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A DSI RF Systems White Paper:

Considerations for a Remote Camera Network

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Executive Summary

In today's hyper-competitive broadcast environment, television stations are continually forced to look at how they can stand apart from their competitors and offer their viewers the best experiences, all while keeping an eye on expenses – both capital and operational.

Remote camera networks are a cost effective tool for a station to provide reliable, exclusive shots for news and traffic reports, and act as a tool for station promotion and revenue generation.

Overview

Remote camera networks are pretty much what their name implies: a series of professional quality video cameras, that can be remotely controlled, to bring desired images back to a studio or video production facility.

Many remote camera networks are in use today for traffic reporting, beauty shots, B-roll, or providing a presence at a local landmark. Because they are remotely controlled, stations do not have to deploy a truck or operators in the field in order to get a desired shot. Usually, a hardware controller unit in a news or production room is all that is needed to handle the major camera functions.

Some operators sell sponsorships associated with the camera shots, either for cash or often in barter with the landlord where the camera is located. For example, a hotel with a good vantage might receive on-air mentions instead of a monthly check. In other cases, cameras, or the particular shots they provide may be sold as part of a sponsorship package (e.g. "The Panasonic Jam Cam" outside of New York City's Lincoln Tunnel).

The remote cameras themselves and their associated field electronics are securely mounted and housed in weatherproof cases so as to endure to worst that Mother Nature has to offer. Unlike many surveillance cameras that can share similar style cases, the remote cameras used for broadcast purposes have higher quality cameras and lenses, making them appropriate for transmission to either standard or high definition televisions. In a well constructed installation, a TV viewer will not notice a significant difference, if at all, between the quality of the pictures provided by the remote camera network and those provided by field newsgathering crews using more elaborate setups.

The planning process

Planning a remote camera installation can seem like an overwhelming task. Breaking the task into small, bite-sized pieces and then completing each one before moving on to the next can help make things more manageable

As with all projects, it's important to start with the end. That is, what are you trying to accomplish at the end of the project? The station's staff – representatives from the news department, operations, engineering and even sales and marketing - will need to determine what they collectively want this remote camera to do both now and in the future.

Is it capturing traffic congestion on local roadways? Having beauty shots for the late news? Having a point of presence at a local sporting arena? Are there shots that can serve double duty? Are there things that can be done today that will offer flexibility later down the road?

By carefully mapping out and understanding the goals of the project, time and money can be saved and aggravation avoided.

Key to planning and implementation is determining who the project manager (PM) is. Someone needs to be accountable for the timetable, budgeting and process, as well as be the focal point to hold others to their required tasks. This person should have some cross-functional skills so as to be able to communicate clearly and easily with other project stakeholders.

The project manager should also be well versed on key skills such as task prioritization, parallel tasking and understanding task dependencies. The PM's ability to be flexible and keep the project moving towards its logical end can mean the difference between a smooth, effective implementation and a project marked with confusion and cost overruns.

In drafting the project scope, the project manager needs to allow for any unexpected issues that could arise such as: weather-related delays, the discovery of concealed or unknown structural issues at the camera installation site and equipment manufacturing or shipping delays.

As to the actual work on designing and implementing the remote camera network system, an inventory of internal skills needs to be taken in order to assess who on the staff has sufficient knowledge to take on these tasks and specify the required hardware systems, contact the manufacturers to understand product capabilities and ultimately place an order.

Although team members can work on the installation an "as-available" basis, there will be a significant increase in the installation time and a greater chance for things to "fall through the cracks" as attention waxes and wanes through the process. Setting a dedicated team with a fixed to-do list and timetable is the most efficient mechanism to get the project done.

Financial considerations

Some might argue that this is the most important part of the planning process. After all, if you can't pay for the project, does it really exist?

What is the budget allotted for the project and can the project be designed to the budget? If not, can dollars be contributed from other department's budgets, so as to help fulfill all desired objectives of the project?

One path of least resistance to building out a remote camera network might be to get an initial infrastructure into place by buying a basic system now and making plans to upgrade it at a later time. This method would enable the station to get something on the air as quickly as practical.

A system integrator may be able to provide leasing terms as a means of earning your business - and freeing up your cash flow! Leasing with a buyout option may also be available.

