

Construction of a command and control vehicle suitable for RAYNET use



By Phill Hills G7JRV

There are a great number of things which need to be taken into account when starting out on the path to construct a vehicle of this kind all of which will need to be given careful thought and some may need to be reviewed during the construction process. I will try to highlight as many as I can in this document and no doubt I will continue to think of more content which should have been included long after I publish my findings here. I have worked on a number of vehicles over the last 25+ years in the voluntary sector and I will try to pass on as much useful information as I can here. This kind of capital investment needs to be more than a 'van and radio', you will need to look at the whole life costs of this investment, who is going to drive it, and how it's going to be used. This vehicle will need to be highly available on a 24/7/365 bases and to that aim needs to be well maintained, well equipped, and legal.

Well, where to start? I guess budget is as good as anywhere as this will set the level of what is achievable. Can you afford to do this when the reality of whole life costs is taken into account? Anyone who has owned a vehicle knows the purchase price is just the start and there is always going to be an ongoing cost of ownership year on year. You need to be very clear what limits you have in place for this right at the start and this needs to be agreed with the groups committee and possibly the whole group membership if the burden of raising funds to maintain the vehicle will fall upon their heads in anyway.

While it may be true that a trailer will have a cheaper cost of ownership, you will still need to find a willing pool of members able to tow it. New drivers can't automatically drive with a trailer and diabetic drivers are normally restricted to 3.5 tonnes train weight.

You must have group support for this project and a pool of members who want to drive the vehicle otherwise the main person behind the project will soon find they are the only one looking after the vehicle. You will also need to identify who is going to drive this vehicle and who you can afford to insure. Business Cat1 is likely to be more suitable for RAYNET use as this normally works out as an affordable option for all of your members over 25 with a clean licence to drive a group owned asset such as this. Under 25's and retired members may cost you more if not named drivers on the policy.

No matter what size vehicle you are going to build you are going to need to store it when not in use. You really should only be looking at secure options in this day and age as leaving a vehicle with some very high value content parked unattended and for any length of time will attract the wrong sort of attention. Even if you don't have windows the antennas on the roof will surely give the game away. For a RAYNET group the options might range from a members driveway and upwards to a paid for and gated lockup under cover. Both budget and size of vehicle will have influence on your options as well as ease of access and your insurance policy. There is little point having this high value asset hours away from your nearest driver. While a bigger vehicle will be more space flexible it's less likely it is that a member will be able to accommodate it on a driveway.

Now you have worked out your budget you need to choose a vehicle to convert into your control unit. Some are more adaptable than others and personally I would restrict my options to the ones which have a history of modification and verities in the field. Let's look at the great example of the Ford Transit which has a whole host of factory options, wheel bases, roof heights and other things useful to the vehicle modifier. Ford are very well setup to help with the process of modifying the Transit, from the 2011 mark 7.2 onwards and even provide on their website a three hundred plus page structural and electrical guide to aid this.

You will find a whole range of body types sitting on a Ford Transit chassis from the humble panel van, to camper, to mini bus, to box van and tipper back they are all there. To you and me this means that it's tried and tested, it's not going anywhere and will be around in years to come

when you need spare parts. The Transit also comes with a wide range of axle weights and four body lengths to suit both your budget and load. More importantly it has three roof height options.

You need a vehicle which you and all of your members can stand up in without bending their necks or stooping. I would rule out a standard height roofed panel van if your internal layout will lead to members walking around with heavy boxes of kit inside the vehicle. A mid or high roof will be more suitable for this kind of activity. The disadvantage of a higher roof line is that it doesn't really add anything in the way of storage capacity as you will need to keep all of your heavy equipment on or close to the floor level to keep the vehicles centre of gravity as low as possible. It will also stop you getting into most car parks with height restrictions and you're going to bang those expensive antennas on more over hanging tree than with a lower roof but on the plus side you are less likely to need to remove antennas to stop them disappearing overnight. A reasonable compromise is the mid height roof vans as these allow most to people stand while keeping antennas high enough to be out of harm's way yet not too high to bang into every tree branch and have reasonable handling with side winds on motorways and bridges.

