



PHOENIX

Real-Time Signal Processing + Post-Processing Server
FOR THE AN/TPS RADAR SERIES

The Phoenix Solution

TSS Solutions' Phoenix RTSP + PPS processing chain pairs a deterministic AMD Zynq UltraScale+ RFSoc signal-processing cluster with a ruggedized, GPU-accelerated post-processing server. The RTSP cluster performs digital beamforming, pulse compression, and CFAR detection entirely in FPGA fabric, with Doppler processing split across the fabric and on-chip ARM processors. The PPS layers AI-enhanced tracking, clutter mapping, recording, and the operator console on top, delivering ASTERIX-standard tracks and video to any modern C2 network. One processing chain scales across the entire TPS-43/70 /75 family.

Real-Time Performance

Function	Implementation	Latency
Digital beamforming	FPGA fabric	<10 μ s
Pulse compression	FPGA fabric	<50 μ s
CFAR detection	FPGA fabric	<100 μ s
Doppler processing	FPGA + ARM	<1 ms
Data formatting	ARM processor	<1 ms

Capability and Resilience Your Radar Never Had

Deterministic FPGA pipeline: Beamforming, pulse compression, and CFAR execute in hardware fabric with guaranteed microsecond latency budgets; no OS jitter in the detection path.

Scalable RFSoc cluster: One ZCU216 board (TPS-43) to a five-board coherent cluster (TPS-75) linked by 25 Gbps Aurora fabric; 6/42/48 receive channels.

AI-enhanced post-processing: ML-assisted CFAR, target classification, and multi-hypothesis track fusion with uncertainty quantification on the PPS GPU.

Kalman/LSTM track processing: 1,024-track capacity, 10-second update rate, 10^{-10} false-track probability.

Electronic protection: Adaptive nulling on receive, autonomous jammer detection and mitigation, and STAP clutter suppression in heterogeneous environments.

C2-network ready: ASTERIX CAT-048 tracks and CAT-240 video.

Lights-out remote operation: Legacy sites staff two console operators per shift; a Phoenix site requires none. Operations and administration run remotely, backed by a single remote system administrator and on-call maintenance.

3x

FINER RANGE RESOLUTION

50 dB

MTI IMPROVEMENT FACTOR

1,024

SIMULTANEOUS TRACKS

<8

HRS/MONTH

PREVENTIVE MAINTENANCE

Two Subsystems, One Processing Chain

SUBSYSTEM 1

Real-Time Signal Processing (RTSP)

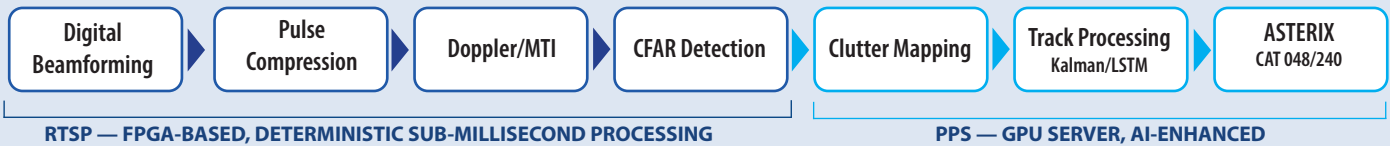
Zynq UltraScale+ RFSoc cluster (AMD ZCU216) performs receive digital beamforming with adaptive nulling and monopulse angle estimation, pulse compression, Doppler processing, and CFAR detection in FPGA fabric with deterministic microsecond-class latency. High-speed Aurora/GTY interconnect scales the cluster from a single board to five boards (non-invasive to the transmit chain).

SUBSYSTEM 2

Post-Processing Server (PPS)

Ruggedized GPU-accelerated rack-mount server delivers Kalman/ LSTM track processing, clutter mapping, mission recording, and the operator console, hosting the Phoenix AI algorithm suite for classification, track fusion, and electronic protection. ASTERIX network interfaces provide C2 integration and remote display, enabling fully remote operation and administration.

Signal Flow RF Samples to C2 Tracks



REAL-TIME SIGNAL PROCESSING

Compute platform	AMD ZCU216 RFSoc (Zynq UltraScale+ FPGA + ARM)
Cluster scale	1 board (TPS-43) / 5 boards (TPS-75)
Cluster interconnect	Coherent RFSoc Cluster: One ZCU216 board (TPS-43) to a five-board coherent cluster (TPS-75) linked by a White Rabbit timing system bounded to an atomic reference
Receive channels	6 (TPS-43) 42 (TPS-70) 48 (TPS-75)
Beamforming	Receive-only; simultaneous multi-beam, adaptive nulling, monopulse
Internal resolution	16-bit ADC–DAC processing path
DDC bandwidth	5 MHz
CFAR spectral engine	1024-pt FFT, 50% overlap, Hamming window
Adaptive clutter cancellation	10 scans, self-adaptive

Detection & Tracking

Parameter	Specification
MTI improvement factor	50 dB
Probability of detection	80% @ 10 ⁻⁶ false alarm rate
Tracking algorithm	Kalman/LSTM filtering
Track capacity / update	1,024 tracks/10 sec
False-track probability	10 ⁻¹⁰

POST-PROCESSING SERVER

Platform	Ruggedized rack-mount server
Processors	Dual AMD EPYC
Memory	256 GB ECC RAM
Storage	128 TB NVMe RAID
GPU acceleration	NVIDIA A6000 or UP
Power	Redundant power supplies
Functions	Track processing, clutter mapping, recording, operator console, remote display

INTERFACES

Internal fabric	Aurora 64B/66B — 25 Gbps
Server ingest	100GbE — raw data to PPS
Track output	ASTERIX CAT-048 — 10 Mbps
Video stream	ASTERIX CAT-240 — 100 Mbps
Management	SNMP v3
Power	Redundant power supplies
Functions	Track processing, clutter mapping, recording, operator console, remote display

Phoenix AI Algorithm Suite

Adaptive Detection
ML-enhanced CFAR processing

Target Classification
AI-powered ID and characterization

Track Fusion
Multi-hypothesis, uncertainty-quantified

Tracking Resilience
Holds tracks in contested environments

Range Resolution
150m (Phoenix) vs. 450m (legacy TPS-43)

Electronic Protection
Autonomous jammer detect and mitigate

STAP
Clutter suppression, heterogeneous terrain

Predictive Maintenance
Health monitoring degradation forecast

Growth: 4D SLEP
Transmit DBF via ZCU216 DACs (up to 40 beams)

>98%
AVAILABILITY

>10K HOURS
MTBF (CRITICAL)

16.4K FT
OPERATING ALTITUDE

<2 HOURS
MTTR (LRU SWAP)