Media's Role in Building a Weather-Ready Nation: Deployment of the First Network of TV Station-Owned High-Frequency S-Band and Fixed & Mobile X-Band Weather Radar Systems in the US

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Introduction

Earlier in 2016, one of the numerous major US media outlets embarked on an aggressive, new campaign to advance TV weather technology to a whole new level. As part of this project, Enterprise Electronics Corporation (EEC) developed and deployed a network of two new types of technologies, both a first of their kind in the media weather industry. The new EEC Defender SK1000H High-Frequency (3.5-3.6 GHz) Dual-Polarization S-Band Doppler Weather Radars, as well as a fleet of mobile EEC Ranger-X5 Dual-Polarization Solid-State X-Band Doppler Weather Radars have changed the way TV stations gather and disseminate life-saving weather information. In addition to these new types of radar systems, EEC also deployed numerous fixed Ranger-X5® radars, as well as a standard-frequency (2.7-3.0 GHz) Defender S1000 Dual-Polarization Doppler Weather Radar to media outlets around the US, further expanding the footprint of this ever-growing network of TV-owned radar systems.

Using critical, time-sensitive information captured by these new systems, TV stations in some of the largest population centers in America are now able to better arm not only their on-air meteorologists, but also local entities, such as emergency managers, first responders, government officials, and public businesses. These efforts further the goal of building a Weather-Ready Nation and transforming weather operations in the media sector to help America respond. Not only has the project been an overwhelming success, but the new technologies have proven the value of operating a network of radars as it pertains to advanced warning during extreme weather events.

Systems Overview – Ranger-X5®

The Ranger-X5® Fixed and Mobile X-Band Dual-Polarization Doppler weather radars features include:

- Polarimetric system: Dual 500-watt transmitter design — flexible & redundant
- Solid-state transmitters: low cost, low power, high reliability
- X-Band frequency: compact size, high sensitivity
- Advanced super-high resolution 16-bit digital receiver (IQ2)
- Reliable antenna and pedestal system
- Remote operation, maintenance, and troubleshooting

Technical Specifications:

Ranger®-X5	
Operating Frequency	9200-9700 MHz
Pulse Width	0.4-100.0 µsec
Pulse Repetition Frequency	100-2500Hz, User Selectable
Dual-Polarization	Simultaneous H/V
Transmitter Peak Power	500W per channel
Antenna Gain	≥ 37.3 dBi (Mobile) / 40 dBi (Fixed)
Antenna Size	1m (Moible) / 1.8m (Fixed)
3-dB Beam Width	≤ 2.3° / ≤ 1.3°
Sensitivity @ Typical Range	18 dBZ @ 120km

Fixed Ranger-X5® Installation in Southern California

Mobile Ranger-X5® System Tracking Storms Near Dallas, TX

Systems Overview – Defender SK1000H

The Defender SK1000H is a 1-megawatt, high-frequency (3.5-3.6 GHz), dual-polarization Doppler weather radar system operating in the S-band frequency. As part of this project, EEC delivered 2 of the first high-frequency S-band weather radar systems in the world. Major features include:

- Polarimetric system utilizing Circular Depolarization Ratio (CDR) technologies
- 1,000,000 watt Klystron transmitter — high stability and coherency
- S-Band frequency: maximum storm penetration
- Advanced super-high resolution 16-bit digital receiver (IQ2)
- 20-foot antenna + 30-foot radome – high-frequency spectrum allows for < 1.0° beam width using smaller antenna (standard S-band would require 28-foot antenna to achieve < 1.0°)
- Remote operation, maintenance, and troubleshooting

Technical Specifications:

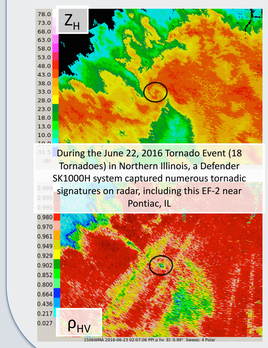
Defender SK1000H	
Operating Frequency	9200-9700 MHz
Pulse Width	0.4-4.5 µsec
Pulse Repetition Frequency	200-2400Hz, User Selectable
Dual-Polarization	Simultaneous H/V (CDR)
Transmitter Peak Power	1-megawatt
Antenna Gain	≥ 45.0 dB
Antenna Size	6.096m
3-dB Beam Width	0.95°
Sensitivity - Reflectivity	-20 dBZ @ 30km

