

ALABAMA EDUCATIONAL TELEVISION COMMISSION

MICROWAVE SYSTEM REPLACEMENT AND UPGRADE

1.0 Alabama Educational Television Commission is requesting bids for replacement of its current microwave interconnect system. The system is basically 7 GHz with one 13 GHz hop in Birmingham. The replacement will also include several upgrades. The current system is a duplex non-redundant system with 29 hops including nine television transmitter sites. In the replacement system all sites will become hot standby sites. There will be the addition of one hop from the Flagg Mountain site to the Clanton EMA headquarters. The radios will be included for this new hop in this bid; however the tower, lines and dishes will be part of a separate bid. Some sites may require the addition of space diversity antennas on the receive side. These will have to be evaluated on a hop by hop basis and if needed will be part of a separate bid request. Venders will be required to do a path analysis of the system and make recommendations as needed to insure reliable performance of the system. The system shall be designed around attempting to achieve 99.999 per cent reliability with no reliability between any two hops being less than 99.99 per cent and overall system reliability must average no less than 99.995. The system will operate under FCC part 74 Rules and Regulations. There must be a total available bandwidth available for AETC use of no less than 70 Mbps utilizing 16QAM modulation. At a minimum the system will be required to support two separate 19.39 Mbps ASI streams, one 5 Mbps occasional use ASI stream, and a 20-25 Mbps Ethernet network. The occasional 5 Mbps will be between one-way from the Network Operations Center to the Montgomery studio. When the occasional 5 Mbps stream is not being used, the bits shall be allocated to the Ethernet network to ensure a 25 Mbps network. Radios must be capable of other modulation schemes ranging from QPSK to 64QAM which can be selected remotely and can differ from one hop to the next. The system must have an embedded monitor and control system which utilizes browser support. The monitor and control must report back to a central computer/appliance in Network Operations to allow for alarm notification from any of the sites without operator intervention. There will be a **required site visit** by venders, although it will not be necessary to go to each site as many are exact in description and equipment. **APPENDIX B** lists all the current microwave licenses along with other information pulled from the license. A map of the APT microwave system is included as **APPENDIX C** - the hops AUM, EV Smith and AU Studio are not included in this project.

2.0 GENERAL SPECIFICATIONS

- 2.1 All radios shall be of an integrated design.
- 2.2 There must be hot standby support at all sites and errorless priority switching support at sites which may have space diversity added.
- 2.3 There must be embedded monitor and control Web browser support.
- 2.4 The system shall maintain FCC requirements to allow part 74 licensed radio links as the final link to the nine TV transmitter locations.
- 2.5 The system shall be designed around 16QAM modulation which will support 72 Mbps at 19.9 Msps thus staying within the 25 MHz licensed bandwidth.
- 2.6 All ASI signals shall interface directly to the system to eliminate the need for external converters or adapters.
- 2.7 All ASI data rates shall be independently adjustable between 1-90 Mbps.

- 2.8 There shall be a minimum of four (4) available data interfaces which are internally multiplexed at transmit inputs and de-multiplexed at receive outputs.
- 2.9 During the ASI Multiplexing process, under no circumstance shall any PIDs in the MPEG transport stream be remapped.
- 2.10 All available bits above video requirement shall be allocated to Ethernet data support. The minimum user available bandwidth allowed will be 24 M/bps when the occasional 5 Mbps ASI stream is not being utilized. This does not include any required overhead.
- 2.11 A LAN extension shall be available at all sites to allow for remote control and monitoring of any IP addressable device at a site. All radio interfaces must be open data port supporting open Ethernet connectivity. This shall be an open pipe design and not require a physical Ethernet interface.
- 2.12 A 24 port layer 2/3 switch shall be included at each site for local site connection into the Ethernet portion of the data stream. This switch must have the capability to control the data rates available to each port.
- 2.13 The data switch will serve as the demarcation point for the system and APT will be responsible for configuring past that point.
- 2.14 All radios and associated equipment shall be -48 volt operation with the exception of the alarm system master. Some sites which are currently -24 volt will be changed to -48 volt by APT staff for conformity throughout the system.
- 2.15 All radios shall contain IP addressable Ethernet/IP interface with Web Browser interface and SNMP management support.
- 2.16 All radios shall have an internal processor to monitor all system functions and allow remote control via IP interface Web Browser.
- 2.17 All transmitters at any hop longer than fifteen miles must have the High Power Option included.
- 2.18 All radios shall have user definable interface support and support a minimum of three inputs **NOT** including the Ethernet 10/100 BaseT. All radios must be supplied with two (2) ASI (BNC) and one (1) high speed Ethernet (RJ45) ports. The radios in the direction from NOC to WAIQ will be supplied with three (3) ASI ports.
- 2.19 The 5 Mbps ASI port must be able to be turned off when not in use and the bits allocated to the Ethernet.
- 2.19 All radios must have an integrated multiplexor.
- 2.20 Transmitters and receivers must be separate units and cannot be included in the same mainframe.
- 2.21 Supplier must provide turn-key system to include factory build, integration and testing of hardware, installation, commissioning and training services.
- 2.22 Supplier must have been in the business of manufacturing microwave radio equipment for a minimum of twenty (20) years.
- 2.23 Supplier must be ISO2009 certified.
- 2.24 Supplier must provide 24/7 support for supplied equipment.

