KOSTET

ENGINEERING EXPERIENCE PROFILE

RF & Electromagnetic Engineering Experience

Four decades of practical electromagnetics, antennas, UWB, GPR, RF systems, time-domain electronics and complete system engineering.

FROM FIELD PHYSICS TO OPERATIONAL RESULT

EM FIELD → ANTENNA → RF FRONT END → SAMPLING → DSP → TIMING → NETWORK → ANALYSIS → OPERATOR

A strong system is not a collection of good subsystems. The interfaces between them determine whether the measurement remains tr

40+ YEARS

Hands-on engineering experience across the complete chain - from electromagnetic field behaviour and antenna structures to RF electronics, sampling, signal processing, timing, software and operational systems.

ENGINEERING PERSPECTIVE

Experience built across disciplines

The strongest engineering decisions often sit between traditional disciplines. RF behaviour, mechanical geometry, pulse fidelity, timing, signal processing and software cannot always be separated cleanly.

The experience behind Kostet has developed through more than four decades of designing, building, measuring, troubleshooting and refining electronic and RF systems. The common thread is practical electromagnetics: understanding what the fields and signals are actually doing, then carrying that understanding through the entire implementation.

PRACTICAL

Simulation, equations and component specifications are essential tools - but the final answer must survive real cables, enclosures, antennas, ground conditions, interference, parasitics, timing errors, dynamic range and operator use.

Electromagnetic foundations

Field behaviour, coupling, impedance, resonances, shielding, near-field effects, polarization and propagation.

Hardware realization

Antennas, RF front ends, pulse electronics, timing/reference chains, interfaces and purpose-built instrumentation.

Signal processing

SDR, DSP, channelization, detection, demodulation, coherent processing, diversity and analysis.

System architecture

Networking, data integrity, control, storage, visualization, diagnostics and operator workflows.

Measurement discipline

Calibration, uncertainty, repeatability, provenance, dynamic range and knowing what a number actually represents.

Technical investigation

Finding physical mechanisms behind unexpected behaviour rather than merely suppressing symptoms.

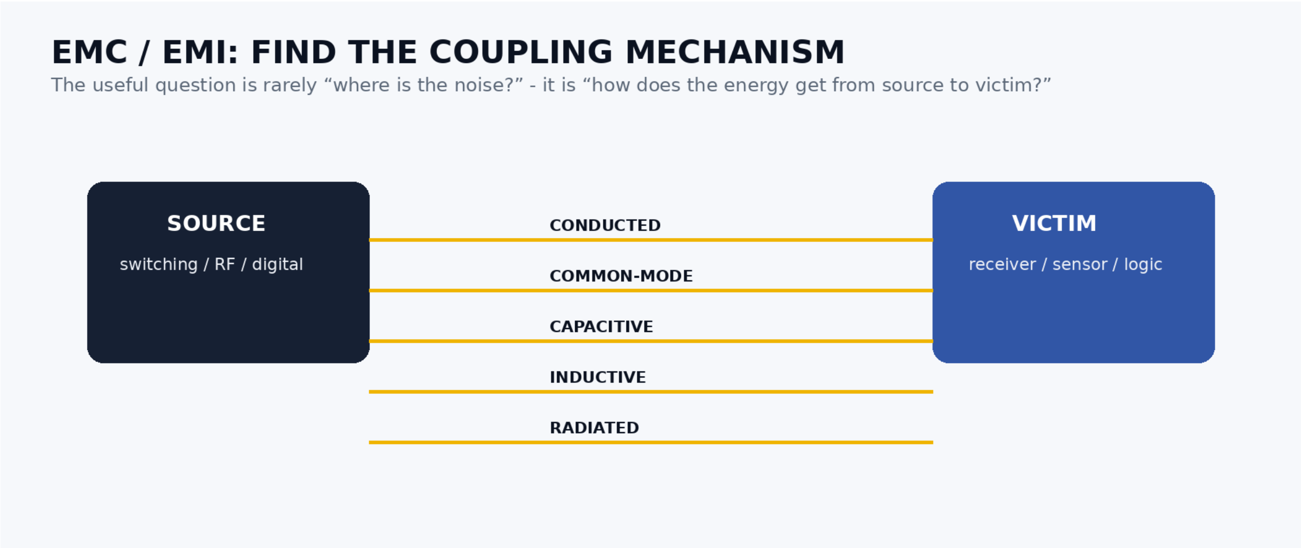
A recurring engineering question is not simply “does it work?” but “what physical mechanism makes it work - and what mechanism will make it fail?”

