The Last Great Analogue System (part two)

This project took four years in the doing. Clearly, over such a time span there would be a lot that happened and much of which might be interesting from a CCTV industry perspective. In Part One I indicated that we used "off the shelf" equipment, but integrated all these separate components into what is now a somewhat unique operational service. In this, Part Two of the story, I will now touch on a number of specific design aspects and perhaps one or two things that may be considered "odd".

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Last month I introduced CCTV Focus readers to the Australian Customs Service's National Waterfront CCTV project. This is the important venture embarked upon by Customs and which involved placing an operational CCTV network around the main ports of the Australian coastline.

While this was an operational service from end to end with cameras sending video back to monitors at the Customs Houses, it is underpinned and was only made possible via a significant installation exercise, which drew together many facets of surrounding technologies.

Customs had invented the wheel in an important sense, in that we had already placed seaport cameras in the state of Victoria. We did this prototype in the years preceding 1998, so we knew the investment was worthwhile operationally and we had learnt a lot technically. But there are no iron ore berths, or coal terminals, or bauxite loaders in Victoria. The gangways don't rise

or fall by several fields of view in Victoria riding on the tide, or otherwise disappear as a ship fills with its red dirt. There are no wet seasons, or cyclones, or crocodiles to be found in Victoria. A day's driving will just about get you around the coast from a NSW motel to a South Australian motel with lunch in Melbourne, but a day's driving will be flat out getting you to the twenty yard line in Western Australia or Queensland. There was much uncharted territory that lay ahead and there was no handbook to guide us. In CCTV terms this was indeed a bold venture.

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Our large customised dome in a prime location atop a silo, overlooking one of our major port wharf areas, certainly falls into the latter category. Strongabuilt in Brisbane manufactured and installed this very large dome, which houses a Fujinon 44X broadcast zoom lens. This dome is remarkably stable and remains unaffected by strong winds, and we can use the full zoom range with little or no scene movement.

For obvious reasons, R2D2 is our nickname for this odd camera housing, but Customs does not want to get drawn into any patent issues, so of course this is not its official nametag.

I wonder if this is the largest CCTV dome in existence. Maybe a TV station has a larger housing somewhere atop their building's roof looking for weather reports? It may be interesting for CCTV Focus readers to report back to Vlado if there is a bigger CCTV camera housing in another part of the world.

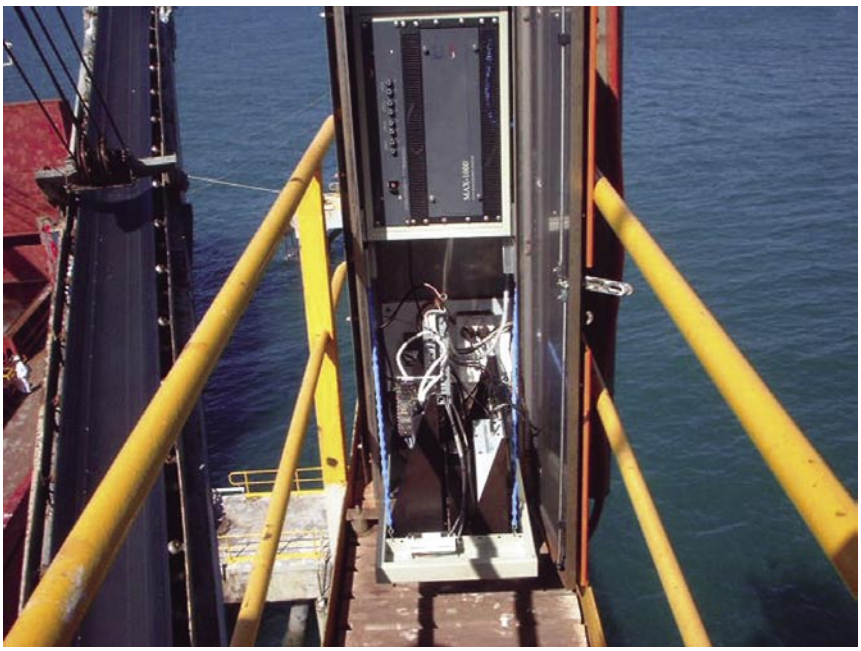
The waterfront environment is very

The largest customised camera housing - "R2D2"

