LINEAR TRANSLATOR AND REMOTE BASE APPLICATIONS FOR A 10 GHz SDR RADIO SYSTEM

An application for an SDR-based radio system would be replacement of our existing linear translator and beacon at Mt. Allison in order to provide detailed technical feedback regarding a user's transmit signal, leveraging the capabilities of on-site DSP and a user's PC at home, running SDR software via an on-site data channel connection. Attributes reported would include transmitted frequency, RF signal strength, modulation level, spurious signal content and characteristics of other modulation modes as needed, and a visual real-time spectrum display would be available to group members.

Brian Kline WA6QDP has suggested that all this information could be embodied into a data channel-controlled remote two-way radio with a bit more effort. The tower-mounted transmit and receive modules would use a 2.4 GHz IF to communicate with the IF processor in the site vault, allowing increased upconverter/downconverter physical separation on the existing tower in order to minimize transmit desense in a full duplex application. The data channel would be implemented by a point-to-point 5 GHz WiFi bridge for bidirectional communications.

For a transceiver in receive mode, he envisions capturing a user-selected bandwidth slice of the 10 GHz spectrum and sending it digitally to the user, whose SDR software would then demodulate the baseband signal at the desired frequency. This process would be reversed to uplink a transmit signal using a narrower bandwidth within the same passband. The passband would be chosen to maintain reasonable link bandwidth. This would be a transmit/receive switched system (not full duplex).

Implementing separate transmit and receive passbands in the 10 GHz spectrum would enable full duplex translator communications from one 10 GHz station to another. Either transceiver or translator mode would allow monitoring the signals from multiple users within the passband.

This application would keep the SDR radio system project going, based on Gary Lauterbach's 10 GHz RF and IF hardware with the addition of the DSP processing and user interface software to enable data channel access with selectable baseband bandwidth. This design would exploit the capability of new IC chips that can downconvert from the 2.4 GHz receive IF signal direct to I and Q baseband waveforms for digitizing, prior to entering the downlink data channel. The transmit chain would operate similarly in the opposite direction.

This would basically be an upgrade to our existing analog linear translator and parametric beacon, with the same user base as present currently. A configuration diagram for this system is shown in Figure 1.

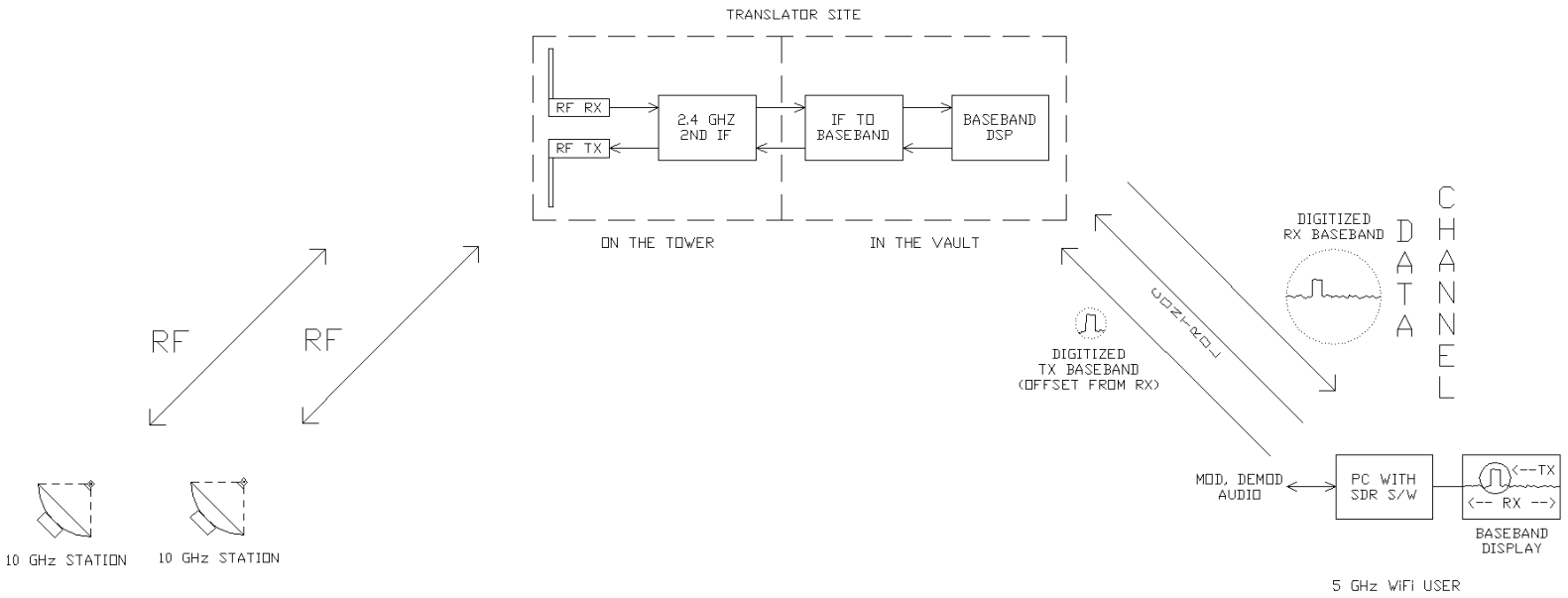
10 GHz DIGITAL TRANSLATOR CONFIGURATION DIAGRAM
TRANSLATOR SITE
RF RX
RF TX
2.4 GHZ
2ND IF
IF TO
BASEBAND
BASEBAND
DSP
ON THE TOWER
IN THE VAULT
RF
RF
DIGITIZED
RX BASEBAND
DATA CHANNEL
DIGITIZED
TX BASEBAND
(OFFSET FROM RX)
MOD, DEMOD
AUDIO
PC WITH
SDR S/W
<--TX
<-- RX -->
BASEBAND
DISPLAY
10 GHz STATION
10 GHz STATION
5 GHz WIFI USER

Figure 1.