3.0 ALARM AND MONITORING SPECIFICATIONS

- 3.1 The following items 3.2 through 3.46 apply to the Master Station and items 3.47 through 3.80.4 refer to the remote terminal units. All items are mandatory unless

designated option/capable with capable meaning supporting the feature as a future purchasing option.

- 3.2 Unit shall be rack mountable in a standard 19 inch rack.
- 3.3 Unit shall have dual 110 volt AC power supplies
- 3.4 There will be a front panel LCD to display unit status
- 3.5 Unit will have a 3.0 GHz processor or better.
- 3.6 Unit will incorporate a mirrored hard drive or RAID array.
- 3.7 An internal CD-R writeable drive, USB port and 3.5 inch floppy are required.
- 3.8 Unit must support an optional SVGA or better monitor and keyboard.
- 3.9 Unit must have a 10/100 BaseT LAN interface.
- 3.10 Must have the ability to support concurrently poll protocols on multiple ports.
- 3.11 Must either come standard with or have option to support alarm mediation such that it will selectively forward the alarms collected to another monitoring platform using any of the following protocols: SNMP, V1 and V2.
- 3.12 System shall support up to at least 15 concurrent users for monitoring functions.
- 3.13 Must be capable of supporting a redundant master architecture with database and alarm synchronization via LAN. Initial deployment will only have a single system.
- 3.14 Must have the following system security attributes and must have independent control access to specific functions per individual users.
 - 3.14.1 Restrict which alarms are visible to each user.
 - 3.14.2 Alarm Acknowledgement control by classification of alarms.
 - 3.14.3 The ability to silence alarms by group or individual point.
 - 3.14.4 The ability to issue control.
 - 3.14.5 The ability for data basing and reporting control.
 - 3.14.6 The unit must have a diagnostic mode.
 - 3.14.7 The unit must allow trouble log access control.
 - 3.14.8 There must be the ability to create security profiles for user groups.
 - 3.14.9 Certain levels shall have user ID password enforcement.
 - 3.14.10 System must store which user acknowledges an alarm.
- 3.15 Support software modularity so we do not end up buying functionality not needed.
- 3.16 Software licensing must be such that once a protocol is purchased on the system there are not additional charges for devices used. EG: in the case of SNMP no charges per IP monitored or specific device types.
- 3.17 Vendor must be able to remotely support the alarm master via direct dialup modem connection into the master. Database administrator should be able to see all actions as they are performed by vendor.
- 3.18 The alarm history must maintain at least 750,000 alarm events with reports selectable by date, site, point and time. The alarm history must be CSV exportable.
- 3.19 The unit must have diagnostic ability to troubleshoot the system and network.
 - 3.19.1 Must check master station hardware components.
 - 3.19.2 Gather statistics on quality of polling per address.
 - 3.19.3 Gather statistics on quality of polling per polling port.
- 3.20 Must have internal operational alarms such as CPU temperature, fan and fuse which appear like any other system event alarms.
- 3.21 The alarm display shall have the following attributes.
 - 3.21.1 APT shall be able to customize the alarm display format to which fields are to be displayed and in what order and color.
 - 3.21.2 Clear alarms shall be able to be displayed in a different color than failed alarms.