So now you have your new van, how are you going to lay it out and what do you really need on board? First thing I think you should remember (as most builders seem to forget this one or leave it so late in the build it becomes a big issue to fix) and that is there is already, even before you start adding bulkheads two areas you need to modify. Yes that's right you forgot about the outside just like everyone before you did. If you are going to have this vehicle available on a 24/7/365 bases then you can bet your bottom dollar that you'll either be setting up or packing away in the dark so you need to do something to make life easy for yourself and the other people who will use this vehicle. Set aside a good budget for lighting both outside scene and inside task need to be covered. You have to think differently when building a vehicle for other RAYNET members to use, think like an employer bringing employees in to a place of work and that needs to be safe regardless of the time of day or weather.

With the outside scene lighting I prefer to tackle this with professional units such as Whelen's Perimeter Enhancement Light and Scene Lights. Weatherproof external grade LED scene lights are common place on these type of vehicles and therefore the prices have come down in the last few years. Between 3 and 5 LED scene lights should give you a 360 degrees blanket of white light to easily setup any ancillary equipment you need to get up and running quickly. I also have a personal rule that lights on the outside of the vehicle need to be controllable by the driver and only the driver when the vehicle keys are in the ignition. This is very easily done with a commercial Switch Panel such as a Woodway Micro~link Compact Switch Panel on the driver side of the cabin. Programmable button pods normally send digital signals to a relay bank elsewhere in the vehicle and keep the wiring to an absolute minimum. Not only can these Switch Panels be used for the scene lights they can be used for any amber lights you might choose to fit or to command other loads. Having to run new cables into the dashboard area can be tricky and one word of caution if any is needed would be to make sure any live cables are fused battery end of the cable before they come anywhere near the zone which a driver may have to be extracted from. These cables need to 'go cold' as soon as any cutting equipment come into contact should that need ever arise.

Inside task lighting can be controlled and switched locally with switches located close by in each area as these do not affect other road users. Whatever you do wire in, do it right – do it once. Properly fuse and label everything. Try to keep all your auxiliary fuses in one area of the vehicle, your members won't thank you for hiding that one fuse they're always blowing somewhere awkward.

What other equipment should you be looking to install in reach of the driver? Well personally as little as possible! I think the most you need to have up front with the driver is a single dual band 145/435 MHz radio, a Sat-Nav and a phone charger. Given a choice, I would always choose the Kenwood TM-D710G for this roll as this will introduce APRS into the vehicle with the possibility of allowing its progress to be tracked remotely. Also this model of Kenwood radio can be used as a very capable cross-band repeater (TTU) which would allow the driver to move around the scene on arrival with a handheld while continuing to use the vehicles antenna.

I would also choose to place a steal bulkhead behind the driver and passenger seats to improve security and to remove the possibility of any loose items in the rear becoming a distraction or worse, a missile under heavy braking. The bulkhead will also act to reduce the amount of sound coming from the rear or vice-versa travelling into the rear and therefore aid the possibility to use the forward driver cabin as a second or third operating position, somewhere to rest or make phone calls etc.

Once you start to look at the remaining area you have for your command and control area always be thinking about storage and how to make the best use of the space you have available. You don't need that much space to operate a radio. Are you going to try to fit two radio positions in or one and a logger? Do you need two radio operator positions at all? I have seen to date little evidence for the need to have two RAYNET radio operators operating out of the same vehicle and think the best option is to provide desk based seating for two members of staff, one whose primary role is to operate the main radio net and the second position for a logger / engineer / runner who should be closest to the door to fend off and answer questions from other persons who may approach the vehicle.

For storage look to box everything up into neat packages, Euro-containers and Really-Useful-Boxes are your friends. Look to use robust, interlocking and stackable storage systems such as Euro Containers, these stacking systems come in all shapes and sizes to suit the items you need to store. Shallow ones are idea for cables, bigger ones for brackets, and deep ones for bulky items. Really-Useful-Boxes are more suited to lighter items such as stationary and small items of equipment.

