Joined up astronomy – connecting up all the hardware.

Equipment that allows state of the art astronomical observation is now available to the amateur astronomer at prices well within the reach of the average enthusiast. Generally this equipment has been designed with some readily available standards like RS232 and USB as a means of connecting the systems to computers. However, the number of devices, cables and power requirements if not considered carefully can easily produce unreliable operation. It can be really annoying to start an imaging evening with the computer unable to find one of your USB devices or worse to get through a series of long exposures only to find that the guide camera has stopped talking to the computer.

Typical Imaging set up.

So what sort of things do we need to connect together?
Lets just take a typical imaging set up:

Goto Mount (EQ6)
Dew heaters (Kendrick)
Filter wheel (SX)
Focus system (Lakeside)
Guide Cameras (Lodestar)
Main Camera (SXVR H18)

All of these need power and most need a computer connection. So what is difficult about that?
You might be tempted to just get some long USB cables and connect each system direct to the computer. This will almost certainly produce unreliable operation and in some cases not work at all.
In the observatory it is unlikely that you will be able to get the computer close to the pier as it will be in the way of routine observing. You also need to be able to walk round the pier without the risk of moving or worse tripping over a cable in the dark. This can do serious damage to your expensive camera connectors and maybe your dignity.

Observations about the interconnection standards.

From the many experiences that have cost me lost nights of observing over the years, these are the conclusions.

- Connectors that are not bolted together can come apart so this will need some attention in the case of USB.
- They also tend to get more loose and unreliable the more times you connect them.
- If you have an expensive device that comes with a manufacturers power supply, use it, if you don't want to expend a lot of design effort and have to spend time on the phone with the manufacturer.
- Very sophisticated equipment will in most cases be demanding of its interfaces. e.g SXVR H18 download 8.3m pixel 16 bit image in 4.5 seconds.
- Much of the IT standard equipment like cables and USB hubs are designed to be used close to your computer in an office, not on a long extension USB cable.
- Behind most office computers there are wires that no one can remember why they are there until they are disconnected! So maybe document the setup in your log.

What are the needs of the equipment?

The process of thinking through a design for the operation of your observatory should have at its core reliability, simplicity of operation and of course safety.
So starting with the basic design, how about a plastic pipe say 2-3 inch diameter under the floor or set in the concrete to take computer cables and power either up the centre of the pier or close to the base. You could just lay them under the wooden floor but I have found that mice like some types of cable. Ensure that you can get those bulky USB and maybe even RS232 connectors through the pipe. A good earthing cable for the pier is probably a good idea. I think this is the easy bit!!
I am sure you are now thinking that you will now have to take an OU course in electrical engineering to get the observatory working properly. But I think the following guide lines will help without the need to understand the detailed operation of the interfaces.

There are three basic electrical needs of a sophisticated device like a cooled camera for example.

Clean and well regulated power with the capacity to meet all the operational demands. Good data signal levels and enough uninterrupted bandwidth (data rate) to operate with the computer software drivers.

'USB Powered' – power for device operation supplied by the port.

For all items that are only connected by a USB cable, where it also supplies the power, use a powered hub at the pier, with the power for the hub provided at the pier. Because this hub will be some distance from the computer it would also be wise to use an active or buffered USB extension cable. This will apply to items like the Lodestar guide camera that takes a lot of current from the USB. The internal signal buffering in the active cable will also ensure that clean and reliable USB signal levels are available at both ends. On this hub you might also be able to put equipment that has very low data demands like the filter wheel. It would not be a good idea to put the main camera and the guide camera on the same hub as they both have high data transmission rates and the main camera would probably be best placed on its own active USB extension cable without the need for a hub, as in the case of the SXVR H18 it has a manufacturer supplied power supply. This means that it is unlikely that the USB cable will have to supply much current.

RS232 systems

Most goto mounts and focus systems are driven by RS232. Since the conversion process requires some power, I would adopt the 'USB powered' process and put a separate powered hub for all the RS232 converted systems, like the focus and mount, even though the mount has its own power feed. The alternative is to buy a quad USB to RS232 box and provide power to that.

Supply voltages 12v and 240v

That just leaves the two other power requirements. 12Volts and 240Volts AC for the manufacturers power supplies at the mount. If you run a 12v cable up to the mount it should be sized to take at least 3 times the maximum current that will be used at the pier. Dew heaters take quite a significant current as does the mount when slewing fast. So you don't want noise on the 12v at the mount to have an impact on the RS232 signals.

I have found that for simplicity a 12volt distribution box at the mount that comes from a fused and switched source in the computer bay is the best solution. This switch also controls a relay to connect the mains power to the extension sockets on the pier.

This means that I only have to press one switch to turn on all the pier equipment.

USB Connector issues

It is important that in particular USB connectors do not move relative to the equipment they are connected to, as the design allows some sideways movement and potential for electrically noisy connections. So allow a loop when coming out of the camera or filter wheel, then attach the cable to the nearest non moving metalwork.

'Cable tidy'

The cables running around the mount need to be able to move without 'snagging' as the mount moves. This will be very individual to the scope configuration but I have found that there are many 'cable tidy' solutions on the market that are able to smooth the movement as the mount moves over its full excursions. I have used a simple plastic spiral to enclose the cables , fixed at the pier and at a central location between the two scopes.

Go for Gold – where possible!

Finally, take a look at the buffered USB extension cables and all connectors used in the observatory. If available use versions that have gold plated pins. This decreases electrical contact resistance and less chance of humidity causing bad connections.

Some useful links:

12V charging controller
http://www.sunshinesolar.co.uk/khxc/gbu0-catshow/Regulators.html

Nikkai 5M active USB2 cables (gold plated)
http://www.maplin.co.uk/Module.aspx?ModuleNo=097272&TabID=1&QV=Y

4 port RS232 powered converters
http://www.easysync-ltd.com/product/537/es-h-1004-m.html