ELECTROMAGNETICS

Real structures, real fields

Practical EM work starts by treating conductors, cables, enclosures, ground, nearby objects and the user environment as parts of the electromagnetic system.

- Near-field electric and magnetic coupling, including unintended paths that do not appear on a schematic.
- Common-mode and differential-mode currents, cable radiation, return paths and the consequences of imperfect reference planes.
- Resonances, standing waves, impedance transitions and geometry-dependent behaviour in structures that are electrically large enough to matter.
- Shielding and aperture behaviour, bonding, filtering and the difference between adding metal and creating an effective RF enclosure.
- Polarization, antenna orientation, ground proximity, dielectric loading and structural scattering in practical installations.
- The interaction between measurement equipment and the system under test - including probes, cables, fixtures and reference points.



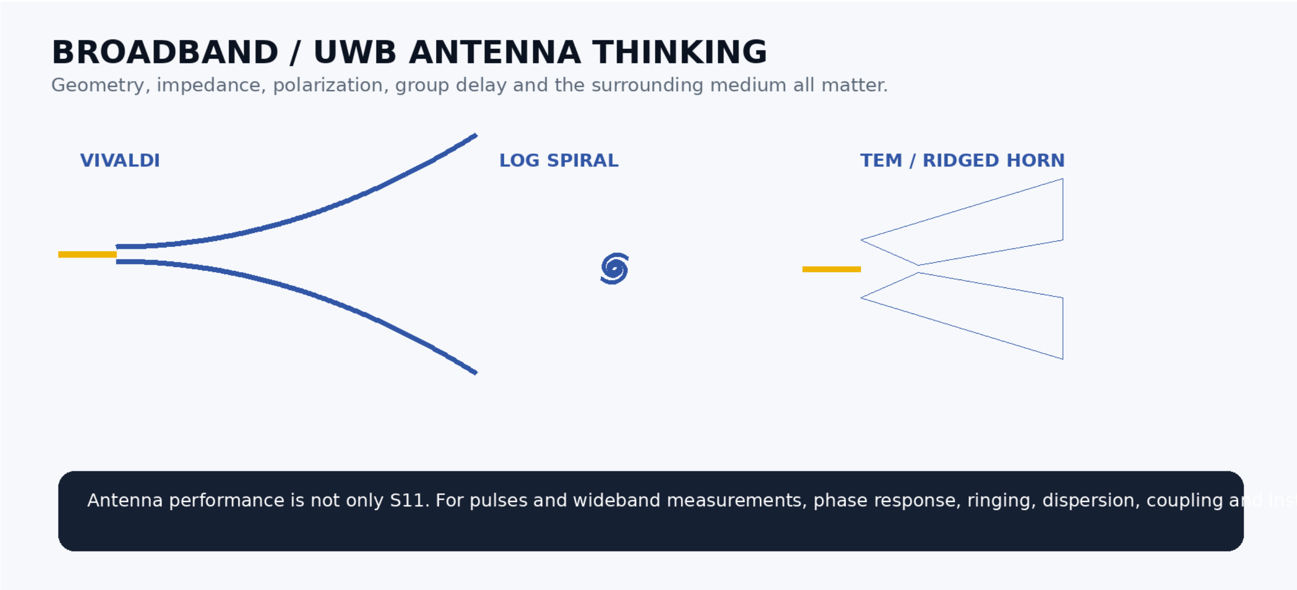
MECHANISM

When an RF or EMC problem is difficult, the most productive path is usually to identify the coupling mechanism first. Once the energy path is understood, the corrective design becomes much more deterministic.

ANTENNAS

Broadband and UWB antenna engineering

Wide bandwidth changes the problem. Return loss alone is not enough when the antenna must preserve a pulse, phase relationship or wideband measurement.