As previously mentioned, there may be economic considerations that could help defray the costs. Examples include:

- Trading out site leases in exchange for on-air mentions.
- Selling sponsorships to the camera (e.g. The Panasonic "Jam Cam")
- Selling sponsorships of the shots provided by the camera (e.g. The Apex Tire look at traffic on Route 1")
- Putting the camera's shots on the station's website to enhance value to current sponsors or to associate with entirely new sponsors / revenue opportunities.
- Selling the images to other stations in the market.
- Selling the images to other media's websites in the market (e.g. local radio stations or newspapers). These parties may be more interested in doing reciprocal promotion instead of paying cash. You should determine what is best for your station.
- And obviously combinations of the above, which may help all parties.

Choosing a location

Before any design (and installation) can happen, a location needs to be chosen. The location(s) will have a direct bearing on the type and nature of the equipment you will purchase, so please don't buy anything till you've vetted the location out, including basic lease terms with the landlord.

Decide what beauty shot or major highway intersection, exits or bridge you are interested in and then go to these locations and perform a site survey - look to evaluate the suitability of the location as a camera site.

Bring along a digital camera and take pictures. Be sure to get photos of the location as well as what the camera will be able to "see" from this location. Also, take along a ruler that can be held up next to structural members when a photo is taken, to give you a sense of scale and a record of mounting requirements.

Find out who the landlord for the site is and what kind of roof rights or other site-dependent permissions you may need to get. If there are already tenants on site with antennas or cameras, make sure that here are no restrictions on bringing aboard anyone new. A location that already serves broadcasters can be quite handy, since not only has the electrical and signal infrastructure been installed, but the landlord probably understands the unique needs that broadcasters require.

When planning today's installation, keep in mind your future plans for this remote camera location. Try to strike a balance between getting the most use out of it now and also having it ready to be easily upgradeable later.

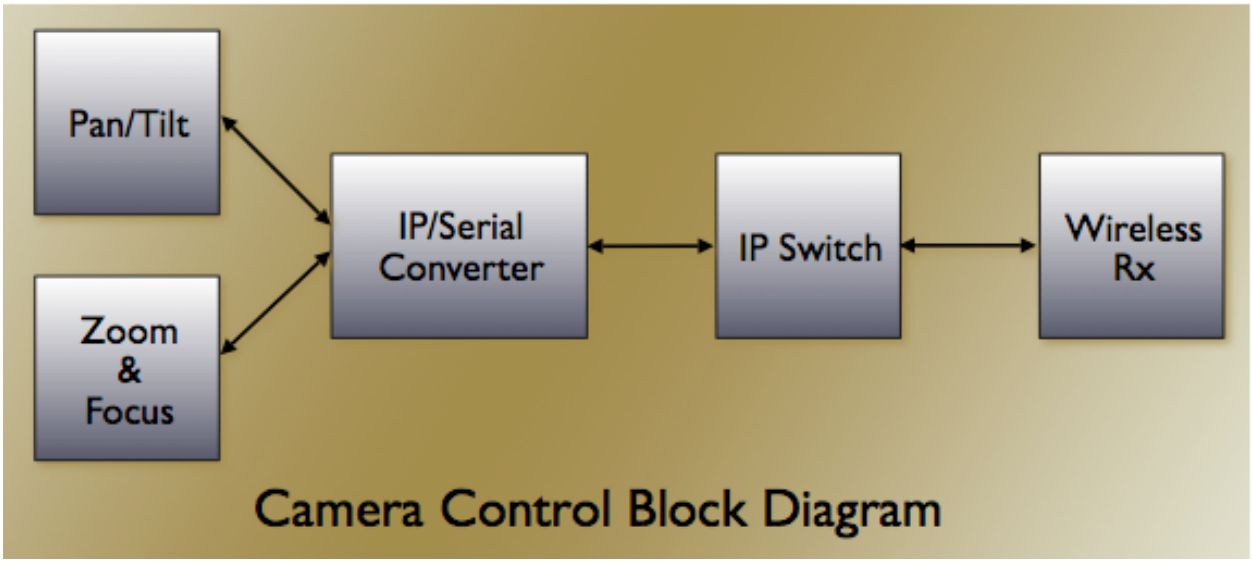
There are site-specific requirements that will be different for an installation on a building rooftop vs. a tower-mounted location. A really simple install on the roof of the studio building can probably be handled internally; don't take chances if you're not sure about it. More about bringing in outside help follows below.