- 3.21.3 Must be able to display all alarms that are currently in existence.
- 3.21.4 Must be able to display a separate list of all event change of state that has not been acknowledged by the user.
- 3.21.5 Display both the date and time the alarm was reported to the master.
- 3.21.6 Support and display RTU collection time stamp information.
- 3.22 The unit must have an audible alarm to generate sounds when there are critical, major or minor alarms pending.
- 3.23 The unit must support the ability to interface with an external alarm annunciation device.
- 3.24 The alarm point attributes shall have at least the following characteristics.
 - 3.24.1 Must support N/O and N/C operation with reversible alarm points.
 - 3.24.2 Must have a primary alarm description field of at least 40 characters.
 - 3.24.3 Must have a secondary alarm description field.
 - 3.24.4 Must have at least 4 severity levels: Critical, Major, Minor and Status
 - 3.24.5 Separate condition indicators for Fail and Clear: EG- Door open/closed
 - 3.24.6 The ability to classify the alarm into at least 5 groups; EG- Critical, Power, Generator, Area of responsibility and Standby switch.
 - 3.24.7 Independent control of whether the alarms go to screen or to history file.
 - 3.24.8 Must have the ability to delay the reporting of an alarm until it has been in the system for a specified amount of time.
- 3.25 Must have the ability to create higher level alarms based on the presence of specific combinations of other alarms. Also must take into consideration time of day or day of week.
- 3.26 System shall be capable of collecting, displaying and storing analog readings.
- 3.27 Users shall be able to remotely operate relays contained in RTU.
- 3.28 Must have a real time clock and must have the ability to sync with time sources via network.
- 3.29 Must have the ability to easily take devices off line.
- 3.30 Must have detailed help in-cooperated within the programs.
- 3.31 The system must support serial connectivity in addition to LAN. The serial I/O must be able to natively expand up to 24 ports with the ability to be equipped with any of the following interfaces: RS232, RS422/485, V.23/202 and dial up modem. Each individual port must be modular for easy replacement and future expansion. The initial configuration shall be one RS232 and three 33.6 or better modems.
- 3.32 The LAN interface must have the following attributes.
 - 3.32.1 Must support polling of DCPF/DCPX family of alarm remotes.
 - 3.32.2 Receiving SNMP traps and Forwarding SNMP traps should these modes be required.
 - 3.32.3 Remote alarm viewing using web interface.
 - 3.32.4 Shall support or have the ability to support HTTPS.
 - 3.32.5 Windows client software for remote access and alarm viewing. Installation without licensing fees on as many PC's as required.
 - 3.32.6 FTP capability.
- 3.33 The graphical interface must have the following attributes.
 - 3.33.1 Must have software that presents a "war room display" that runs on APT's Windows XP or Vista platforms. As new Windows platforms are developed, Windows 7, it is hoped the software will be developed to run on those platforms.

