

Experiences in moving from CRT to flat panel LCD monitors for diagnostic PACS workstations

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INTRODUCTION

PAH and RBWH implemented PACS as part of the Queensland Health QPACS project that commenced in 1999. These implementations are based around the AGFA Impax® PACS, AGFA Web1000 for enterprise delivery and AGFA CR. Towards the end of year 2004 it was evident from QA measurements and increasing failure rates, that the original CRT monitors (see Figure 1) were rapidly approaching their end of life. This represented an obvious problem for the hospitals in terms of maintaining a soft copy based radiology service. It also represented a problem for the product vendor (Agfa) in terms of an ability to continue to service superceded technology, plus the cost of providing that service.

PACS Support had previously undertaken studies[1] to define the requirements of a "diagnostic" monitor. As a consequence of these studies and the aging of the original CRT monitors, a decision was taken to move to high brightness, high resolution, monochrome LCD panels.

In collaboration with the vendor a plan was developed to deal with this problem. The vendor proposed to replace the CRT display monitors with Planar C3i and Planar PX212 LCD monitors, under the existing service contract terms in return for a continuing commitment on the part of the hospitals to the workstation service contracts. PAH and RBWH were able to completely replace their inventory of CRT "diagnostic" monitors with Planar C3i monochrome flat panels (see Figure 2). This monitor was known from previous evaluations [2] to be a high quality image viewing monitor suitable for radiological diagnosis. The monitor replacement project was completed in December 2004 to the benefit of all parties involved.



Figure 1: Original Agfa supplied CRT reporting monitors. These were 1k x 1k 20 inch landscape and 1k x 1.5k 21 inch portrait monitors supplied by Agfa as part of the original QPACS installation.

Figure 2: Planar C3i monochrome LCD display monitors in clinical application at PAH and RBWH.



METHODS and RESULTS

• RBWH has 25 dual monitor DS3000 with B&W monitors, 1 DS3000 with dual colour monitor needed for colour display of Doppler Ultrasound and 1 XA3000 in Coronary Care Unit with single colour monitor need for display of cardiac Ultrasound images.

• PAH has 17 dual monitor DS3000, 2 quad monitor DS300, 2 dual monitor CS 5000 (all with hi brightness monochrome displays) and four dual monitor DS 3000 with colour display.

• 53 monitors were replaced at RBWH (50 C3i, 3 PX212 Planar Monitors).

• 54 monitors were replaced at PAH (46 C3i, 8 PX212 Planar Monitors).

• Display cards used were:

Monochrome Display: Planar DX2/pci dual display card.

Colour Display: Matrox "Med" dual display card.

• All monitors were set up in portrait orientation at preference dictated by radiologists.

• All monochrome monitors were configured with luminance of 500 cdm-2

• Colour monitors were matched and configured to maximum luminance of around 200 cdm-2.

• Very positive feedback regarding image quality was received from radiologists.

• Centralised monitoring via Simple Network Management Protocol (SNMP) is performed by PACS support (see Figures 3, 4 and 5).

Monitor	Target	Current	Alert	Unit	Block	Bright	Target	Current	Alert	Unit	Block	Bright
0001	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0002	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0003	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0004	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0005	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0006	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0007	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0008	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0009	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0010	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0011	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0012	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0013	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0014	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0015	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0016	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0017	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0018	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0019	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0020	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0021	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0022	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0023	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0024	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0025	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500

Figure 3: SNMP monitor status web page at RBWH. The red alert indicates a possible error status. In this case it is a warning associated with the white level zero result as these monitors were "asleep" at the time of the test.

Monitor	Target	Current	Alert	Unit	Block	Bright	Target	Current	Alert	Unit	Block	Bright
0001	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0002	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0003	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0004	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0005	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0006	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0007	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0008	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0009	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0010	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0011	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0012	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0013	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0014	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0015	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0016	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0017	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0018	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0019	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0020	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0021	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0022	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0023	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0024	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0025	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500

Figure 4: SNMP monitor status web page at PAH. Again the warning status is due to the respective monitors being "asleep" at the time of the test.

Monitor	Target	Current	Alert	Unit	Block	Bright	Target	Current	Alert	Unit	Block	Bright
0001	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0002	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0003	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0004	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0005	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0006	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0007	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0008	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0009	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0010	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0011	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0012	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0013	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0014	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0015	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0016	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0017	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0018	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0019	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0020	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0021	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0022	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0023	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0024	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500
0025	500	500	Pass	Pass	Pass	500	500	500	Pass	Pass	Pass	500

Figure 5: Monitor status and activity data for a single PACS workstation (Quad monitor configuration).

All monitors were acceptance tested to provide baseline performance data (see Figure 6). Ongoing QA is managed using auto calibration functions. Tests performed include conformance to the DICOM response function, and luminance measurements. The results are collected centrally via Simple Network Management Protocol (SNMP). This has removed the need for physical access to each monitor for manual calibration. Independent QA testing by medical physics based on TG18[3] is planned annually.