We cannot emphasize enough the importance of planning. Each remote camera site has its own quirks and challenges, but careful planning and attention to details will help avoid the majority of traps. Remember, a mounting pole that is incorrectly installed is as much bad news as an improperly weatherproofed connector when the camera system is 500 feet off the ground!

Designing the remote camera system

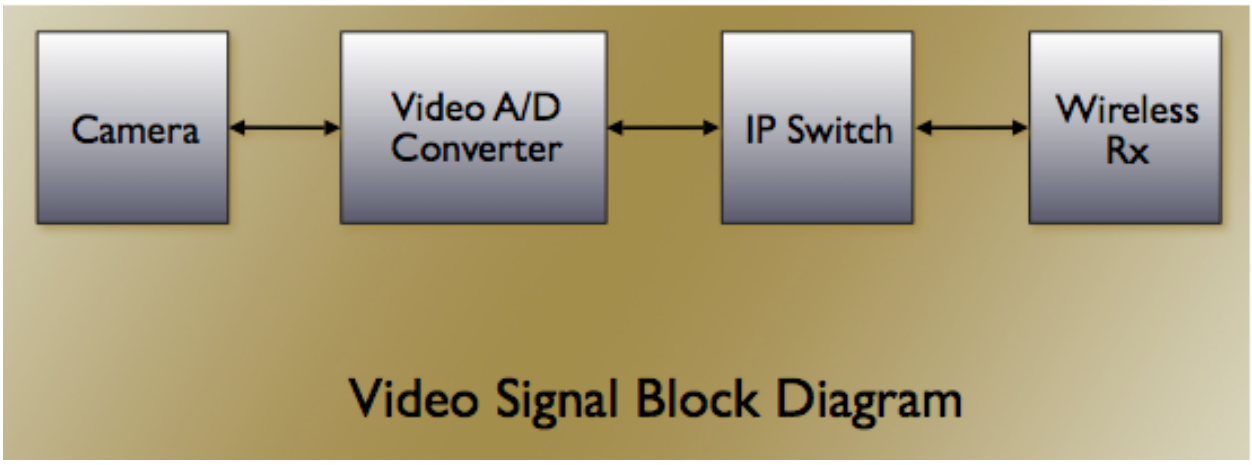
A good way to help your planning is to work with block diagrams on graph paper or use one of the computer graphics programs such as Visio (PC) or Omni Graffle (Mac) to help envision the electronic flow. Start with macro views – the highest order system flows and then break the boxes down into smaller component flows. It's like the old joke goes, "How do you eat an elephant?" "One bite at a time!"

At its heart, the remote camera system is made up of two separate systems. The first, the control system, starts at the camera control point and ends at the remote camera. The control system tilts and pans the camera as well as provides for focus, iris and zoom control of the camera's lens.



In this particular installation we have shown a block diagram of the remote location. We are using a wireless RF link to get the control signals to the camera. This same RF link will also bring back the video. In this instance, we have also chosen to use IP over the RF link as the data transport. Starting at the far right of the block diagram is the wireless receiver. The receiver is connected to an IP switch, which then feeds an IP-to-serial converter. This converter will separate the serial pan, tilt, zoom, focus and iris signals from the IP stream.

The second piece of the remote camera system is the video path that starts at the camera and terminates at the studio.



