Application Case Study

SIG-INT: Wideband Interception & Direction Finding System

VadaTech is known for our leading and bleeding-edge hardware solutions. In this application, our software development services took center stage, helping to fill in the gaps for the customer's SIG-INT application. The result was a new generation of radio platform for real time monitoring, listening and direction-finding on very wide high instantaneous bandwidth over the full VHF/UHF band.

Application

The SIG-INT solution was designed for wideband signal interception, monitoring and direction finding. The technology was based on direct sampling with a high interception speed. Combined with its related software linked to an integrated database, it allowed the automatic classification of collected data.

The SIG-INT system was comprised of a 5U processing unit and 1U RF frontend unit which allowed filtering and switching functions necessary for integration and interface with a DF antenna.

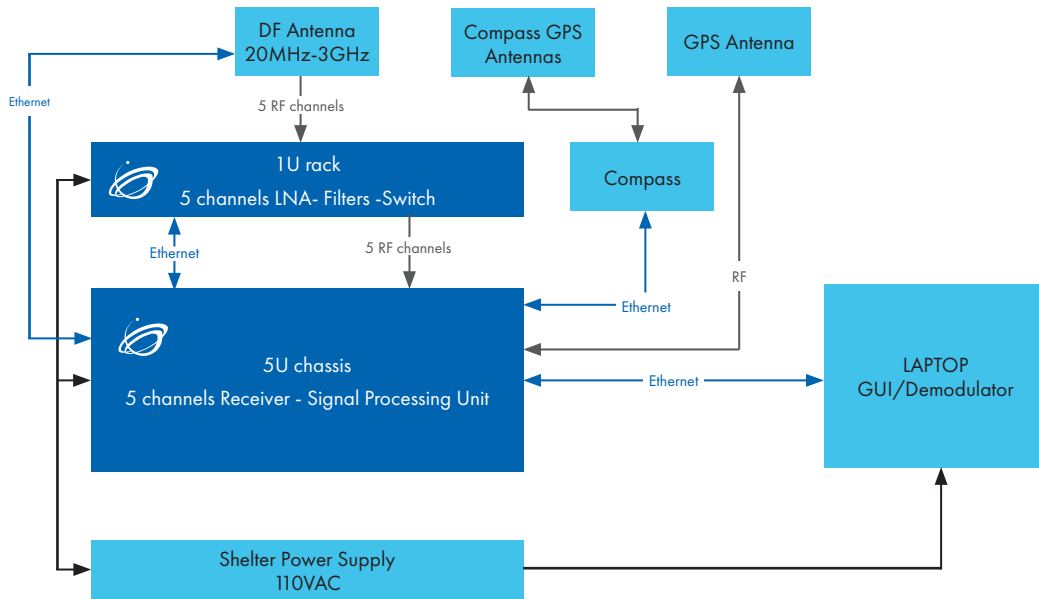## vadatech
THE POWER OF VISION

Figure 1: Architecture Block Diagram of the Full System

Base Platform

The base platform for the SIG-INT solution was based on a 5U MicroTCA chassis platform with several standard AMC modules. From a hardware perspective, VadaTech's vast ecosystem provided a complete solution. The platform comprised of:

- VT861 – 5U MicroTCA chassis platform (12 full size AMC slots, 1 MCH, 1 PM)

- UTC002 MicroTCA Carrier Hub (MCH)

- AMC720 Processor AMC, PCIe

- AMC600 storage module, SATA

- AMC514 Virtex-6 FPGA

- FMC225 4.0 GSPS ADC and 5.7 GSPS DAC

The rackmount chassis platform was lightweight, compact and modular. Figures 2 and 3 show the architectures of the chassis system and a photo of the loaded chassis. The AMCs provided signal processing, algorithm processing, storage and RF wideband interface functions. An AMC720 Single Board Computer based on Intel processor allowed the customer to design their GUI on an innovative web interface compatible with any OS. The architecture allowed the customer to develop some innovative key features including:

- Interception and direction finding of fixed frequencies, burst and frequency hopping with high instantaneous bandwidth in a frequency

Figure 2: Architecture Block Diagram of the loaded MicroTCA Chassis Platform

Figure 3: Loaded MicroTCA chassis platform

band covering 20MHz to 3000MHz

- Implementation of aggregated channels for larger monitoring bandwidth or five independent channels for simultaneous multi-operators monitoring.
- Client-Server architecture allowed remote control of the system.
- Scanning function allowed the user to control on one screen the whole spectrum from 20MHz to 3GHz
- The very high sensitivity combined with powerful algorithm offered the possibility to detect signals at -115dBm and to perform direction finding on signals with only 5dB of SNR.