Two batteries and Split charging. With a vehicle of this type it would be fool hardy not to have extra battery power on board. To keep the day to day vehicle operation at simple as possible for the users this should be as automated as possible. Modern intelligent battery systems (IBS) will take away the need for any driver interaction or need to remember to flip switches. Keeping the diameter of the wiring between batteries as large as possible (35mm² or greater) will allow the second battery (the Aux) to start the vehicle if needed. Don't try to connect all of your extra wiring directly to the aux battery, instead install a high amp bus-bar and wire away from there.



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The South Sussex RAYNET Group Event Communications Unit (ECU) is a highly visible and great publicity tool for the group. Keeping the RAYNET markings 'national' allows the vehicle to be used over a wider area, at zone or even used nationally. This vehicle started out as a BBC DAB radio testing unit.



This picture from another vehicle build serves to demonstrate layout. Note the steel bulkhead rear of the driver, the 200Amp Aux battery in close proximity to the final radio equipment. The operator's desk built across the vehicle to distribute weight evenly, plywood on a box section steel frame and enough room for two people to sit at the desk. The kneehole isn't as deep at the desktop which allows more room in the rear for storage. Note also the flat floor and one piece non-slip wet room lino covering which is essential on those early morning damp grass days and ever so 'British summer' days.



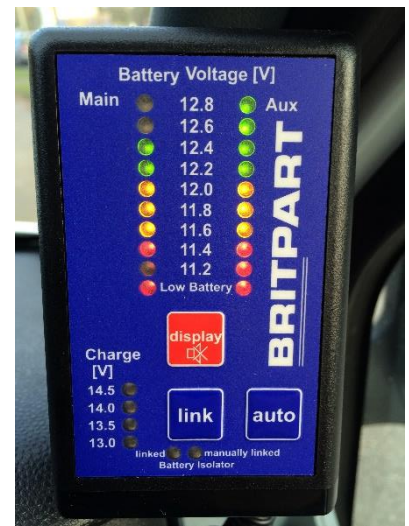
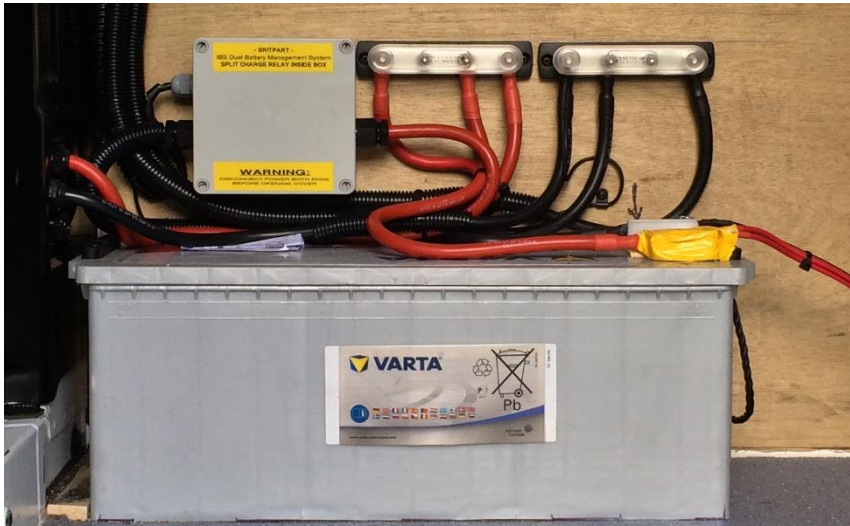
One of the first jobs should be to insulate the vehicle with Rockwool and closed cell foam sheets. This is a must do to help reduce the effect of condensation and to help regulate the vehicles internal temperature when operating in the heat of the day or on those overnight events.



Scene light will make the vehicle more useable at night and these external lights should be controlled from the drivers position.