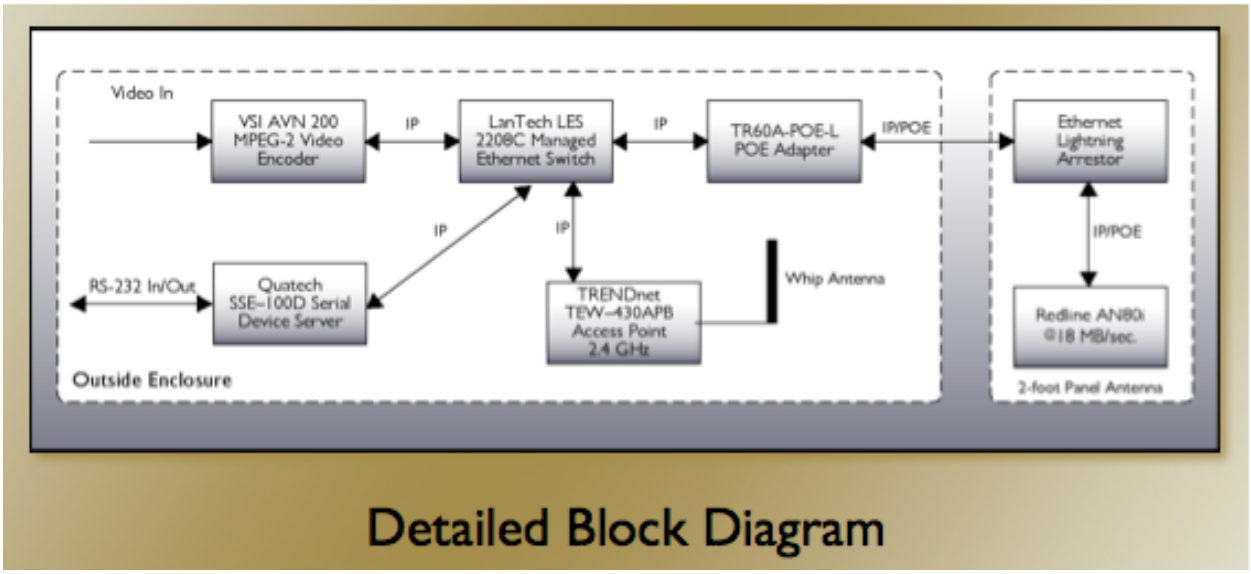
The camera video output goes into a video analog-to-digital (A/D) converter which converts the video into an IP data stream. The converter output is then connected to an IP switch that feeds the wireless transceiver for the trip back to the studio location.

In the detailed block diagram below, the camera control and video output blocks are combined and more definition is added. Note that this block diagram is divided up into two parts using a dotted line to show which components are mounted in a weather-proof outside enclosure.

The managed Ethernet switch passes the common IP data for both the serial control commands to the camera and the return video data.

Starting on the left side of the diagram, the camera video feeds into the MPEG-2 encoder, through the switch and then through a power over Ethernet (POE) adapter and lightning arrester before it connects to the RF transceiver and panel antenna.

In this iteration, a wireless access point also connected to the IP switch for local, portable connectivity.



Next, consider the pieces that make up the actual camera system installation.

We can split up this installation into the physical installation and the electrical installation. The physical installation is all about mounting the equipment in its intended location. The nature of the mount is very important. Camera mounting can be a bear if the camera is to be installed on top of a pole or on a tower location. The weight and bulkiness of the pan / tilt mechanism requires it to be properly rigged while being hoisted up into place.

A rooftop location for camera mounting is usually ideal. Before starting, examine and take measurements of the roof hatch and climbing ladder / stairs to verify that all equipment will fit – it may have to be disassembled in order to be taken to the roof. Be careful of moving pieces of equipment across the rooftop and be sure to keep everything tied down during if the installation occurs on windy days.

A non-penetrating roof mount needs to be sufficiently stable to hold up, even in the heaviest winds. Penetrating mounts need to be carefully installed to ensure that water does not leak through and damage the building below. All of the hardware, clamps, pipes, bolts and nuts need to be on hand and all must be rated for outdoor use. The specific location of the installation is

important too, since the camera and electronics needs to be able to fit within the designated location, or be safely mounted a short distance away.

In the electrical installation, the cables need to be able to reach the camera enclosure and the interface box in a safe and secure manner, complying with local building and electrical codes. Hundreds of feet of cabling may be required to connect the system and since everything will be living outside, all connectors need to be properly installed and weatherproofed and cables, unless in conduits, will need to be UV rated.

Allow sufficient lengths of all cables for service loops but be sure, when dressing the cables, that water can flow *away* from the boxes.