Vivaldi / tapered-slot concepts

Traveling-wave behaviour, taper geometry, feed transition, low-frequency size limits, polarization and installation effects.

Log-spiral structures

Frequency-independent geometry, polarization behaviour, feed/balun considerations, phase centre and practical truncation effects.

TEM horns

Controlled transient launching, plate geometry, impedance evolution, aperture effects and pulse fidelity.

Quad-ridged / ridged horns

Broadband impedance transformation, polarization options, field symmetry, feeding and mechanical tolerances.

Time-domain response

Group delay, ringing, late-time energy and dispersion matter whenever the signal is a pulse rather than a single tone.

Measurement and environment

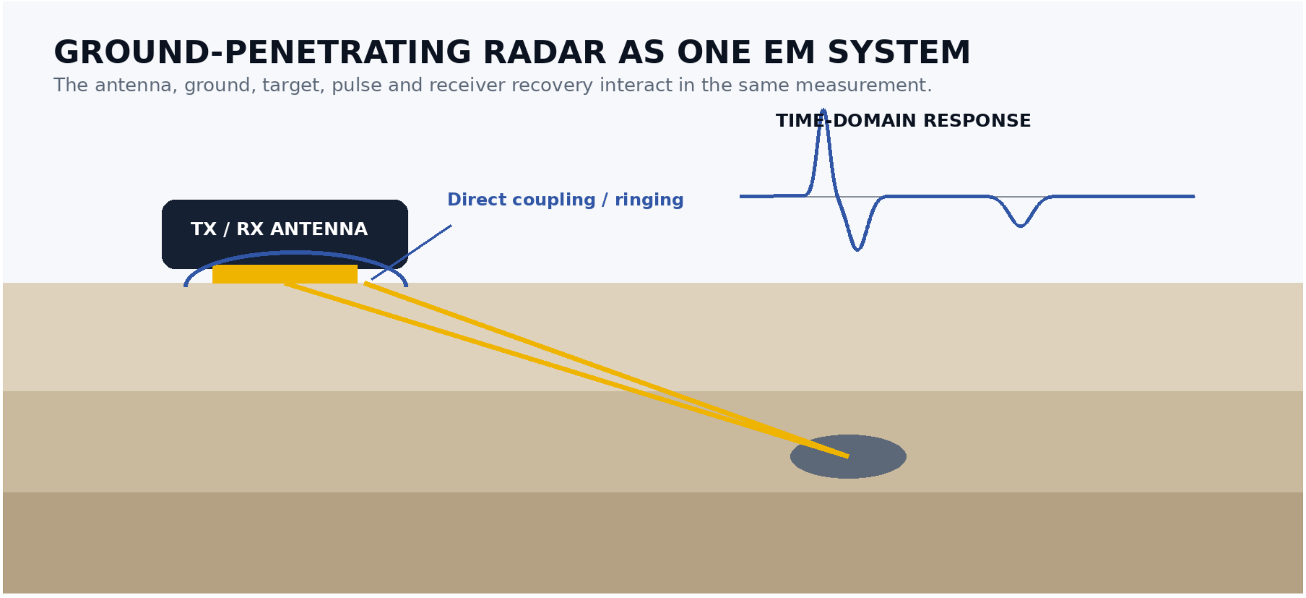
Anechoic/free-space results are only part of the story; ground, mounting, cables and nearby structures can change the useful antenna response.

A broadband antenna is not truly broadband for a pulse system if its time-domain response destroys the information carried by the pulse.

GPR

Ground-penetrating radar antennas and system interaction

In GPR, the antenna is not operating in free space. The ground is part of the antenna environment and part of the measurement physics.



