PLC based dome control system in the WHT:

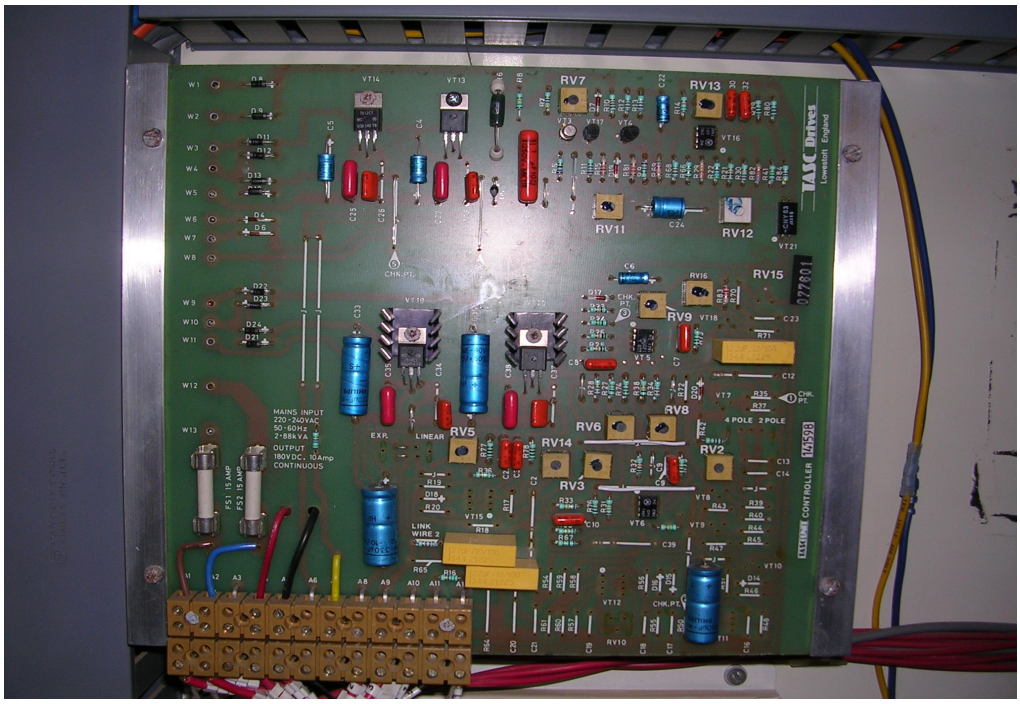
Scope:
This documents describes the new dome control system in the WHT, replacing the originally installed, obsolete TEM-L system.

Introduction:
The original dome control system in WHT consisted of telemetry equipment, which provides the facility to transmit contact states and TTL levels between the telescope control system (TCS) and the dome via CAMAC. The principle is based on so called: Time Division Multiplexing, transmitting serial words over a pair of wires, through the slip-ring into the moving part of the dome. A similar system is used in the INT.
The original system called TEM-L, was supplied by M.L. Engineering. This system is based on different modules with TTL electronics, which was designed and manufactured in the late 70's. Spares boards are difficult to get and in the mean time the system getting towards the end of its reliable life. A recent fault in the WHT was that the dome started moving by itself, with the telescope in engineering mode. Therefore a replacement system was justified.

Original system:
It has to be noted that the original design of the TEM-L system for the WHT was designed much more complex than ever used, as it also included the operation of the shutters and shutter-encoder feedback for computer control. This made up the total amount of bits to be transmitted of about 100.
However, shutter control and encoder feedback was never implemented, so 2 of the 3 TEM-L wall boxes in the dome have been made redundant.
In the original system, there were 11 bits send by TEM-L from the control room to the moving part of the dome, using a slip ring system. Two decades of BCD-data representing the speed the dome has to be driven. 1 bit for CW drive, 1 bit for CCW drive and 1 bit to switch the motors on. This data is coming from a CAMAC output driver, OD48 which in its turn is operated from the TCS. The data send from the dome back to the control room is only 2 status bits: Remote and Power on. The BCD-data

Picture 1: Dome slip rings

representing the speed, is converted into an analog signal by means of a digital to analog converter, this analog signal in turn is fed into the TASC unit, to drive the servo system to control magnetic clutches which in turn connect the motors to the dome drive system.