This is a face-mounted, tower installation. The upper metal box is the interface-box that houses the control circuitry and power supplies. The lower metal box is the camera enclosure washer-box. It pumps windshield washer fluid onto the front glass of the camera enclosure and works in conjunction with a small wiper. Note that the pan / tilt is mounted on the top of a pipe that is clamped to the tower member. In this arrangement, the camera enclosure can be swung out around the leg of the tower so that the tower does not get in the way.

Camera considerations

There are lots of camera choices in the market. Part of the initial groupthink about what you are trying to accomplish should help define the features of the camera needed. After compiling a list of qualified cameras, pare down the list to what will look best on the air. An important consideration is going to be durability / reliability since the camera will be in a remote location and not always accessible for service and maintenance.

The overall performance of the remote camera system is going to be a combination of the camera, lens, zoom and iris functions as well as the video output format.

Decisions will have to be made about standard definition (SD) versus high-definition (HD) video output. What will look best during the station's newscasts?

An SD solution can be switched from 4:3 to 16:9 aspect ratios, as necessary.

When going HD, it is important to plan upfront for the HD bandwidth requirement.

A switchable SD/HD camera may offer the most flexibility.

Keep in mind that once the camera mounting, control cabling and other infrastructure are in place, you may still be able to upgrade in the future. Be sure to make this a part of the plan from the beginning so you are ready.

The video codec market has been advancing rapidly and there seems to be new products available all the time. The best ways of keeping abreast of these changes is to stay current with the industry's technical trade-publications and visit the hardware manufacturer's websites regularly.

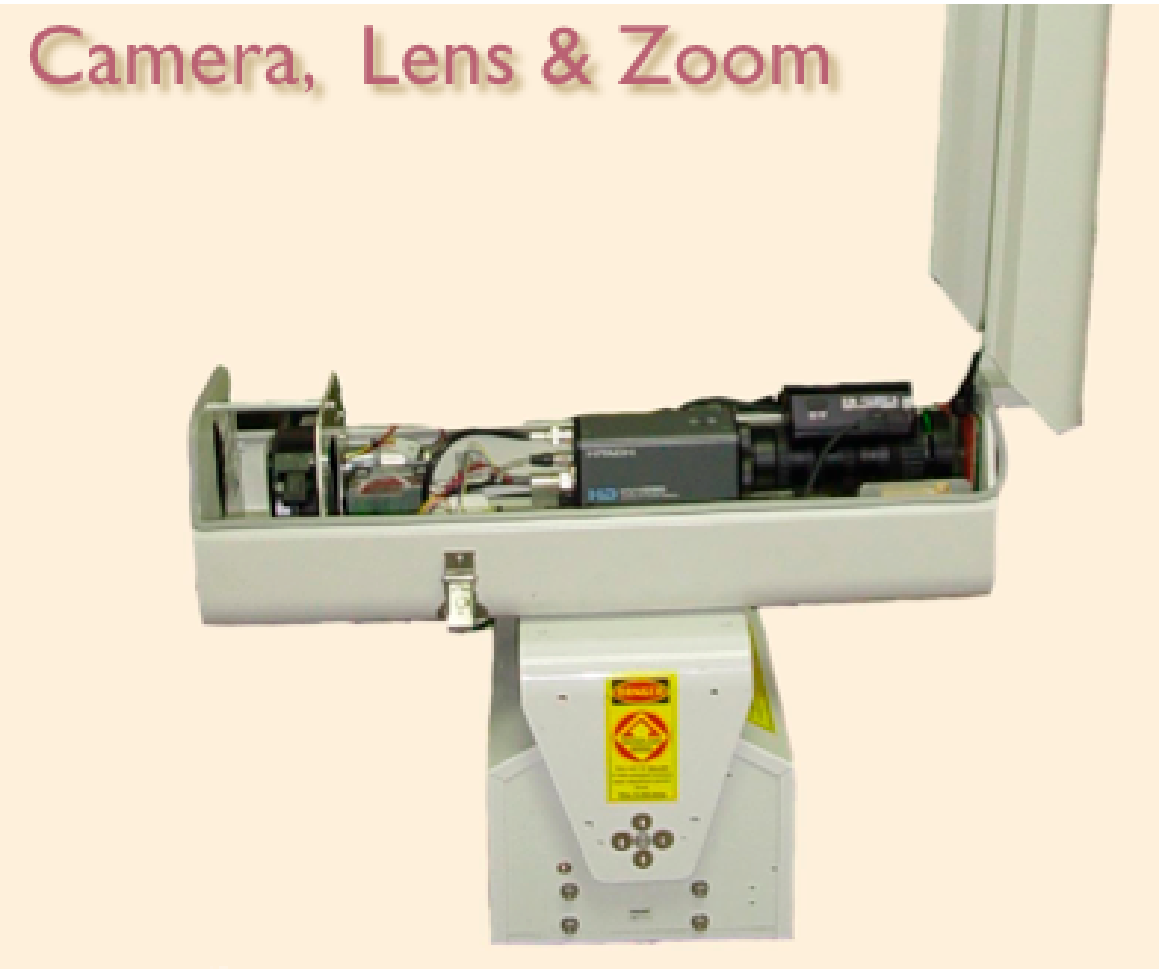
The video output formats that is typically used from a remote camera is SD-SDI, which can be used in a 4:3 or 16:9 format. Many cameras allow this to be remotely switchable.