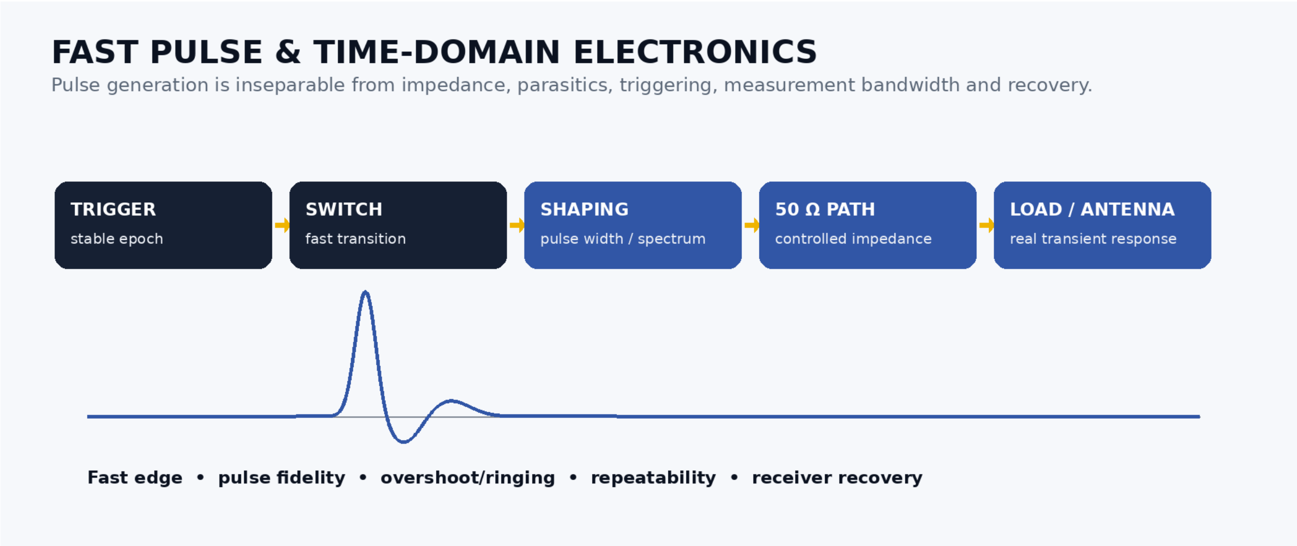
- Antenna-ground coupling changes impedance, radiation pattern, effective bandwidth and energy penetration.
- Direct TX-RX coupling and antenna ringing compete with the very early reflections that may contain important shallow-target information.
- Ground permittivity and conductivity influence velocity, attenuation, wavelength, resolution and useful penetration depth.
- Pulse shape, antenna impulse response and receiver recovery determine the usable time-zero region and near-surface performance.
- Mechanical spacing, shielding, absorber treatment and antenna orientation can be as important as the nominal electrical design.
- The final radar trace is the convolution of transmitter, antenna, propagation, target response, receive antenna and receiver - interpretation depends on respecting that full chain.

ONE SYSTEM	For GPR, treating the antenna as an isolated 50-ohm component is often misleading. Antenna, soil, target and electronics must be considered together.

TIME DOMAIN

Fast pulse generators and transient electronics

Nanosecond-class electronics expose every parasitic. Layout, impedance, switch behaviour, trigger quality and measurement bandwidth become part of the circuit.



Pulse generation

Fast switching concepts, energy storage, trigger repeatability, pulse width and amplitude control.

Pulse shaping

Rise/fall time, overshoot, ringing, spectral content and the trade between sharpness and controlled behaviour.

Transmission paths

Controlled impedance, connectors, fixtures, launch geometry and reflections from discontinuities.

Receiver recovery

Protection, blanking/recovery, overload behaviour and restoring sensitivity quickly after a strong transmitted pulse.

Trigger and timing

Jitter, time-zero stability, reference distribution and measurement of delay through the complete chain.

Measurement reality

Oscilloscope/probe bandwidth, fixture response and de-embedding can easily become the dominant limitation when edges are fast enough.

At nanosecond time scales, the schematic is only the beginning. Physical geometry becomes circuit behaviour.

RF & MICROWAVE

Receiver and front-end engineering

A sensitive receiver is not simply a low-noise amplifier followed by an ADC. Real performance is a balance of noise, linearity, selectivity, gain, shielding and calibration.

- Noise figure and sensitivity considered together with blocking, intermodulation and strong-signal survival.
- Gain distribution and headroom across filters, LNAs, mixers, ADCs and digital stages.
- Preselection, notch filtering and RF-path configuration to protect downstream dynamic range.
- Oscillator/reference purity, phase noise, frequency accuracy and the consequences for narrowband and coherent measurements.
- Zero-IF/DC-spike limitations, offset tuning, image/alias behaviour and practical stitching of wideband spectral measurements.
- RF-path calibration and deterministic correction without letting live signal content redefine the measurement baseline.