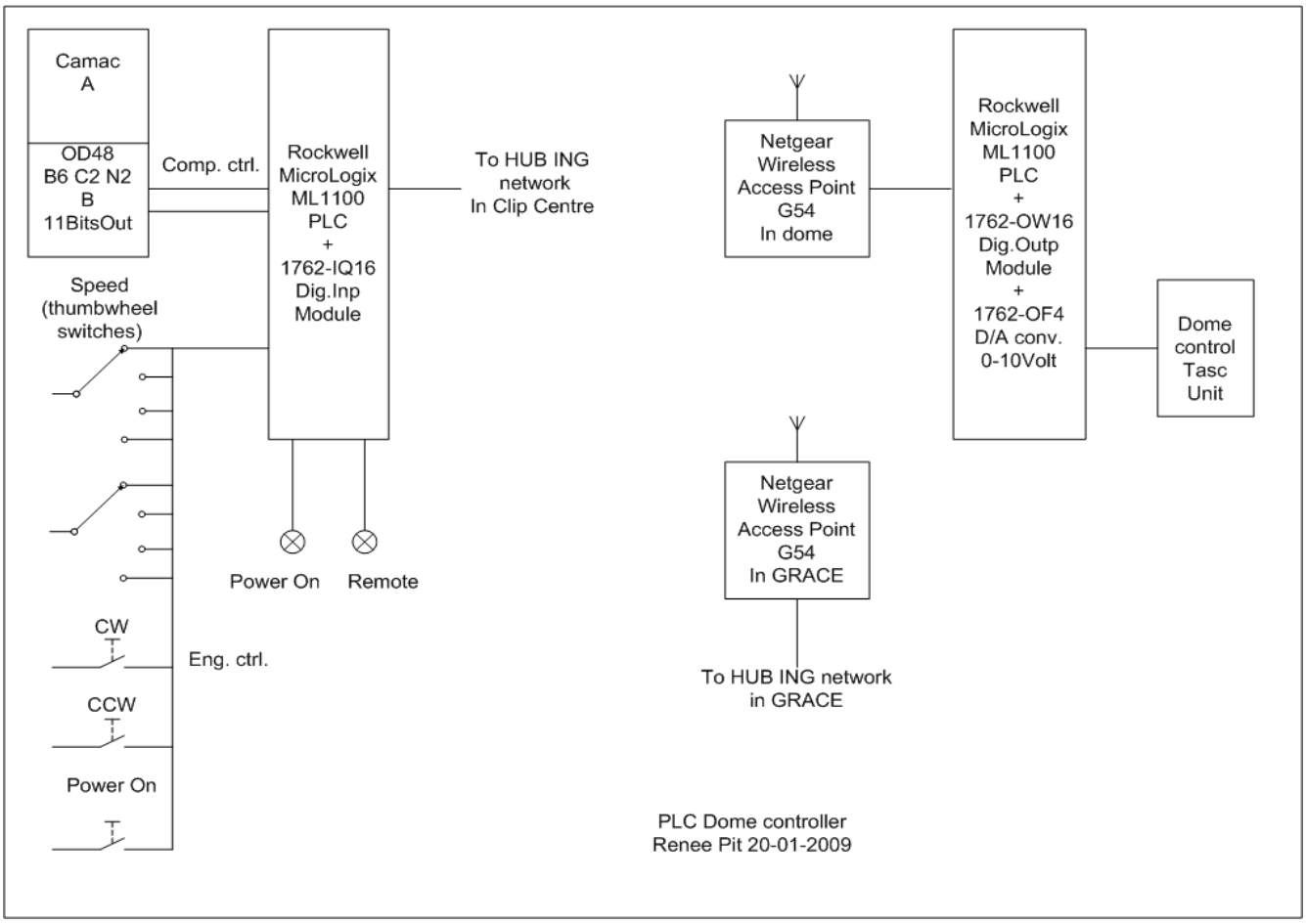
Picture 2: TASC unit in dome cabinet

There is a second TEM-L system in the back of the engineering desk which is used for manual control of the dome, by means of push-buttons for direction and thumb-wheel switches for speed. Change over is done by a relay operated by the Engineering/Computer signal.