- DF and ITU measurement simultaneously
- Monitored and DF simultaneously
- Scorpionware software allowed the end user to supervise the entire status of its system

Software Enhancement

The Customer required some software services to enhance the application. VadaTech provided various levels of software support including GUI and database development support for the interception and direction finding data. The end solution included robust algorithms to provide high end sensitivity and resolution. Figure 4 below shows the customized GUI interface developed with the customer.

The interception GUI is separated in 3 parts:

- **The graphical interface** (Figure 4 on the left) illustrated an example spectrum and waterfall. The user was able to see the 200MHz bandwidth on a spectrum on a signal strength/ Frequency over time interface. The spectrum automatically highlighted the Frequency of Interest that was selected in the interception list.
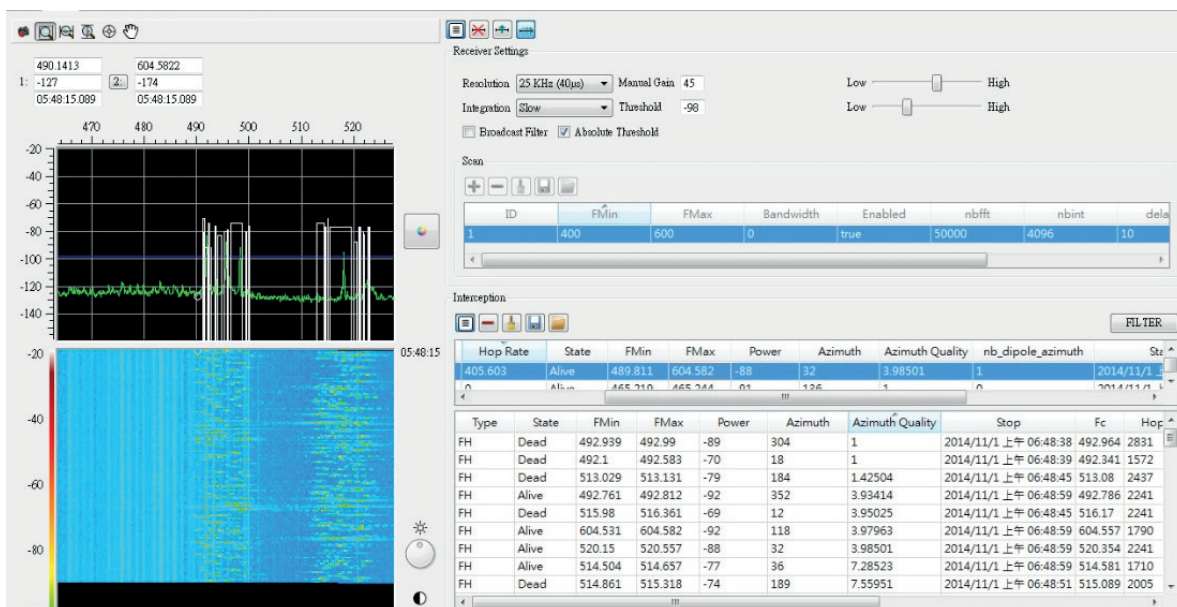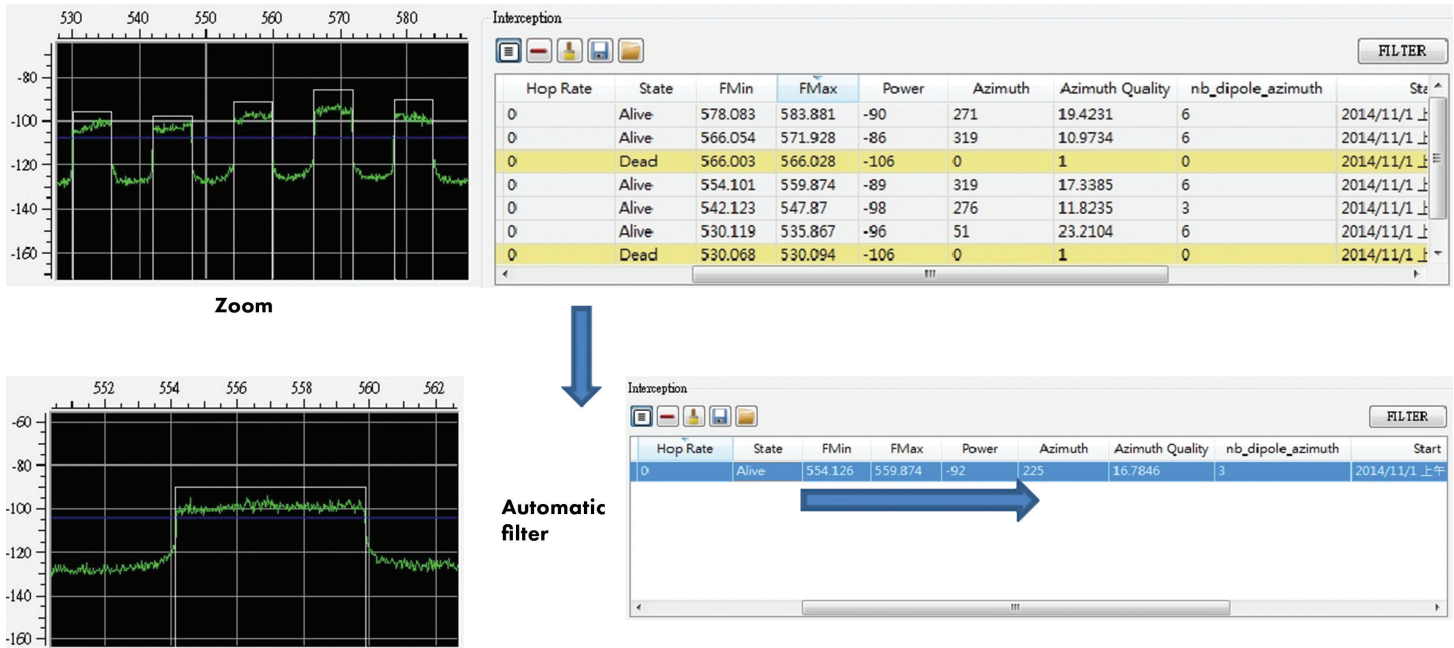