Using the Allison development effort as a foundation, I'm particularly interested in what we could do with a second SDR-based system overlooking the San Joaquin Valley, in order to broaden group member 10 GHz communication opportunities beyond the immediate Bay Area. Candidate sites are being researched.

This second system would be useful for providing traditional beacon information in that area for dish pointing and frequency calibration.

A 10 GHz remote transceiver there would provide opportunities for Bay Area microwavers to talk to Los Angeles area folks if a suitable directional antenna is used, such as a higher gain horn or small parabolic dish. I'm told that propagation is possible into parts of Orange County (to Signal Peak in particular) and to the Palos Verdes peninsula from higher elevation San Joaquin Valley locations. In addition, there should be many more propagation enhancement opportunities for LA area hams at that distance than would be available to the Bay Area directly.

The San Joaquin Valley site would be controlled by another WiFi data link from an intermediate site that is visible to both the SJV site and to Mt. Allison, enabling an all RF path from a Bay Area 10 GHz station to Southern California.

A 10 GHz Bay Area to LA connection could be implemented by using the San Joaquin Valley system as a simplex narrowband remote base, using just a directional antenna pointed at Frazier and a few watts. A slotted waveguide omni antenna could be switched in for Bay Area to SJV coverage, or for beacon mode. The remote base radio would default to receive unless a digitized PTT signal is sent to it from Mt. Allison.

In my opinion, this would significantly encourage 10 GHz activity in the Bay Area beyond a few weekends a year currently. A configuration diagram for this system is shown in Figure 2.

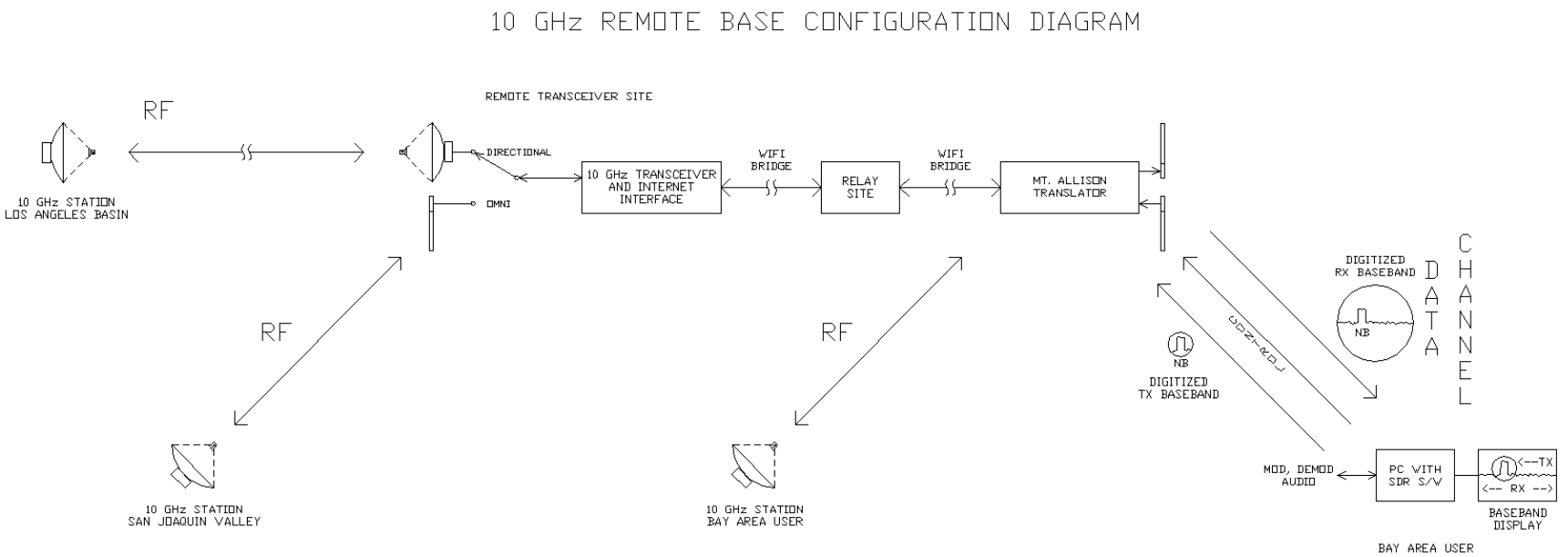
10 GHz REMOTE BASE CONFIGURATION DIAGRAM
RF
10 GHz STATION
LOS ANGELES BASIN
REMOTE TRANSCEIVER SITE
DIRECTIONAL
OMNI
10 GHz TRANSCEIVER
AND INTERNET
INTERFACE
WIFI
BRIDGE
RELAY
SITE
WIFI
BRIDGE
MT. ALLISON
TRANSLATOR
RF
RF
10 GHz STATION
SAN JOAQUIN VALLEY
10 GHz STATION
BAY AREA USER
NB
DIGITIZED
TX BASEBAND
DIGITIZED
RX BASEBAND
NB
DATA CHANNEL
MOD, DEMOD
AUDIO
PC WITH
SDR S/W
<--TX
<-- RX -->
BASEBAND
DISPLAY
BAY AREA USER

Figure 2.