dirty in electrical terms. There are high voltages and currents powering the large portainers (port containers) and conveyor belts, lifts in silos, high wattage lights, etc, etc, etc. As a fundamental design concept we used fibre at all front end locations to join the camera up to the central wharf hub. If we had chosen to critically review each camera to identify some places we "might get away with" a cheaper co-axial connection, perhaps we could have initially saved a few dollars. But for each one of these "initial savings" where we got it wrong because there was an unknown high voltage cable in the next conduit, or even if a later wharf redevelopment/ expansion there caused interference to our existing picture, then downstream we would pay much more than any initial savings, both in additional administration and fault finding dollar terms, and installation correction dollar terms to sort all this out.

Another area where we played the cautionary card was in our choice of the type of pan tilt heads for our larger long focal length lens standard

"Rock a bye baby"



An odd spot for a switcher and a cabinet

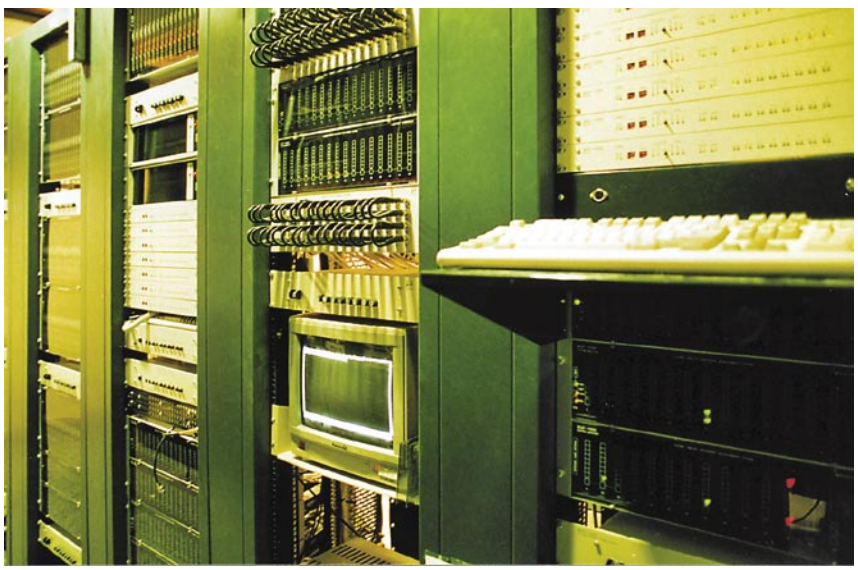
housings. Four years ago, I had no doubt that 360-degree pan tilt heads were advantageous for all the obvious reasons. They would be operationally better with no dead pan spots, and would be easier and cheaper to install regarding the trailing cabling that is associated with 355-degree heads. But I was not game enough to trust the slip ring technology in this marine environment of salt air and other bulk dusts that could potentially get into the ring's electrical contact area, either normally or during later maintenance. I'll never really know, but if slip rings couldn't handle the harsh waterfront environments across Australia in the long term, then our subsequent operational down time and remedial maintenance bills would have been very hard to justify.

We have a lot of MAX-1000 switchers around Australia. The majority of these reside at wharf locations, such as electrical switch rooms or wharf sheds. Each switcher has a CPU, and some Maxpro cards even have their own microprocessors. Even though the equipment cabinet is top shelf and squeaky clean inside, there remains the fact that we are wholly dependent on local mains supply, even if we use a UPS. Now if a CPU microprocessor locks up (has your home computer ever locked up!) then we are out of business - as well as the financial cost of a maintenance call out for the technician to probably only turn up and switch off/on the equipment. The foregoing issues will be magnified if the fault location is in a remote area.