Figure 4: Customized GUI Interface

Figure 5: Zoom and automatic filter

- **The control interface** (Figure 4 on the top right) allowed the user to configure the following parameters:
  - Chose mode between fixed instantaneous Bandwidth or Scanning
  - Choose the resolution: 12.5, 25, 50, 100, 200, 400, 800, 1600 KHz
  - Controled the Gain
  - Controled the extraction threshold to filter the intercepted frequency based on their power level
  - Set the different scanning band to allow fast switching between different bands of interest
- On the bottom right **the result interface** (Figure 4 on the bottom right) allowed the user to visualize and filter the intercepted frequency:
  - Visualized all the frequency detected above the extraction threshold level
  - Visualized the history of one or several burst
  - Filtered the result in function of their power / frequency / azimuth / time of activity
  - Saved the interception list in a .scv format

Analysis Software

Another element of the SIG-INT platform was analysis software, making the end user experience as intuitive as possible. This included Zoom on the spectrum that would automatically filter the frequency of the interception list by displaying the frequency included in the zoomed window. See Figure 5 for an example.

Full control of the result table's column display was also implemented. This allowed the user to choose to focus on the parameters that were needed the most. See Figure 6.
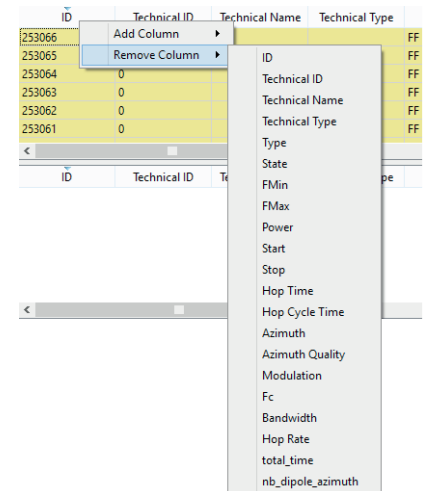