- 3.33.2 System must come equipped with two instances of graphical software and have the ability to add up to 10 more if required in the future.
- 3.33.3 Maps must be GIS based.
- 3.33.4 Must be able to have multiple layers on the map.
- 3.33.5 Must be able to use our own JPG or BMP backgrounds.
- 3.33.6 Graphical interface must be able to launch web browsers, applications and telnet sessions.
- 3.34 The following protocols must be present on initial deployment: DCPX, DCPF, SNMP Inbound and ICMP/TCP/UDP.
- 3.35 System must come standard with or have the option of supporting the following protocols: NEC, MODBUS, Badger, Larse, ASCII, TL1, Datalok, Teltrac and TRIP.
- 3.36 The system shall support the following notification methods: email, Numeric pager, Alpha Numeric pager and SMS messaging.
- 3.37 The system shall have a schedule on who should be emailed or paged for various categories of alarms.
- 3.38 System shall be capable of escalating an alarm after a specified period of time if no response.
- 3.39 Alarms must be able to be filtered on a per-alarm by both time and frequency. EG- if standing by X minutes or X times in X minutes.
- 3.40 Alarms must be able to be disabled either until further notice or for a specified start and end time.
- 3.41 The software used must be currently deployed in over **75** locations and have been in production for at least **3** years. Vender must provide references.
- 3.42 There must be a minimum **2** year warranty on the hardware and 90 days on the Master Station software.
- 3.43 There must be an ongoing annual software and hardware maintenance program.
- 3.44 Vendor must offer regular training sessions at the factory.
- 3.45 Vendor must be able to offer on-site training services if requested.
- 3.46 Software manufacturer must have been in business for at least **5** years.
- 3.47 Remote terminal units must contain at least the following alarm, control and analog inputs unless specified for a particular location: **32** discrete alarms, **8** control and **8** analog. Television transmitter and some microwave hop sites will require addition alarms and control. A listing of the number of inputs required at each site is contained in **APPENDIX A**. Additional inputs can be obtained through internal expansion or daisy chaining additional units. All remote terminal units shall be **-48 VDC** input voltage.
- 3.48 Discrete alarm inputs must have the following attributes.
 - 3.48.1 32 optically isolated alarms.
 - 3.48.2 Software reversible (N/O and N/C) operations.
 - 3.48.3 Must terminate in industry standard connectors on all inputs and outputs.
 - 3.48.4 Must support alarm qualification times for declaring alarms.
- 3.49 Control outputs must have the following attributes.
 - 3.49.1 Minimum of 8 relay contacts.
 - 3.49.2 Form A with N/O or N/C selectable operation.
 - 3.49.3 Maximum input voltage shall be at least 60 VDC/120VAC at 1 Amp.
- 3.50 Analog inputs shall have the following attributes.
 - 3.50.1 Input voltage range shall be -94 to +94 VDC or 4 to 20 mA current loop.
 - 3.50.2 There must be at least 4 alarm thresholds: major plus, major minus, minor plus and minor minus.

- 3.51 The unit must have the ability to ping up to 32 IP addresses and send notifications after no responses.
- 3.52 Ability to SNMP V1 ping (GET) up to 32 devices and send notifications after no responses.
- 3.53 RTU must support Dual 10/100 BaseT Ethernet so it could reside on two networks.
- 3.54 Unit to have PPP support with Client and Host capability in permanent, backup or on-demand setting.
- 3.55 Must have an integrated modem for alternate access.
- 3.56 RTU must have a RS232 craft port for on-site access.
- 3.57 RTU must have the following reporting and notification capabilities.
 - 3.57.1 SNMP with version 1 traps, version 2c informs and traps and version 3 traps.
 - 3.57.2 Granular MIB with 1 unique trap ID for each individual alarm and clear.
 - 3.57.3 Must be able to send traps to at least two different physical masters.
 - 3.57.4 Must be able to issue a Get and Set.
- 3.58 Must support the DCPX protocol to an upstream master via LAN or RS232.
- 3.59 Must support Alpha and Numeric paging.
- 3.60 Must support e-mail notification.
- 3.61 Web Browser access shall support monitoring and control functions along with database modifications.
- 3.62 Multiple people should be able to access the Web Browser monitoring screens concurrently.
- 3.63 The local audio/visual notification shall have a LCD which displays a descriptive list of failed alarms and crossed analog thresholds. There shall be a local audible alarm for changes in state which can be muted if desired.
- 3.64 Unit must come with a Windows based utility for provisioning via LAN, dialup or directly to the unit.
- 3.65 Unit must have the following terminal server functionality.
 - 3.65.1 Must have at least 8 RS232 ports capable of 115,200 baud
 - 3.65.2 Must have at least 1 RS422/485 port capable of 115,200 baud
 - 3.65.3 Ports shall have send and receive traffic indicators.
 - 3.65.4 Unit must be accessible from LAN via Telnet and provide dialup capability.
 - 3.65.5 Serial ports shall employ RJ45 type connection termination.
- 3.66 Firmware must be downloadable via LAN as well as through the craft port.
- 3.67 RTU software updates should be available at the vendor's web site at no charge.
- 3.68 Unit must have multiple user profiles with access rights. EG: view, edit, various access.
- 3.69 Must have a secure modem call back, support IP white or black list, radius support and it is desirable to have a Hardware Accelerator (HTTPS support).
- 3.70 Unit must support NTP time synchronization protocol.
- 3.71 Unit must time stamp alarm events.
- 3.72 Unit must maintain a recent event history for review.
- 3.73 Must have a real time clock.
- 3.74 Must have an internal temperature monitoring ability.
- 3.75 Must support dual -48VDC feed with current draw not to exceed 300mA.
- 3.76 Easily accessible external fuse with fuse blown indicator and closure alarm.
- 3.77 Must have battery voltage monitoring for each individual power feed.
- 3.78 Desirable to have a 12 volt output to power external power sensors.
- 3.79 RTU's must have the following physical and environmental attributes.
 - 3.79.1 Unit shall be 1 RU in height and not exceed 12 inches in depth.