We automatically self-correct as follows: a standard MAX-1000 output card is programmed to give a pulse out every several minutes. This pulse continually resets a pneumatic timer whose contacts are in series with the cabinet mains supply (and of course after any UPS). If two consecutive Max pulses are missed, the timer does not reset and so after seven minutes it times out and cycles by disconnecting the mains for a short period and thereby cold boots the equipment cabinet inclusive of the MAX-1000 CPU. So if the CPU is locked up, we won't get any output pulses and it will automatically cold boot within seven minutes. This cold boot resets the MAX-1000 CPU and we are back in business maybe without knowing we were ever out of business. This is an excellent outcome in all of the circumstances.

We have a maintenance terminal at our Canberra Technical Services Centre. This terminal has dial up ISDN access into all the regional systems. From Canberra we can control any camera and we can access the current error log, or select and view the various switcher menus. This remote maintenance terminal is invaluable in allowing us to determine a fault area (or non-fault area) and then issue more focused instructions to a maintenance entity several thousands of kilometres away. But most valuable is that from Canberra we can target

The hazards of salt berths



MAX-1000 - The heart of the system

District office console

and warm boot any of the national Max-1000 CPUs. In any modern large scale electronic system, where there are microprocessors cascaded throughout the hardware, being able to warm boot often will fix a fault that might otherwise be unusual in nature. Even if a fault does not happen very often (which is desirable), to be able to fix a problem in Port Hedland from Canberra at the cost of several minutes of online ISDN time is a much better outcome than flying a technician from Perth to Port Hedland. It is quicker too, with less operational down time. We can also change the camera HOME positions from Canberra.

We have introduced some simple, but useful customised keyboard features. A single press of separate keys "Zoom Tele" and "Zoom Wide" automatically operate the lens to zoom right in, or right out. "Speed Slow" and "Speed Fast" varies the pan/tilt speed up or down. A very slow speed is vital to be able to slightly adjust a long focal length lens just a bit this way, or that to get the scene just right. "Home" is most useful. "Home" is just an underlying preset position. Each camera has been commissioned with a wide-angle, general purpose HOME position. A single keyboard press will bring the camera on display back to this "starting position". This is most useful for remote operation over ISDN at night. If a camera is panned into a dark area and tilted, it is not hard to get lost or confused. Now a single press of the "Home" key will automatically bring the camera back to the bright lights of the wide-angle general wharf FOV (Field Of View), and we can start again.

CCTV cabinet in the dust

Setting remote focus or zoom adjustment over a slower update ISDN service can be very frustrating. This is so if the lens focus adjustment is fast – you are forever overshooting the mark. For the most part we have physically inserted dropping Zener diodes into the lens zoom and focus DC control lines. This lowers the drive voltage to the lens motors and slows down the focus and zoom adjustment and also makes this remote adjustment more ergonomic. A nice touch.

I know that very few CCTV systems will have anywhere near the number of underlying microwave links that we have, but even if you have only a few links, I put forward the following design concept. What do you do if the communication authority tells you your microwave is interfering with the people on the other side of town? Well, the most useful information to be aware of would be whether this is true, or false. If, at installation design, you have wired your comms circuit to remote control the 12V supply to your individual microwave transmitter, you can switch it off from the comfort of your control room, rather than catch a bus and a train and climb the mountain to physically switch it off. Is the interference with the other party still present? Alternatively, if we experience interference to ourselves, we can switch our own local system microwave transmitters off from the lounge room and turn them back on, one by one. When does the interference reappear? Or does it not go away at all, which would indicate it coming from "outside"?

The two key design criteria here are (a) to embed this maintenance on/off facility into deep cover so the user cannot accidentally turn the microwave link off, and (b) to make sure the initial design does not turn the main comms link off with the microwave video circuit, or you won't be able to switch it back on again.

