C    =>
<=        C-STORE-RSP   C
```

This is done for every DICOM object you transfer.

With default synchronous DICOM transfer you can only send the next object when you received back the answer of the previous object.

Possible Solutions

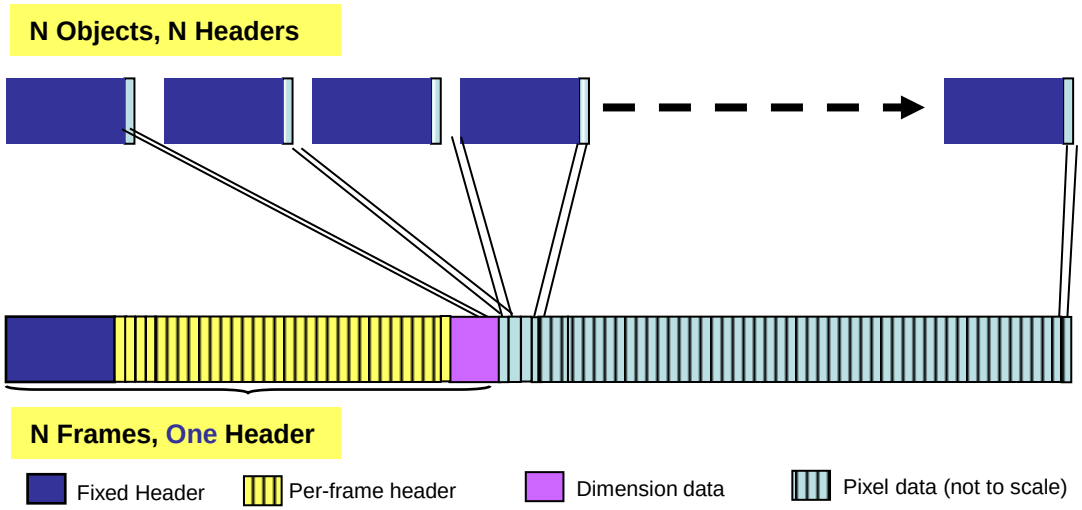
Find a way to reduce the waiting for each other.

How?

1. Send less objects
2. Use a-synchronous DICOM transfer

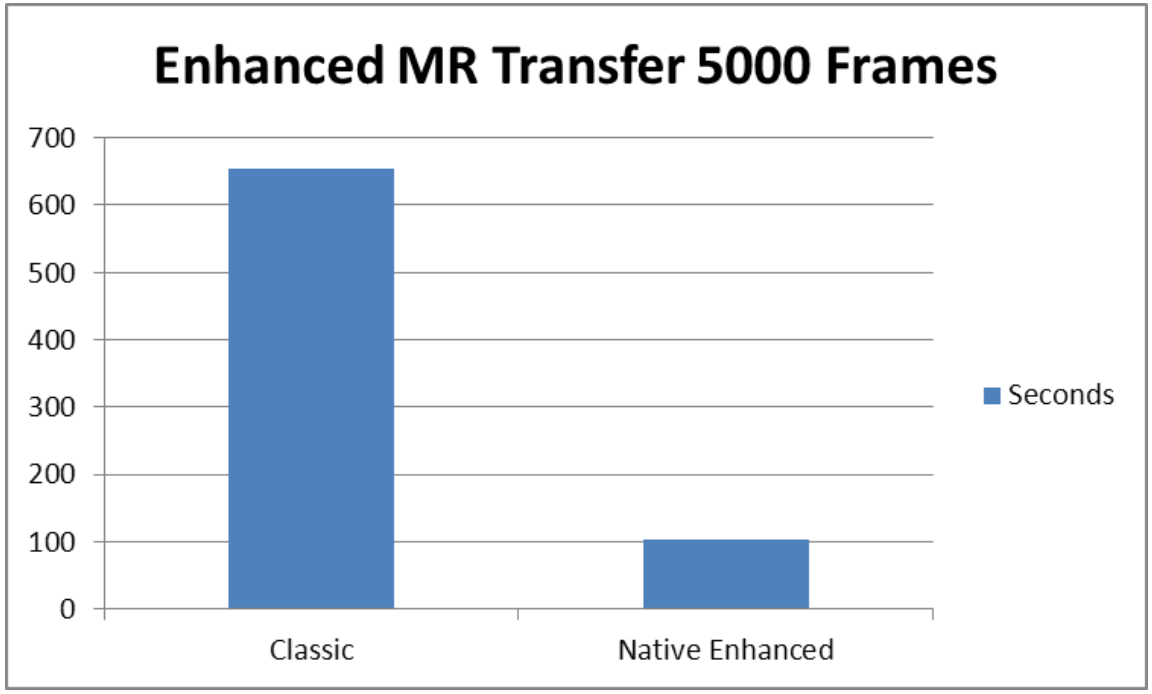
Use of Enhanced Family of IODs

The new DICOM Enhanced Family of objects gives you the multi-frame principle. Instead of n objects for a Series with repeating Patient/Study/Series information you have 1 object containing all information of that Series.