Figure 6: Table features

The customer also required the ability to automatically provide the direction of all the frequencies intercepted in the list. This enabled the user to see their position
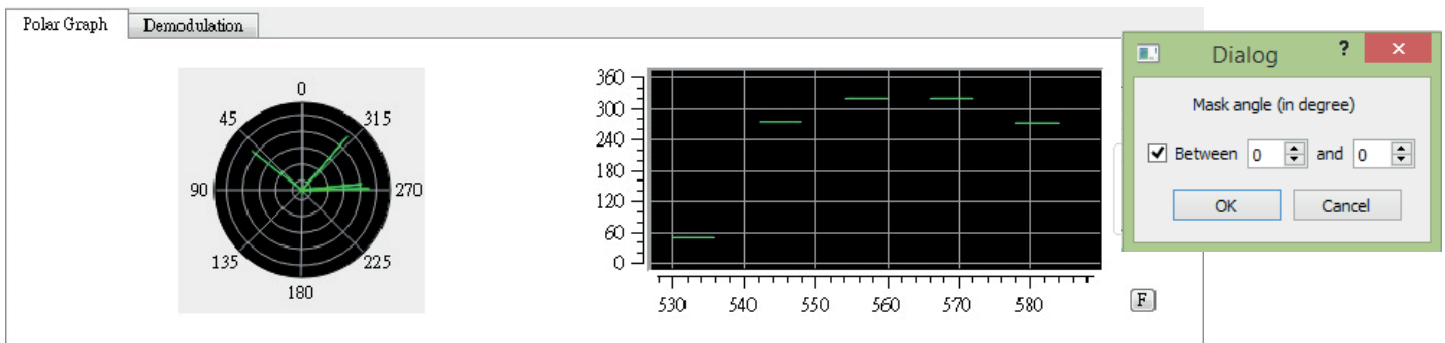
Figure 7: Intercepted frequencies and relative position

relative to the north or a given reference on a polar display, compare the azimuth of several frequencies and display one of the frequencies on a graph. See Figure 7 example. Further, areas could be masked to avoid noise from friendly targets or other transceivers.

As the customer had a mobile vehicle application, the customer desired some software customization to analyze the best site for deployment. By deploying the vehicle in an elevated area, they were able to find several good locations to start the signal interception. Figure 8 below shows the area topology and the corresponding elevation analysis tool.
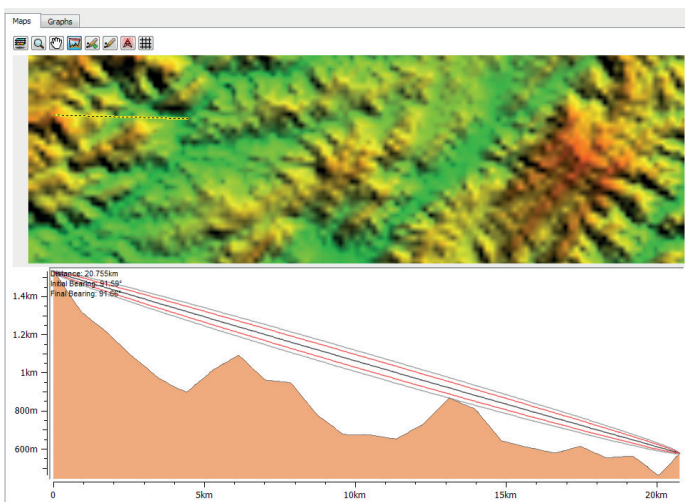

Figure 8: Elevation analysis tool for optimal deployment

Interception & Direction Finding

The SIG-INT platform's signal processing capabilities provided the ability to automatically perform direction finding on each intercepted signal using cutting-edge algorithms and provided azimuth via the user interface.

In case of multiple system deployment: once the direction of the transmitter of interest is known the C2 software was able to triangulate the signal and provide the GPS the location. See Figure 9.

Figure 9: Direction Finding (DF)

Wideband

As the band allocated to transmission in the applications, could be Aero or Combat Network Radio, as well as, combat units using multiple types of radio transceiver spread over a wide spectrum, it was key for a monitoring system to cover the widest band instantaneously. The SIG-INT solution offered high instantaneous bandwidth allowing the coverage of the full band and intercept FHOP signals spread on that spectrum.

Another useful tool in the application was VadaTech's ScorpionWare® System Management Software used to control, manage and monitor MicroTCA platforms. The software application provided an easy-to-use Graphical User Interface with several features for monitoring, trouble shooting and easy integration of these platforms.