- 3.79.2 Unit shall mount in a standard 19 inch rack.
- 3.79.3 RoHS 5 of 6 or better.
- 3.79.4 Operating temperature rating of 32 to 140 degrees Fahrenheit with non-condensing humidity up to 95%.
- 3.80 Units shall have the following expandability options.
 - 3.80.1 Option to add addition alarm points.
 - 3.80.2 Option to integrate with a building access system.
 - 3.80.3 Option to drive remote enunciation displays.
 - 3.80.4 Web browser must be capable of supporting a LAN based camera control.

4.0 RADIO SPECIFICATIONS

- 4.1 All radios shall have variable symbol, constellation and forward error correction rates. FEC must include Reed-Solomon and selectable rate Viterbi technology. The Viterbi rates shall include $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$ and $\frac{7}{8}$.
- 4.2 Radios shall be capable of modulation schemes ranging from QPSK to 64QAM. Modulation schemes must be able to be changed remotely. The modulation scheme must be able to be changed on a particular microwave leg or even between hops.
- 4.3 All radios shall have a field tunable integrated upconverter/oscillator with less than 5ppm stability and less than .6 degrees of RMS phase noise.
- 4.4 All upconverter/oscillator assemblies must be field tunable across all channels used by APT depending on band (7 or 13 GHz).
- 4.5 All radios and associated equipment must be -48 VDC input.
- 4.6 The Hot Standby shelf shall have the following attributes.
 - 4.6.1 Monitoring of all local radio fault parameters.
 - 4.6.2 Signal and RF switching based on fault acknowledgement.
 - 4.6.3 Signal distribution through active buffer stages that are protected through dual redundant buffer design.
- 4.7 All transmitters must have a minimum of +30dBm power output measured at the output of the radio with 16QAM modulation.
- 4.8 At all sites where path is longer than fifteen miles a high power option must be installed in the transmitters. This option must increase power by not less than 3db. A map of the APT system is included as **APPENDIX C**.
- 4.9 All radios shall have the ability to have either internal or external RF filters. The system will use the current external filters as per **Appendix A**. The use of additional internal/external filters as specified in **Appendix A** shall be part of the base bid. Also the base bid must include any adapters and cables required to connect radios to current filters.
- 4.10 All receiver radios shall have a noise figure of less than 4db. The system gain shall be at least 115db typical at 16QAM.
- 4.11 All receivers must have an RF input dynamic range of -30dBm to -85dBm at 16QAM.
- 4.12 The highest possible sample rate must be used for all A/D and D/A conversion.
- 4.13 All receivers must have a minimum of 5 adaptive demodulation modes which can be selected remotely.
- 4.14 There must be an integrated internal pseudo random bit stream generator for testing which can be remotely selected.