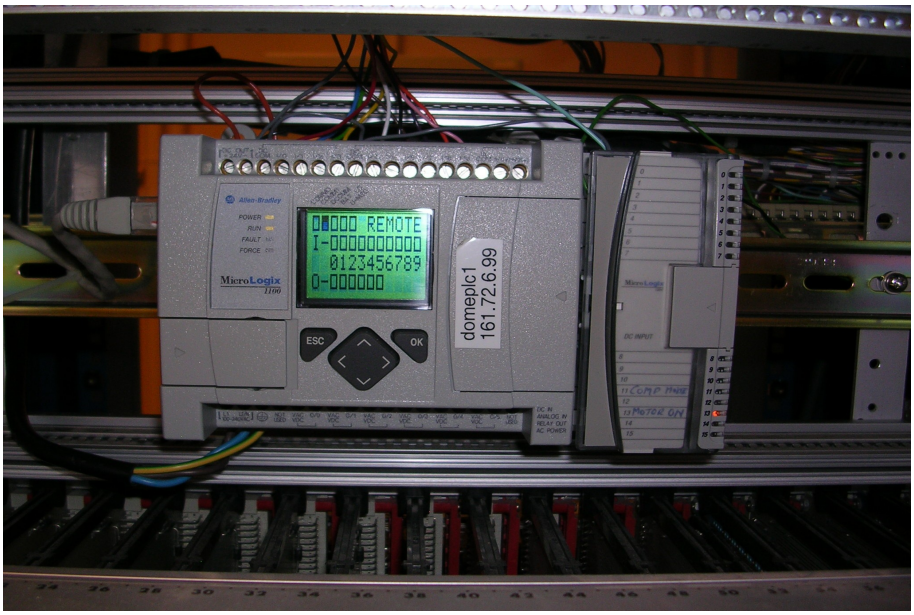
Replacement System:

It was decided to use 2 Programmable Logic controllers of the Rockwell MicroLogix family. One controller is situated in the control room and connected to CAMAC, the second controller is situated in the moving part of the dome, therefore it needs a wireless link to be able to talk to the ING network. This is a flexible solution, as these controllers have sufficient I/O capacity to allocate both computer and engineering control of the dome.

The MicroLogix 1100 PLC has 10 digital inputs, 2 analog inputs and 6 digital outputs. It also has a build-in 10/100Mbps Ethernet controller. In the control room we need a MicroLogix 1100 + 1 Digital input module. This system was named: domeplc1, and was mounted in the original TEM-L 19” enclosure in the WHT clipcentre cabinet.