DYNAMIC RANGE

Dynamic range is often won or lost before the ADC. A high-resolution converter cannot recover information that an overloaded or poorly filtered front end has already destroyed.

Design target

Useful measurement quality across the intended RF environment, not maximum gain in isolation.

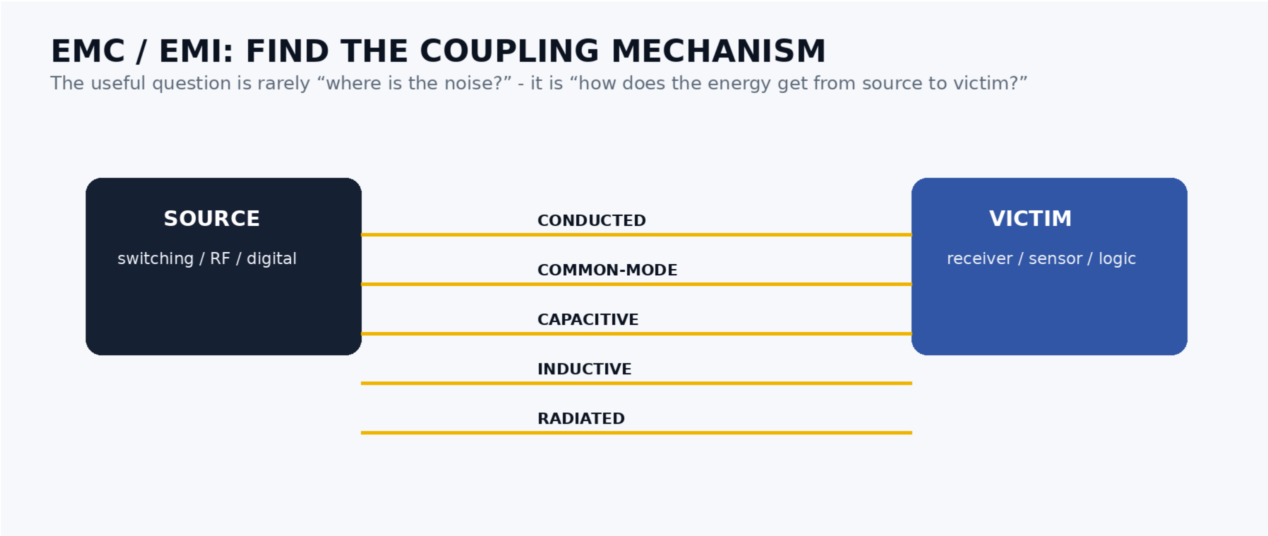
Verification

Known-signal injection, BITE concepts, repeatable calibration paths and health checks that distinguish “no signal” from “receiver failure”.

EMC / EMI

Interference, coupling and technical investigation

Long experience with difficult EM problems leads to a disciplined sequence: characterize the symptom, isolate variables, identify the energy path, verify the mechanism, then correct the design.



Conducted interference through power, ground, control and shield connections.

Common-mode current on cables and structures that were intended only to carry differential signals.

Capacitive and inductive near-field coupling between high-impedance/high-dV/dt or high-current/high-dI/dt circuits and sensitive nodes.

Radiated coupling through apertures, seams, cables and resonant structures.

Self-generated interference from clocks, switch-mode converters, processors, USB/Ethernet interfaces and digital displays entering sensitive RF paths.

Measurement techniques chosen to avoid changing the problem while observing it.

VERIFY

A credible corrective action should change the identified mechanism in the predicted direction. If it does not, the diagnosis is incomplete.

SDR & DSP

Software-defined radio as RF engineering

SDR moves many functions into software, but it does not remove the RF physics. The digital chain is only useful if it preserves what the analog and sampling chain actually measured.

Acquisition

Sample rate, usable bandwidth, RF tuning, clocking, gain state and hardware limits treated explicitly.

Channelization

Digital translation, filtering, decimation and channel extraction designed around actual occupied bandwidth and processing cost.

