**Morrow Project Updated Communications**

Morrow Project Modern radio systems are hybrid SDR systems that can receive a very wide range and transmit in specific frequency bands for portable and wide ranges for mobile and base radios. This means they can listen from DC to 2.4ghz in CW,AM,USB,LSB,FM FSK,PSK,and all known digital modes. Modern Processing capabilities give these radio systems capabilities that were impossible only a decade ago.

Standard Morrow Radio operations use a DMR communication with the options for no encryption, simple cipher key and AES256. Due to the advanced processing every radio can be used to try and crack an encryption. By recording the digital signal it can then start brute force cracking of the encryption. Some take only minutes, AES256 can take longer at 27 Trillion Trillion years. Battery life may be an issue trying to crack AES256, plugging into a power source is highly recommended.


Vehicular radios have the ability to transmit and receive on everything they can listen to as long as they have a proper antenna installed for that band. All vehicles come with self tuning antenna systems but some of the Lower HF will have severely limited range if a longwire is not attached. The vehicular radios have multiple data interfaces and a dedicated computer and navigation database. These also contain an updateable atomic clock for a precision time base

for portable navigation enhancement. Data connections to vehicular nav displays as well as project computing devices are available. Multiple control heads are available so that comms can be handled by multiple operators. Multi band operation is possible on up to 4 simultaneous bands.

Each radio can also act as a repeater to extend radio operation range. Portables can even be turned on in a repeater mode so that a chain of teams can stay in communication well past the operational range maximums of 10Km from mobile to handheld and 5K range handheld to handheld. Mobile to Mobile is possible to have about 25Km range with a base station set up on a hill with the portable tower erected to extend up to 100km range. Data can also be repeated along this path, location finding ceases to function in this mode.

**LOCATION REPORTING**

A notable feature of all Morrow Radio gear is the inclusion of gyroscopic dead reckoning hardware that can get updates from the vehicles that use a far more advanced dead reckoning navigation location system that is also updatable by celestial measurement. By using modern super fast processors and precision time clocks a single vehicle with the standard 4 antenna array can get an instant heading from a radio transmission. And then send a quick timing message to measure distance. This can get within a 30 meter radius accuracy when the portable radio is within a 1500 to 2000 meter distance. Accuracy starts to suffer at a rate of 2 meters per 100 meters distance increase. When two stations are available and their positions known then the radio network can use timing principals that are found in GPS and LORAN systems to measure distance and bearing from the two fixed locations to get a 10 meter radius accuracy up to 5Km with a degrading accuracy as distance increases.

This data is not accurate enough for surveys of land plots but for tactical awareness it can significantly reduce the search radius to find a injured person or travel to a waypoint. If a portable radio is on a known map point they can be updated to a corrected position and then the accuracy is back to normal for d100 minutes before it starts to drift at 1M per minute until it is a max accuracy of 100 meters. The portable can update their data from the stored USGS maps or the mobile or base stations can update that units information based on a report.

More fixed locations with correct locations stored increase accuracy. Data packets are sent regularly from radio to radio but can be changed to tactical mode when they are only sent when the user keys the mic. This allows a team member sneaking up on a position to silently key the

radio to send an updated position.  In this mode updates sent to the radio are completely silent and do not light the screen or notifications.

**SATELLITE DATA LINKING**

Any base station or mobile radio can be interfaced to one of two high power satellite communication arrays to allow over the horizon communication as well as global communication.  The optional SATCOM kits have two operational modes,  Turnstile non pointing for LEO communications and self aiming and setup suitcase dish systems that can utilize Geostationary and slow moving high altitude communication options.  Inputting a TLES (Two line Element Set)  will enable the system to communicate to the location hardware and get the dish pointed where the satellite should be and then start searching for a signal and lock on.

Example TLE data below….

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ISS (ZARYA)
1 25544U 98067A   08264.51782528 -.00002182  00000-0 -11606-4 0  2927
2 25544  51.6416 247.4627 0006703 130.5360 325.0288 15.72125391563537
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Once linked into a base or mobile radio all other radios in the network have the ability to use the communication pathways established if authorized from the operator control panel any time after linking.

There is a secondary mode that the SATCOM kits can use but they require to be vehicle powered as it will require very high power for operation and requires the optional  SKWV-3M  3 meter dish to be mounted in place of the standard 1 meter dish.  When enabled and placed in

a high location such as on top of the vehicle and has a clear unobstructed view of the sky for 20 degrees in the desired direction, SKYWAVE operation can bounce signals off of the troposphere and achieve about 300-800Km communications point to point at stationary locations. This mode of operation is dependent on weather and time of day. Sporadic E propagation events can disrupt communications for extended periods of time as well as minor solar storms. If the sun is within 10 degrees of the aiming point communications will cease until the sun travels out of the window. Skywave communications can vary by frequency, and can experience fading. WARNING: keep all personnel clear of a 20 degree window in front of the dish very high RF levels are present when transmitting and severe RF burns can and will happen.

**Stand alone portable Repeater kits**

Portable field repeaters that can be deployed at optimal locations can significantly increase the communication operational theater size. Each repeater if located 100 feet above the surrounding area will extend communications in a 100 Km circle around the repeater ( terrain can reduce this in some directions.) These repeaters, if precisely positioned and then programmed with their location, will also serve as location reporting base stations and further increase accuracy and range of equipment location reporting and calculation capabilities.

Each repeater station is self contained and can run for 3 days without sunlight to recharge it. More if put into a low power mode where location reporting assistance and telemetry is disabled. If discharged it will take 2 hours of sunlight to gain enough battery to operate normally. The system can run 100% on solar but a dead battery takes extra power draw to return to normal operation. Weather sealed and rugged, these can withstand extended and even permanent deployment.

**Advanced Tactical Awareness System**

All radios, Navigation systems and tactical computers can utilize the Morrow Tactical awareness system. This system produces an operation map with all team members visible at all times and can show information such as waypoints and marked items. If a patrol finds an interesting item they can mark it with notes and all other team members can see it's location and the notes. Even photographs can be uploaded via the system for detailed reports. Tactical

devices like laser rangefinding scope and spotting devices can also use the information along with heading and range finder data to also mark targets on the map so that other teams can know of possible contacts to avoid or engage. Moving units can have the directions and speed added and show last position and estimated position calculated by the software. For the device to participate in the ATAS it needs to be able to communicate on the same radio network with digital communication. A laptop may have the software installed but if it is not connected to a radio it can not see and send any data packets. Positional Accuracy of the radios and devices affects the accuracy of ATAS.