SD would need to be shipped back to the studio on a link such as an ASI serial link, available from most telcos. An HD choice would require some compression at the source end if it's to be sent over a long distance. Composite video can be MPEG-2 encoded into an IP data stream and sent over an RF link. More on transport considerations is below.

A wide AGC range on the camera will provide for good nighttime video, while an automatic iris will be helpful for the daytime to nighttime transition.

The camera should be able to smoothly zoom-in so as to see any incidents on a highway, and smoothly zoom-out to show bridges, roadway exits and intersections while retaining a crisp image.

Finally, it is a good idea to get a loaner of the camera / lens system you are thinking about using, and put them through their paces during bright sunlight as well as nighttime traffic conditions. By experimenting with the adjustments and ranges, it will be apparent whether that particular camera set-up is what you are looking for.



This is a standard camera inside an outdoor housing that is mounted on a pan / tilt head. Note that the lid of the camera housing tilts up for easy access to the inside for servicing and to make adjustments to the camera and lens bodies. This particular set up has a Hitachi camera and Fujinon lens. The lens has a control box on the side of it. The lens wiring connector attaches to a master wiring harness, along with serial data, and power and video from the camera. All connections flow through the bottom of the camera housing via a weatherproof connector.

The camera housing has a fan at the rear for ventilation when conditions are warm, and heaters in the front for the lens and window during cold weather. Control is via thermostats located inside the housing.

Also note that the housing is equipped with a front wiper and spray head for glass cleaning.

Additionally, there are clamps on each side of the housing to secure the hinged lid. Locks can be placed on these clamps to keep unauthorized persons from gaining access inside.

Transport considerations

The desired video signal drives the bandwidth required from the remote camera site back to the studio.

If you are planning to use an RF link for video and control, it is necessary to have a clear line of sight and be clear of the first Fresnel zone to ensure reliability. A path link analysis can be done to verify the path conditions. Using IP over RF allows a scalable system where you can start out with composite video and A/D converters and then upgrade the radios and the video later for higher video resolution.

There are both licensed and unlicensed RF links available for use with remote camera systems. The 5.8 GHz unlicensed band is popular and those radios are readily available. The radios have changeable bit rates and bandwidths, with the higher bit rates and bandwidths costing more. The "gotcha" with the unlicensed system is that the frequency spectrum is shared in any given area. New unlicensed systems are put on unused frequencies after using the radio's software utility to scan the frequency band and find a clear channel.

When RF isn't practical, fiber is a good choice for backhaul and control. SD-SDI can be sent back over a telco fiber link as an ASI stream.

The RF link method will probably have a higher capital cost due to the hardware required on both the transmit and receive ends, but will have little ongoing maintenance cost. Fiber on the other hand has little upfront equipment required (that isn't provided by the fiber carrier as part of their service), however, it carries a much higher operating cost due to monthly service charges.