Demodulation

NBFM and other modulation processing, discriminator behaviour, filtering and signal-quality estimation.

Diversity / MRC

Branch amplitude, phase, delay and noise quality used to combine information rather than merely selecting a strongest receiver.

Spectrum intelligence

Wideband search, detection, persistent signal objects, recording and later analysis.

Integrity

Browser/UI presentation decoupled from acquisition so visualization can never throttle or redefine the underlying measurement.

COHERENCE

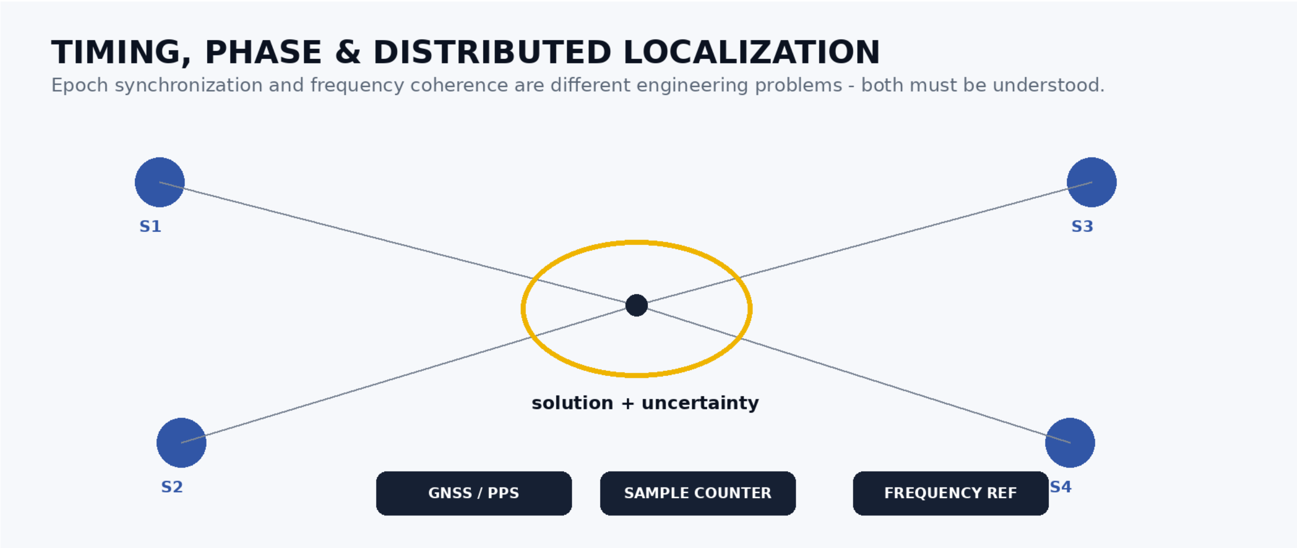
Coherent processing requires more than several receivers tuned to the same frequency. Relative time, phase, frequency error and branch delay must all be understood and controlled.

Software-defined does not mean physics-defined behaviour disappears. It means more of the receiver becomes observable, configurable and testable.

TIMING & LOCALIZATION

Synchronization, phase, TDOA and DF

Distributed sensing turns timing uncertainty into spatial uncertainty. The timing architecture therefore has to be engineered from the sample counter outward, not inferred from network timestamps.



- Separate frequency synchronization from epoch synchronization. A common frequency reference does not automatically provide a common time origin.
- Tie PPS or another timing epoch as close as practical to hardware sample timing when localization-grade timing is required.
- Preserve sample counters, reference-lock state, GNSS/PPS quality and uncertainty metadata with every observation.
- Use TDOA cross-correlation with explicit ambiguity handling, weighting and uncertainty rather than presenting a false point solution.
- Treat DF bearings as vectors/sectors with angular uncertainty, and fuse them with other evidence only when geometry supports it.
- Never let administrative Linux/USB/network timing masquerade as authoritative RF sample timing.

UNCERTAINTY	A localization result is not only latitude and longitude. Its timing provenance, geometry, confidence and uncertainty are part of the engineering result.

MEASUREMENT INTEGRITY

Calibration, uncertainty and provenance

Good engineering preserves the distinction between what was measured, what was corrected using prior calibration, and what was inferred later.