If we have no picture: is it a camera fault, a switcher fault, a microwave fault, or is it an unknown fault? The microwave receiver RF unit inside the dish is normally way up high on the tower or a roof, so it is often difficult to get up there just to measure the AGC or DC Volts reading to quickly determine if the RF link portion is working OK. On the other hand, if these high-impedance signals have been cable extended to the control room at initial installation, a control room operator can glance at the meter reading and advise us in Canberra, several thousand kilometres away, that effectively the microwave circuit is either OK, or crook. A maintenance technician can easily notate these readings at each regular routine service. We actually leave these AGC cable extensions normally disconnected so that they don't act as lightning magnets. We only momentarily connect them for "reference purposes" via a momen-

tary "On" switch in the control room, which operates a connection relay at the dish end.

The master MAX-1000 at our National Monitoring Centre (NMC) in Melbourne is connected to a very accurate master clock. The Max-1000 architecture allows a master switcher to synchronise a downstream switcher time-wise. Each Sunday and Monday morning at 3 AM, the NMC system automatically rings up each national site sequentially and updates any intermediate small-scale time drift. This automatic test process also flags if a site won't connect for some reason. We share this over two days because of the large number of remote sites involved. There is underlying software programming in place that works out if any, or how many, sites are currently online operationally, and then determines if this time synchronisation cycle should not proceed, lest we use up the remaining vacant operational channels. The trick in all this is to allow for time zones and daylight saving changes between the states (after all, Australia is a big country…). As is often the case, this type of start up programming can be exhaustive, but once in place will last forever.

Operating PTZ camera services over a narrower band ISDN link has a number of limitations compared to normal full bandwidth camera access. You have no hope of manually panning a full screen high-resolution

Par for the course

display camera over a 64kbit channel. The camera will physically move normally with the pan command, while the remote display screen will show you where it was pointing one or more seconds ago. The Adpro equipment uses a few nice tricks to deal with this problem. It senses a joystick or mouse PTZ command and shrinks the screen to 1/8 size and sends this lower volume of data at the lower bit rate low resolution. Thus it can keep the 1/8 monitor section remote picture display fairly current with where the camera is actually pointing. For focus adjustment, it shrinks the screen to the central 1/16 portion and is therefore able to send this very small amount of video at the highest resolution over the narrow band ISDN link, so that you can see and effectively adjust the focus changes in real time. While presets are essential for remote narrow bandwidth CCTV services, it is the case that for manual PTZ operation some consideration must always be given to this important camera control area. Some other modern digital transmission products have taken this important consideration into their designs and can now cope fairly well with remote PTZ control over a narrow band ISDN circuit.

I am not wholly current with the modern IT video transmission systems that are emerging, but I am aware that some of these have an inherent latency. Any latency over 250msec would start to be an issue for manual PTZ control. If you are panning or focusing and the scene lags to the extent that it is noticeable, this might cause user operation problems and uncertainty at the instant of PTZ control.

So we arrive at our day/night design parameter. With auto iris lens such as we have, at dusk the iris opens, the Depth of Field (DOF) decreases and the recorded scene will almost certainly go out of focus overnight, but magically will come back into focus the following dawn. If you are time lapse recording, you may notice this "mysterious" circumstance occurring. This presented a fundamental problem in the performance theatre we were operating in. This is how we dealt with it:

We have two camera/lens operating modes. These are normal auto iris mode and what we call 'day/night mode' or D/N. This latter is where we switch the camera to its internal auto electronic iris mode and open circuit the white lead of the auto iris lens, forcing the iris wide open. This switching is effected via relay contacts operated from the nearby site receiver. The camera does the light management whilst in this D/N mode of operation as the lens iris is wide open. Now of course we are also at minimum DOF, simulating night-time. So if we switch to D/N mode (a single keyboard button press) we can set the focus for "worst case" night-time conditions in the daytime, and now set our time lapse VCR to record and go about our business elsewhere, knowing that our recording will always stay in focus overnight. A single keyboard button press reverts the camera/lens to normal auto iris mode.