A serial control link to operate the pan / tilt and the camera functions is a low data-rate stream and is pretty much "along for the ride". Because installations vary, you will need to verify if a separate method will be required to get the control signals out to the camera.

Getting it done

When considering who will install the system, you need to take a look at the workload of the present staff. If the installation will take a week to accomplish, can a staff member be dedicated to this project? Parts of the installation may require two staff members. Will that put an undue burden on resources? Will it negatively affect other departments who were counting on other engineering projects during that timeframe?

Make sure everyone knows the details of the project and supports it or else they need to let their concerns be known to the group. Schedule routine meetings that are informational and provide an opportunity for questions and answers. Progress reports are a must on lease negotiations, equipment research, selection, ordering, purchasing, etc.

Odds are that after the group has taken a look at all the items that need to be done, an outside vendor will be chosen to complete the work.

A plus with working with an outside vendor is that they have done this before and you can use this experience to an advantage, for example, the vendor can create a build-as document along with the project scope and timeline. The station can then review these items and accept them or make changes.

Using outside help

Call in the pros:

- When there are special installation requirements, like tower climbing or creating a special mounting assembly for the camera, pan / tilt unit and electronics.

- If you have staff shortages. A team of installers can reduce the new installation workload to near zero and can focus solely on this task to ensure that it's completed it in a reasonable time.

Outside contractors experienced with remote camera networks have the technology expertise to design the system to your specifications. They can also create any specialty mechanical and electrical interfaces to get the equipment up and running.

Outsourcing also frees up the station's project manager to get an overall view of the installation and make sure it is progressing as planned. Otherwise, when the PM is caught up in all the little things that are required, they lose focus.

Be sure to get references from the installation vendor before hiring them and it can be helpful to actually visit sites the vendor has previously installed to see the work already done.

Tower climbing should also be left to the pros. A trained climber will be a safer climber and will know the ins and outs of securing all wiring to the tower, as well as how to weatherproof exposed connectors.

Check on the credentials of the tower climbers. You might want to ask how long have they been climbing? What's the last big job they've worked on? How high have they climbed?

Also, ask for proof of company liability insurance. Call around to past customers to see how satisfied they are with the work that was completed at their location.

In the end, the station will want to pick someone they are comfortable feel that they can trust. Look for a company that has been doing this kind of work in the past. Many can claim to be able to do this work, but the cumulative experience of a company with a track record in this space will help make your installation faster, easier and most importantly, safer.

Servicing and Maintenance

Why worry about maintenance when the equipment hasn't even been installed yet? Simple - because even if there is just one remote camera to be installed, your news department will be counting on that site to produce pictures every time they need it, and it becomes another piece of the overall expense pie.

Add the remote camera location to your routine maintenance schedule and stop in to see it regularly. Even if it is mounted in a location you can't easily get to, use binoculars to check out the condition of the system and make notes.

Servicing is one of those "gray areas" since no one knows what is going to break or when. Equipment is pretty reliable as long as it is not being misused. For example, putting consumer grade "Slingboxes" in an outdoor box during the heat of summer and low cold of winter would be equipment misuse.

Equipment on a rooftop is easy enough to get to if it stops working. Something mounted up on a pole or tower location will require coordination with a tower climber or crew.

Depending on location, some rooftops are open for tenant use only during certain hours of the day. You may have to call a special emergency phone number for weekend or evening access.

If the equipment is mounted in areas that have a lot of wildlife activity, special installation practices may have been used to keep critters away from the electronics and cables. This may make the equipment harder to get to as well. Also, it's possible that the wildlife actually caused the problem – animals chewing on cable jackets, etc. Be particularly cautious in these conditions.

The camera housing can be fitted with a padlock to keep unwanted persons from opening it up. The system can also be mounted in hard-to-reach locations. Just remember that making it tough for vandals to access also makes it tough for you or your contractors to get to as well!

Conclusion

Though detailed, this white paper is hardly exhaustive of the minutia that must be considered in the design and construction of a remote camera network. Suffice to say, though there is a lot of work involved, the rewards of a well planned and operating system are great.

If you're looking to build a remote camera network and are looking for help and insight, please consider calling the remote camera experts at DSI RF Systems at 732-563-1144. You can also find us online at www.dsirf.com.