TV's First-Ever High-Frequency S-Band Weather Radar (Outside of Chicago, IL)

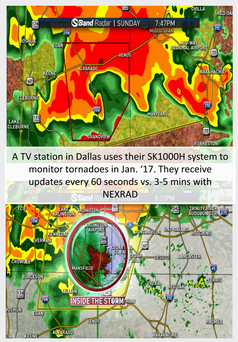
Defender SK1000H Installation Outside of Dallas, TX

Defender SK1000H Operational Success Stories

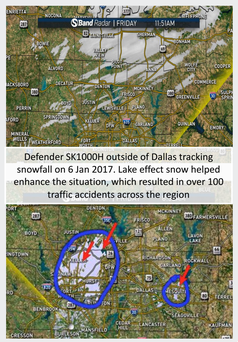
The two new high-frequency Defender SK1000H systems installed near Chicago and Dallas have already provided viewers in those markets with advanced warnings of impending severe weather. Data during these events was also shared with local emergency authorities to better spread the word and support the WRN initiatives.



During the June 22, 2016 Tornado Event (18 Tornadoes) in Northern Illinois, a Defender SK1000H system captured numerous tornadic signatures on radar, including this EF-2 near Pontiac, IL



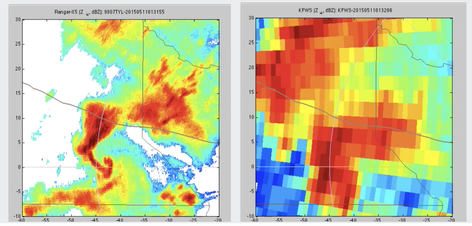
A TV station in Dallas uses their SK1000H system to monitor tornadoes in Jan. '17. They receive updates every 60 seconds vs. 3-5 mins with NEXRAD



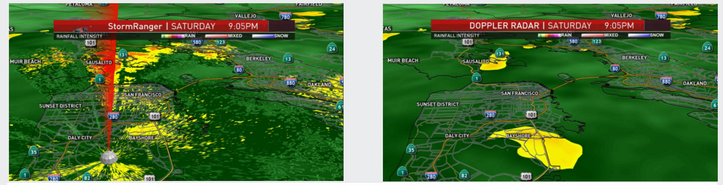
Defender SK1000H outside of Dallas tracking snowfall on 6 Jan 2017. Lake effect snow helped enhance the situation, which resulted in over 100 traffic accidents across the region

Mobile & Fixed Ranger®-X5 Deployments & Success Stories

Examples of Ranger®-X5 radar observations (fixed and mobile), which clearly depict the spatial and temporal resolution advantages provided by operating in the X-band spectrum.



Fixed Ranger®-X5 system in East Texas captures the Van, TX tornado in May '15. The higher resolution, gap-filling Ranger®-X5 system (left) shows much clearer detail of the hook-echo signature as compared with NEXRAD (right), even though some attenuation is seen (and expected).



A TV station in Northern California shows the drastic differences between Mobile Ranger®-X5 (left) and NEXRAD (right) data during the Jan. '17 flooding event, including better spatial and temporal resolution. Note the street-level details provided by the Mobile Ranger®-X5 system.

A TV station in Southern California uses their Mobile Ranger®-X5 system to track wildfires in the area. The higher resolution data provided local emergency managers with more up to date, accurate information on the location & movement of smoke plumes.

Conclusions

In the short time since the deployment of these new, cutting-edge systems, it is clear that the aim of this project has clearly been met. Meteorologists, emergency managers, and the public are now privy to more accurate, up to the minute weather radar information when they need it most. This has directly resulted in making the nation more ready, responsive, and resilient to extreme environmental hazards and severe weather events. As these systems continue to operate and, in the case of the mobile units, deploy across the US, we hope to see more positive results, including increased data accuracy, additional information sharing/cooperation with local weather service offices & emergency managers and increased warning times to better protect people and assets.

Acknowledgment

The near-term and ongoing success of this project could not have happened without the key partnership of EEC, The Weather Company, various TV stations/media outlets that procured these systems. EEC would also like to acknowledge the scientists at the University of Oklahoma Advanced Radar Research Center (OU ARRC) and the for there continued assistance with solid-state pulse compression technology, which is core to the Ranger®-X5 operational performance. Finally, EEC would like to acknowledge the Collaborative Adaptive Sensing of the Atmosphere (CASA) DFW Urban Testbed, where we continue to test new Ranger®-X5 solid-state methods and algorithms.