An unexpected bonus of this D/N

Wharves and cameras more than 4km out to sea

design was that, while the D/N mode was supposed to only be necessary for the short period while adjusting day-time focus for a night-time time lapse recording, we have since found that, in certain lighting situations and combinations, the D/N mode of operation gives a far better scene presentation than the normal auto iris mode. We can now switch between the two and see which picture is best. Also, while not a mainline design parameter, the

PTZ dome tilted up to see above the horizont

narrower DOF circumstance of the D/N mode also means that dirt and blotches on the housing faceplate or dome are out of the lens focus range, and not so obvious on the monitors as they are in the normal auto iris mode.

The auto focus feature of modern mini-domes should make the foregoing D/N design concept obsolete. But be careful, as you wouldn't want a dome that only ever auto focused in response to a physical joystick movement, or otherwise auto focused in the changing light conditions to something other than your area of interest.

We haven't used housing washers in this project. We believe the advantage that may be had from time to time is seriously outweighed by the disadvantages such as the breakdown of this physical motorised jig, insects blocking water outlets, water pipes falling apart from UV radiation and of course, the enormous overhead of having to fill the water tanks around Australia. If the tank is at ground level for fill-up access, we have another pump issue of getting the water upstairs. We recognise we just have to clean our camera domes and faceplates more often. Mind you, we learnt this the hard way as we did have washer services in the prototype Melbourne waterfront design.

We do have wipers, but these are software programmed to only give a three second wipe and then automatically stop. If it is really heavy rain, the camera might struggle to see anything anyway. However, a three second wipe cycle can usefully clear the faceplate in lighter rain. If we had designed for a manual on/off wiper control, it would have been inevitable for wipers to have been left on indefinitely, and the motors burning out and the wipers damaging or scratching the faceplate. In an operational situation it is reasonable to switch away from a camera and then be overtaken by events and forget to turn off the wiper on the camera that's not on the monitor. Likewise, the consequences of an ISDN circuit being disconnected with a remote wiper still in operation are self-explanatory.

One of the most unexpected problems we encountered was the quality of the spot filter material of some large lens brands. In an early installation site I noticed the seemingly poor quality of the picture on the monitor. After a deal of testing, manipulation and theorising, we determined that the spot filter material was causing optical degradation. The night-time picture (auto iris wide open) was very good, while the daytime picture (auto iris stopped down) was very bad. In the daytime when in auto iris mode we had a bad picture, whilst in the night-time when in D/N mode we had a very good picture. Theoretically, the narrow DOF D/N scene should have been a lower quality picture compared to the richer, wide DOF auto iris scene. Not so, and in fact the opposite was true. Our D/N mode came up trumps and led us to the reason for this anomaly, which was that the lens spot filter material was of poorer quality. In the daytime the camera was looking through this series material, which was taking the edge off the picture. The magnification inherent in the long focal length lens amplified this auto iris situation, and the D/N feature evidence was unarguable. To the credit of the lens manufacturers, they replaced all of the faulty lenses with spot filters of better material. It is probable that this project picked up on this situation because we are wholly involved with outdoors and long distances.

Placement of cameras in this project was not so straight-forward. The primary parameter was operational FOV but we always kept in mind future maintenance access. If a camera had a fantastic field of view, but we needed a cherry-picker on a busy terminal each time just for 180 seconds of maintenance access to clean the faceplate, then this location may not look so rosy. In this harsh marine and industrial environment, it was reasonable to expect things to break down more often over their lifetime than might otherwise happen in say a city central car park installation. So,

Gangway via microwave

in many cases we outlaid the upfront dollars of installing maintenance access ladders, which would return cost savings with less overall future plant hire requirements.