Picture 3: Block diagram of PLC based dome controller

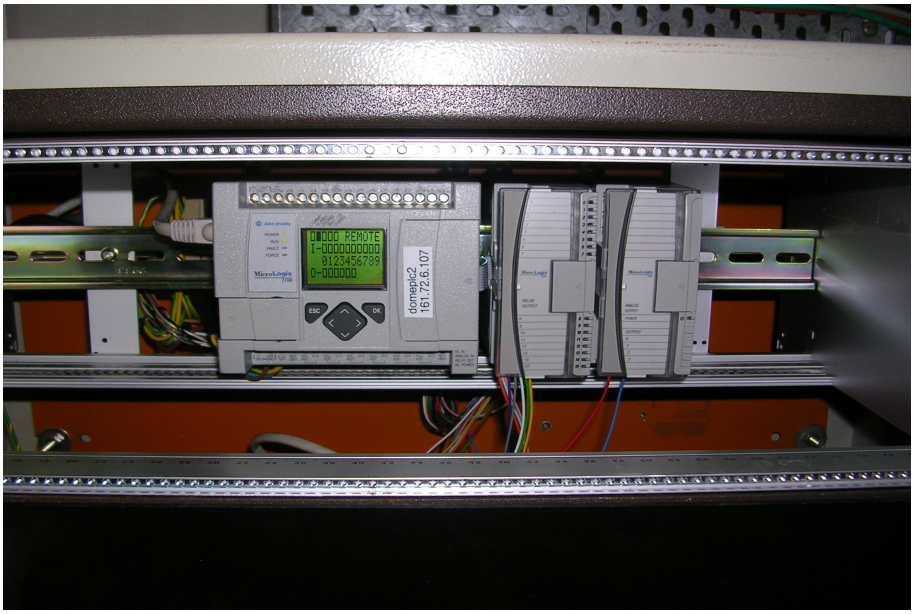


Picture 4: domeplc1 mounted in clip centre

In the dome we need a MicroLogix 1100 + 1 Analog output module + Wifi access point. This system was named: domeplc2.

The PLC's have been configured as follows:

Name	domeplc1.ing.iac.es	domeplc2.ing.iac.es
IP	161.72.6.99	161.72.6.107
Mask	255.255.255.0	255.255.255.0
Gateway		
DNS		



Picture 5:domeplc2 mounted in wallbox2

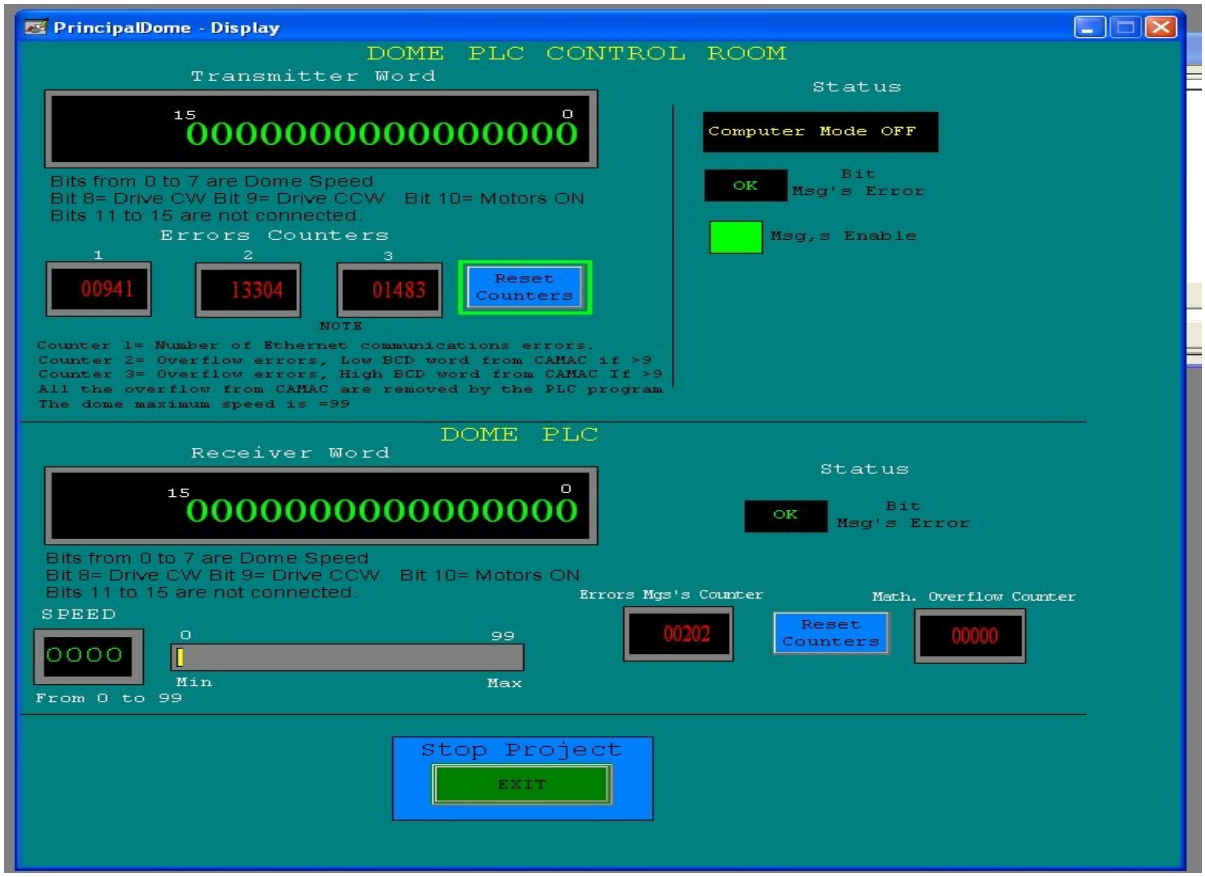
The use of a Wifi access points has the advantage of eliminating the slip ring system used with the original TEM-L system. This slip ring system was reliable with the low