Keep your electrical system simple and easy to follow even if the install is a little more expensive your staff will thank you when the time comes to switch everything on or fault find. The above photo shows an installation which can draw on 230vAC power from two different sources by the simple flick of a switch. In this example the Automatic Battery Charger (ABC) only works when the power is coming from the shoreline and is never live when running from the inverter.



Here we see the two main elements of the 12vDC power source and the intelligent battery systems (IBS). All of the main linking cables are kept as large as possible, here we see 35mm² being used between the two batteries, the split charge relay and the bus-bars. The right-hand picture shows the IBS computer which controls the split charge relay and also displays the charge state of both batteries.



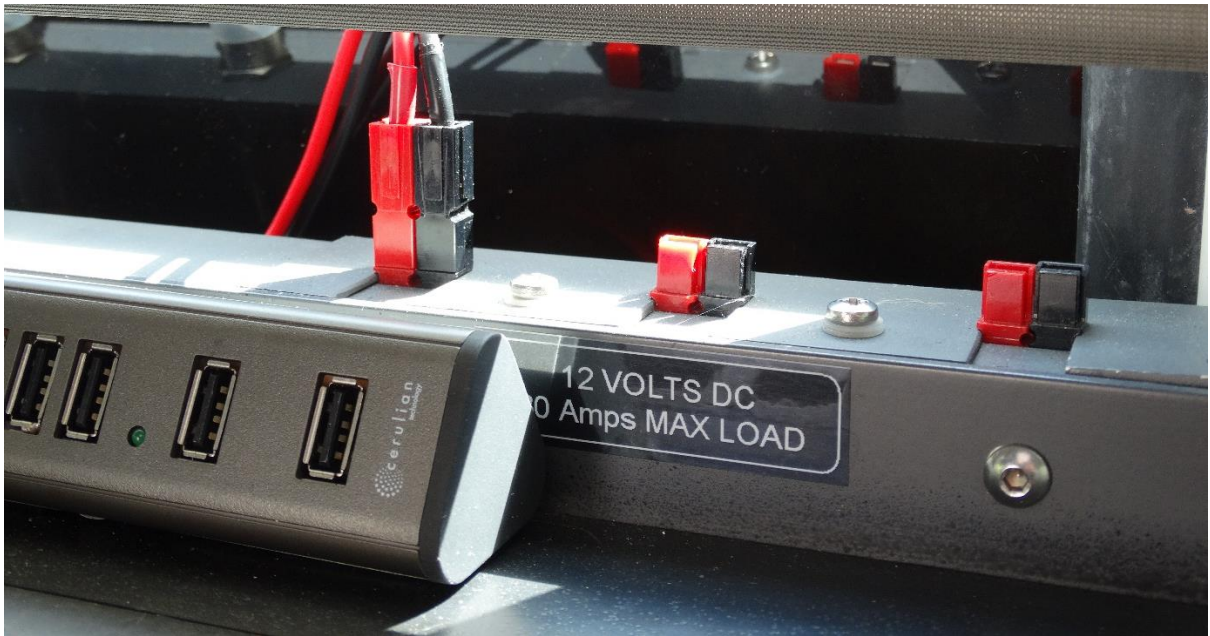
You will never be able to foresee what cables you will need to have exiting the vehicle, so better than trying to accommodate a whole range of ports and sockets on the outside of the vehicle you might like to consider a floor port. In this picture you see a section of 4" (110mm) household waste pipe being repurposed for the job. Cut the hole with a whole-saw or a jigsaw, paint the cut edge of the metal and seal the underside of the vehicle body with a good quality marine mastic.



Divide your space into both operator and storage areas. Keep the operator space simple and uncluttered.



Don't take all of your antenna cables directly to the back of the radios, instead use a patch panel which will allow the easy and quick installation of new radios and the patching to new antennas from existing radio equipment. Keep connectors common (here we see all PL259 being used) and label everything.



Have plenty of spare power for extra equipment which might be required at short notice.



Find ways to use every space.