- 4.15 All radios must have a summary alarm set of contacts to connect to an external alarm indicator.
- 4.16 MER performance shall be greater than 14db for QPSK, 21db for 16QAM, 26db for 32QAM and 28db for 64QAM.
- 4.17 The single carrier digital modulator/modem shall be selectable to include QPSK, 16QAM, 32QAM and 64QAM. This selection must be able to be changed through the remote control of the system.
- 4.18 The single carrier digital modulator/modem shall have a capacity of up to 175 Mbps of data.
- 4.19 The receiver equalizer architecture shall use the latest technology and have at minimum 15 taps of adaptive filtering algorithm and a minimum propagation delay of 6.3 nsec for multipath Dispersive Fade Margin.
- 4.20 All ASI inputs must be 75 ohm unbalanced and meet DVB-ASI per EN 50083-9 standards compliance.
- 4.21 All 10/100 BaseT inputs shall have user programmable HDLC and LAPS mapping protocol. These inputs must comply with IEEE 802.3-2002, RFC1662, RFC2615 X.86 and RMII standards.
- 4.22 All radios must operate within specifications with environmental conditions between 32 to 120 degrees Fahrenheit with up to 95% non-condensing humidity.
- 4.23 All radios must have a front mounted indicator to indicate a major or minor alarm status of the radio.
- 4.24 Transmitter systems must have an external 70 MHz IF input via BNC connector and also have an external 70 MHz IF monitor output.
- 4.25 Receiver systems must have an external 70 MHz IF monitor output via BNC connector.
- 4.26 Receiver systems must have provision for external digital baseband data cross-connect to allow future upgrade for ASI hitless diversity receive configuration.
- 4.27 All input/output connections shall be located on the rear panel of the radio systems
- 4.28 Transmitter and receiver front panels shall only include monitoring functions. There shall be no front panel local control interface in order to prevent unauthorized/unintended system configuration changes.

5.0 INSTALLATION

- 5.1 Vendor shall be responsible for the installation and on-site testing of all radios along with associated alarm and monitoring system.
- 5.2 Vendor will supply all tools and test equipment necessary for the installation and testing.
- 5.3 Vendor must coordinate with APT's Director of Engineering to schedule install dates. Ample time must be given for APT to redirect current services that might be interrupted during the install.
- 5.4 Once installation has begun, work shall be completed in the shortest time possible.
- 5.5 APT engineering staff will be available to assist with the installation.
- 5.6 The cost of installation and testing is to be included in the base bid price.

6.0 SERVICE AND WARRANTY REQUIREMENTS

- 6.1 Each bidder will guarantee all the equipment as represented in their bid against defects in materials and workmanship for a period of two (2) years minimum. The successful bidder further guarantees to replace or repair, without additional cost to the Owner, any items that become defective within the warranty period when the defect is clearly a fault of the manufacturer and not of misuse. This will include shipping to and from manufacturer for repairs or return of defective equipment.
- 6.2 Bidder's other standard terms, conditions and warranties will be accepted.
- 6.3 Any bidder offering warranties beyond two (2) years should clearly state the period of their warranties and any conditions pertaining to the extensions.
- 6.4 Bidder will guarantee to support all products included in bid for a period of not less than five (5) years from the date of installation.
- 6.5 Should vendor discontinue a product or support before the five year period, they must offer a substitute product with equal or greater specifications
- 6.6 Vendor shall supply APT with copies of all service and maintenance manuals to include interconnection diagrams and schematics which are non-proprietary. If a piece of proprietary equipment is discontinued, vendor will supply APT a copy of schematics and service information on such equipment.

7.0 QUANTITY TO BE PURCHASED

- 7.1 Vendor will determine the number of transmitters and receivers needed for completion of the system and include total in base bid.
- 7.2 At each installation site, vendor will determine the actual number of associated equipment needed at that site. This will include cables, adapters, Ethernet switches, alarm equipment and any other equipment needed at the site for complete install.
- 7.3 Base bid will include five (5) alarm remote terminal units for spares.
- 7.4 Base bid will include five (5) 7 GHz transmitters and five (5) 7 GHz receivers for spares.
- 7.5 Base bid will include one (1) 13 GHz transmitter and one (1) 13 GHz receiver for spares.
- 7.6 Base bid will include ten (10) power supply modules which can be used in the microwave transmitters and receivers. If a separate type of power supply module is needed for transmitters and receivers, the base bid will include five (5) of each type for a total of ten (10).
- 7.7 Vendor will include a recommended spare parts kit and include five (5) such kits as part of the base bid. Items listed in 7.3-7.6 are in addition to vendor recommended spares.
- 7.8 A site visit is required by vendors. To schedule the visit, contact Windell Wood – Director of Engineering, 205-876-6668 wwood@aptv.org or Charles Grantham – Chief Operating Officer, 205-572-2960 cgrantham@aptv.org .