data rate, (typical 300 baud) used by the TEM-L system, but proved to be useless with high data rates, as used with Ethernet. Communication between the 2 PLC systems was lost all the time when the dome was moving, causing overshoot of the demanded position.
As mentioned above, in the original TEM-L system the 8 bits BCD representing the demanded dome speed were converted in a digital to analog converter situated in on the grey dome control cabinets. This DAC was an old fashioned bulky unit with obsolete electronics. Therefore it was also decided to replace this converter by a PLC module driven from the MicroLogix 1100. The original DAC has been taken out of service.

For the moment it was also decided, not to implement the engineering control of the dome by means of the thumb-wheel switches and push-buttons on the engineering desk. This can be included again, if needed, in the future. In the dome the PLC unit has been build into the existing TEM-L dome enclosures. The top enclosure contains two 3Com hubs, one operational and one spare and the wireless access point. The middle one the MicroLogix 1100 PLC. The bottom one contains a UPS, also included in the system.

Picture 6 wireless access point + hubs mounted in dome wall box 1

An application program was written in RSLogix 500. A windows application to program the Rockwell PLC's in ladder.
For diagnostic purposes and engineering control, a graphical user interface was designed and written in RSView by Carlos Martin. This GUI can be run on the PLC PC in the control room.



Picture 6: Dome PLC RSView gui

PLC Terminal:	Signal name:	colour	CAMAC Station 2 Reg.B
I:0/0	Dome speed comp. mode 1		1
I:0/1	Dome speed comp. mode 2		2
I:0/2	Dome speed comp. mode 4		3
I:0/3	Dome speed comp. mode 8		4
I:0/4	Dome speed comp. mode 10		5
I:0/5	Dome speed comp. mode 20		6
I:0/6	Dome speed comp. mode 40		7
I:0/7	Dome speed comp. mode 80		8
I:0/8	Dome drive comp. mode CW		10
I:0/9	Dome drive comp. mode CCW		11
I:1/0	Dome speed eng. mode 1		nc
I:1/1	Dome speed eng. mode 2		nc
I:1/2	Dome speed eng. mode 4		nc
I:1/3	Dome speed eng. mode 8		nc
I:1/4	Dome speed eng. mode 10		nc
I:1/5	Dome speed eng. mode 20		nc
I:1/6	Dome speed eng. mode 40		nc
I:1/7	Dome speed eng. mode 80		nc
I:1/8	Dome drive eng. mode CW		nc
I:1/9	Dome drive eng. mode CCW		nc
I:1/10			
I:1/11	Computer mode engaged		
I:1/12			
I:1/13	Motor on		
I:1/14			
I:1/15			

Engineering Control:

With the TEM-L system there was also the possibility to drive the dome and control the speed, with the telescope in engineering mode, by means of push buttons and thumbwheel switches. This possibility has been build in the initial design of the new controller, but afterwards it was considered as an unnecessary feature. Therefore the push buttons and thumwheel switches shown in picture 7 have not been wired up to the PLC at the moment, but can be done in the future if required.

Picture 7: Engineering control

File: Dome-control-document.doc
Renee J. Pit, 5-08-2011