This way you only have the C-STORE-RQ / C-STORE-RSP one time instead of n times.

Performance Figures with Enhanced Family of IODs



We typically see an improvement on the usage of network to the extend that the hard disk speed is then the bottleneck.

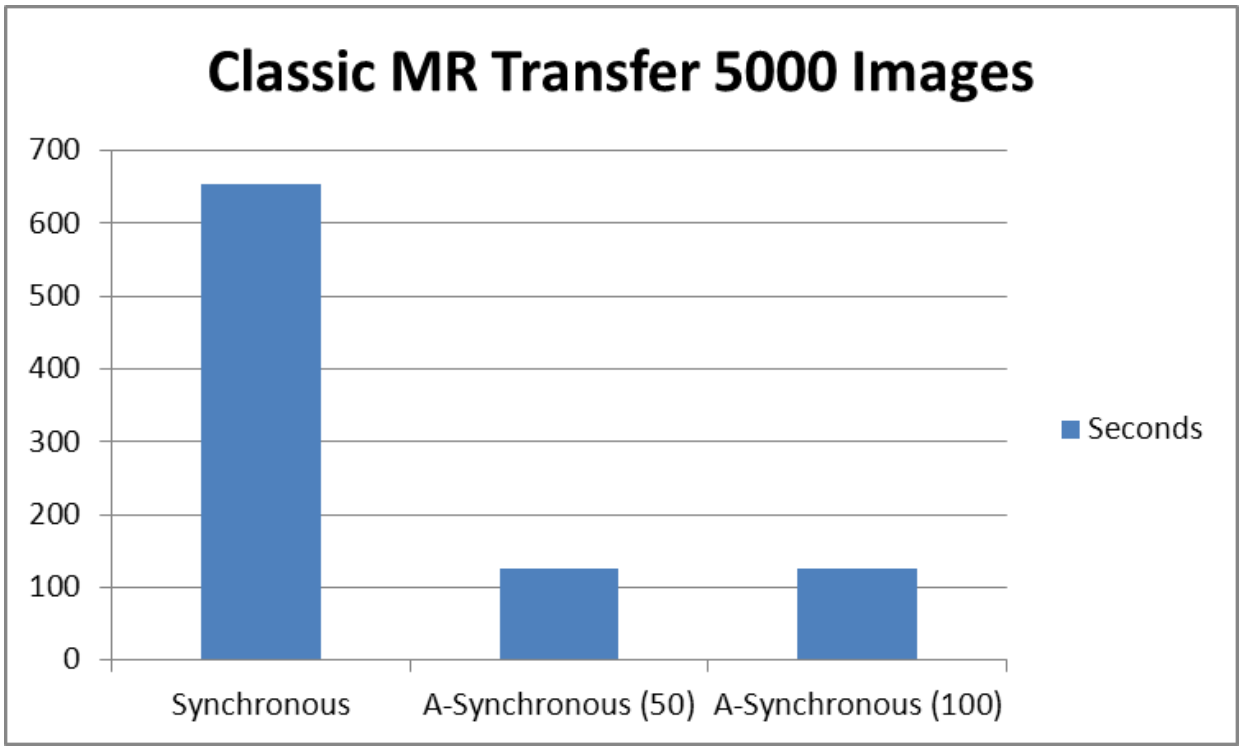
Use of A-Synchronous DICOM Transfer

Here you may continue to invoke further operations or notifications to the performing DICOM AE without awaiting a response.

```
          C-STORE-RQ   A     =>
          C-STORE-RQ   B     =>
<=        C-STORE-RSP  A
          C-STORE-RQ   C     =>
<=        C-STORE-RSP  B
<=        C-STORE-RSP  C
```

- Optional in the DICOM association
- If supported then maximum number of outstanding operations or notifications is negotiated during DICOM Association establishment.

Performance Figures
A-Synchronous Transfer



For your transfer improvement, there is turning point for the number of parallel DICOM operations or notifications you support.

Summary (1/2)

DICOM provides currently 2 ways to improve DICOM Network transfer times:

1. Using Enhanced Family of objects

Advantage:

- Better Interoperability
- Faster Transfer times

Disadvantage:

- Not wide-spread yet (chicken/egg problem)
- More effort expected to implement for senders/receivers

Summary (2/2)

2. Using a-synchronous DICOM transfer

Advantage:

- Possible with the Classic Family of Objects
- Faster Transfer times
- Easy to implement for senders/receivers

Disadvantage

- Not wide-spread yet (optional feature of DICOM association)
- One of the best kept secrets of DICOM (thus this presentation)

Conclusion

DICOM provides currently 2 ways to improve DICOM Network transfer times significantly:

- **Enhanced Family of objects, fit for the future but problematic for Installed base**
- **A-synchronous Transfer can speed up Classic (and Enhanced) Network Transfers considerably, but is not widely used yet**

References

http://dicom.nema.org/

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Thank you for your attention !