Providing an interface to the VadaTech MicroTCA Shelf Manager or the Carrier Manager, the interface was based on IPMI 2.0, AdvancedTCA PICMG 3.0, and MicroTCA 1.0 specifications. Scorpionware could be used to access information about the current state of the Shelf or the Carrier, obtain information such as the FRU population, or monitor alarms, power management, current sensor values, and the overall health of the Shelf. The interface could also be used to update Shelf and Carrier configurable parameters.
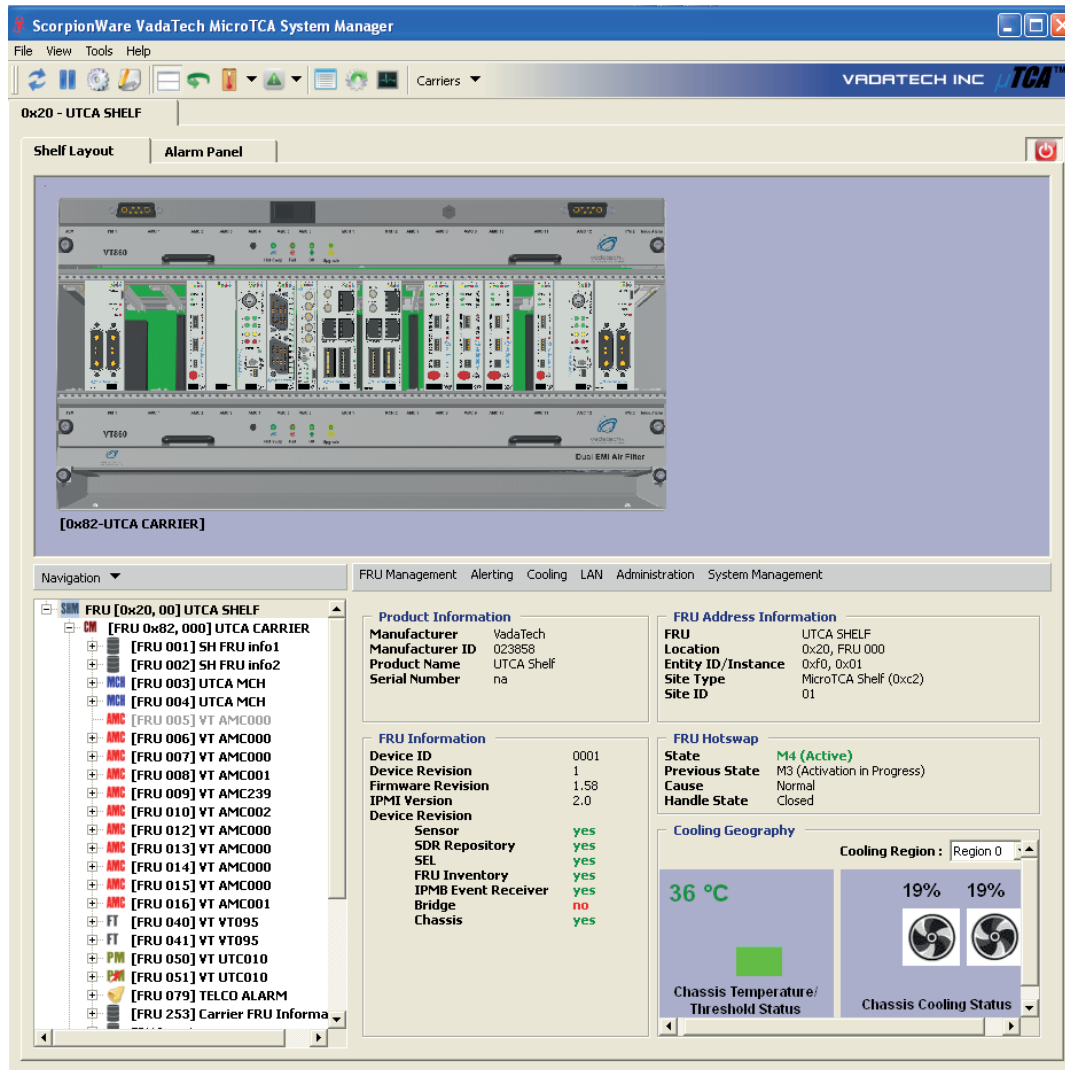

Figure 10: Scorpionware GUI example

Conclusion

With a strong foundation of cutting-edge hardware products, VadaTech can also support and accelerate Customer software development to enhance your application's design. Contact us at info@vadatech.com to discuss your requirement.

Contact

VadaTech Corporate Office

198 N. Gibson Road, Henderson, NV 89014
Phone: +1 702 896-3337 | Fax: +1 702 896-0332

Asia Pacific Sales Office

7 Floor, No. 2, Wenhu Street, Neihu District, Taipei 114, Taiwan
Phone: +886-2-2627-7655 | Fax: +886-2-2627-7792

VadaTech European Sales Office

Ocean Village Innovation Centre, Ocean Way, Ocean Village,
Southampton, SO14 3JZ
Phone: +44 2380 381982 | Fax: +44 2380 381983

info@vadatech.com | www.vadatech.com

Choose VadaTech

We are technology leaders

- First-to-market silicon
- Constant innovation
- Open systems expertise

We commit to our customers

- Partnerships power innovation
- Collaborative approach
- Mutual success

We deliver complexity

- Complete signal chain
- System management
- Configurable solutions

We manufacture in-house

- Agile production
- Accelerated deployment
- AS9100 accredited

vadatech
THE POWER OF VISION