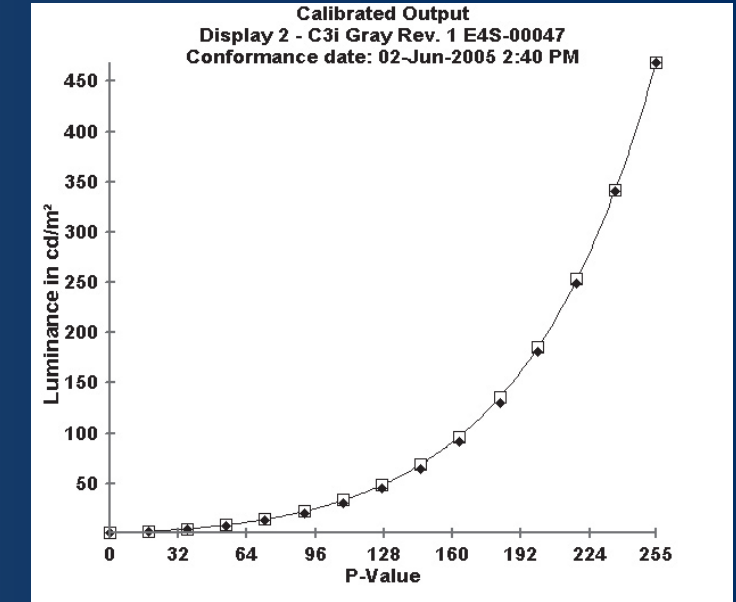
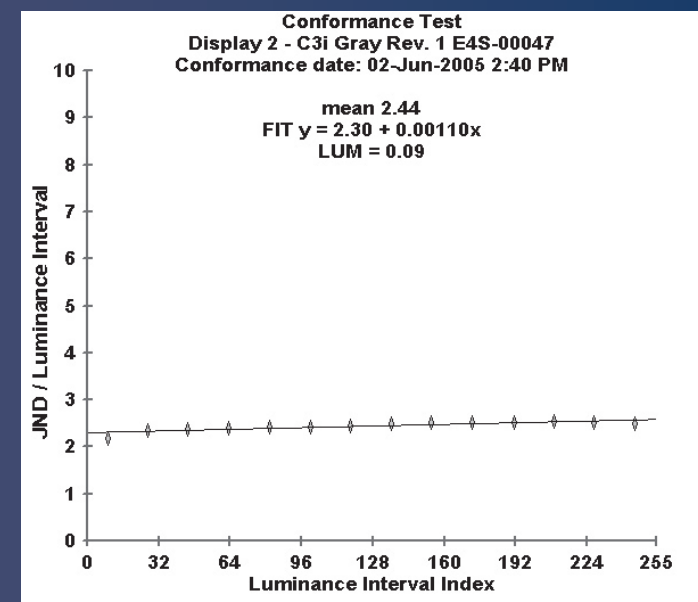


Figure 6: Typical Grayscale conformance curves for Planar C3i monitors.

PROBLEMS EXPERIENCED

- Monitor flickering resolved by new video card on one DS3000.
- 1 Monitor has been replaced by manufacture in accordance with the bad pixel policy [4].
- Unable to run Quad displays initially. Problem was referred to Medilink (local agent) and then to Planar. Resolution of this issue involved the development by Planar of a driver modification for the Impax display software.
- Post installation support by Medilink has been proactive with rapid response and good escalation processes. All issues raised have been resolved.

FUTURE

- Planar C3i and PX212 image monitors have become the "de facto" standard monitor for future diagnostic stations at these institutions.
- Studies are progressing to compare the diagnostic efficacy of the C3i monitor against the PX212 monitor for computed radiography reporting of chest images.
- Diagnostic stations to be used for Digital Mammo will use the Planar C5i (5 megapixel monitor)

CONCLUSION

Clinical acceptance of the new monitors has been enthusiastic. The respective radiology departments at PAH and RBWH now have uniform high quality "diagnostic" monitor technology with images presented to the radiologist on monitors with demonstrated consistent performance settings.

REFERENCES

- [1] Sim L., Manthey K., Esdaile P., and Benson M., Comparison of Computer Display Monitors for Computed Radiography Diagnostic Application in a Radiology PACS, APESM, 27 (3) (2004) 148-150.
- [2] Bleazard M., Monitor Performance Evaluation Report – Planar C3i AMLCD, Biomedical Technology Services PAH, Internal Report, (June 2004).
- [3] AAPM TG18, Assessment of Display Performance for Medical Imaging Systems, Task Group 18 Report, Pre print Draft Version 10, (2004).
- [4] Planar Corporation, Planar Bad Pixel Policy, (Supplied by Agfa), July 2004.

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