I have no doubt that, in some small ways at least, this project has impacted on the depth of the Australian CCTV industry. It is fair to say that all associated with this project have learnt something new, and some may even better understand some CCTV operating principles and/or sound maintenance concepts for the experience. For my part, I may take this final opportunity to refer to some areas that I have become more familiar with:

- The customer contracts for certain standards of goods and services, and if the technician hasn't back-focused the zoom lens correctly before the cherry-picker departs and the wharf resumes normal commercial operation, then there will certainly be later costs and administration overheads

for someone to make a second visit to put things right.

- There can be a difference between a contract manager and an engineering manager (read 'quality control manager'). The two can be the same, and often are with no problems, but when the contract manager is not the engineering manager (or if there is no engineering manager) and does not work closely with the front end installation team, then unnecessary issues can arise.
- If the installation company connects a camera to a fibre circuit, then to a picture in picture unit, then to a microwave link, then to a switcher, then to a monitor, and only tests the completed 'end to end' circuit for the industry standard video measurements, they are likely to run into later service issues which may cost time and additional money to backtrack and put right. On the day, one might get 1Vpp camera video at this 'end to end' testing, but the actual service may later deliver poor video quality at different times. It is possible that the series circuit transmission components are themselves not set up exactly to specs, with intermediate transmission section levels perhaps being up/normal/down/normal/normal, etc. So, at night, the low transmission section will darken the video, and then tomorrow at bright sunlight another high transmission section may overload the transiting video signal, when on a cloudy afternoon it may seem OK, such as when the 'end to end' testing was done. When installing even a minimally complex CCTV system it is important to understand the concept of system building blocks and the need to test each block separately and correctly. Of course the installation technician requires proper test equipment to be able do this properly. It is unfair to expect the installer to deliver an industry standard product if they are not tooled up properly.

A prime location for a camera but large lens necessary

Customs reached the finish line and this is a credit to all involved, but yes there were some difficult times along the way, which in some instances need not have been the case. I can rightly highlight the importance of the connection between the contract manager and the front line technical staff, or sub contractors, and the concept of "quality control." If this connection is elastic or has serious latency, then unnecessary angst may ensue with the client. Of course in a high-end project like ours, it was important to have installation contractor staff who were familiar and capable CCTV engineers and installers. Polished expertise, but which is orientated to say putting a man on the moon, may not always be relevant to the cause at hand if this latter is delivering a fully functional CCTV service.

The video IT revolution will void some of the analogue related installation parameters such as we have experienced in this project, and it will translate some others into other technology domains - but not all. Video technical appreciation, understanding and experience will still remain crucial elements to the success of future large-scale CCTV projects. No matter what, 'bad video in' will still give you 'bad video out', and once video detail is lost if transiting limiting transmission or storage mediums, it is gone forever with no return.

CCTV Focus readers who may be managing CCTV installation projects should not undervalue the worth of attuned technical documentation supply. There is a cost to this, but it is money well spent and will likely save on maintenance dollars later on. This premise echoes the published comments of Charlie Pearce in this same area. I hold that ten pages of detailed schedules and complete block diagrams and cable drawings showing all inter-cabling information in all detail and presented in a simple folder can be much more valuable than say, 100 pages of general commentary bound with an impressive front cover. Equally, specific plain English descriptions of how particular and unusual circuit designs work or are programmed is also very important.

I present this final proposition:

During the installation phases, at some point in time the installer must be aware of every aspect of the actual physical installation. Accurate technical documentation supply should therefore only be an exercise involving the installation entity transferring the material they already have in their possession, to a format suitable for documentation presentation. That is all. There should be no excuse for incomplete installation detail being presented at works end, save that the installation entity didn't record the particular details when they earlier had that very information right in front of them.

May I give a final mention to Customs engineering officer Steve Collett, who has proven to be so important and valuable in the latter stages of this project. Equally, our National Monitoring Centre Melbourne Customs staff deserves special mention. It has evolved that these officers are best placed to deliver our in-house user training and they have managed this task admirably. These NMC officers are now experienced CCTV users and I rate some of these folk as probably more attuned VMD operators that even the manufacturer might have imagined possible. The Australian Customs Service is fortunate to have such in-house talent available. [•]

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