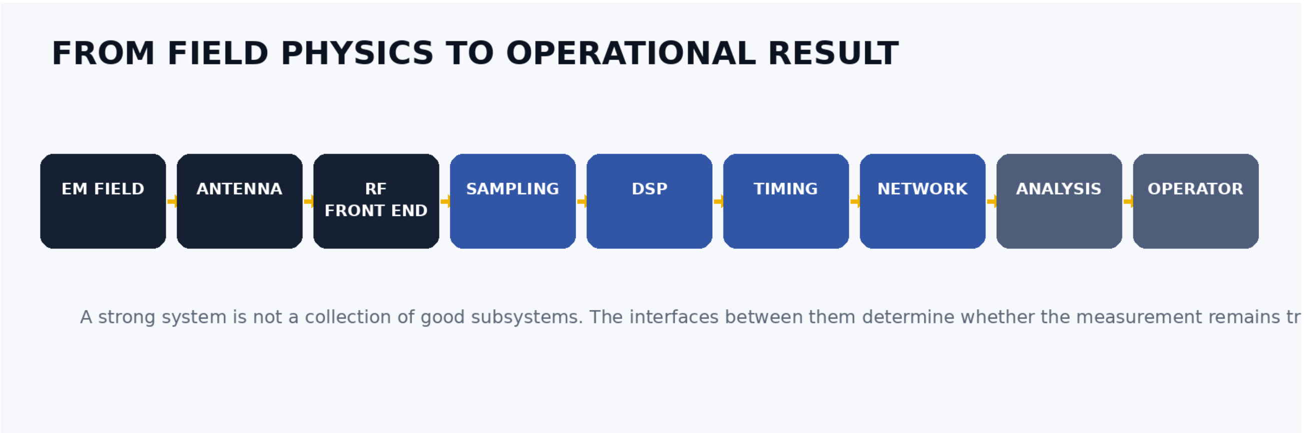
- Raw or native-resolution measurement data should remain available when later analysis may need information hidden by a display reduction.
- Calibration corrections should be static, traceable and deterministic for the applicable hardware/configuration state.
- Live RF content should not be used to renormalize gain, noise floor or absolute spectrum level during an ongoing measurement.
- Metadata such as gain, frequency, sample rate, bandwidth, timing state, antenna/RF-path identity and uncertainty belongs with the measurement.
- Display decluttering, averaging or clustering must never silently alter the underlying position or measurement precision.
- A health architecture should distinguish "quiet RF" from a stopped stream, disconnected device, stale buffer or failed receiver.

TRACEABILITY	If a result cannot be traced back to the acquisition state and the transformations applied to it, it is difficult to defend technically - even when the plot looks convincing.

SYSTEM ENGINEERING

Complete systems, not isolated subsystems

Many difficult failures appear at the interfaces: RF-to-ADC, clock-to-sample counter, DSP-to-storage, network-to-control, or algorithm-to-operator. System design must make those interfaces explicit.



Hardware

Antennas, RF paths, electronics, sensors, timing/reference distribution and practical mechanics.

Firmware / embedded

Device control, acquisition, hardware state, diagnostics and deterministic interfaces.

DSP / algorithms

Detection, demodulation, correlation, localization, scoring and data reduction.

Linux / networking

Services, device permissions, deployment, update paths, communications and fault recovery.

Data / APIs

Persistent measurement objects, metadata, provenance, inter-system exchange and auditability.

Operator workflow

Visualization, controls, alarms, explainability and the ability to diagnose the system while it is running.

The most reliable architecture keeps acquisition, analysis and presentation as separate rates and responsibilities. The operator interface should observe the measurement system - not control its fundamental measurement integrity.

ENGINEERING PRINCIPLES

Lessons reinforced by practice

These are not slogans; they are recurring design rules that emerge when systems are measured, debugged and operated outside the laboratory.

1	Understand the physical mechanism before choosing the fix.
2	Treat antenna, feed, environment and medium as one electromagnetic structure.
3	For UWB and pulse systems, inspect time-domain behaviour - not only frequency-domain match.
4	Protect dynamic range before the converter; digital processing cannot undo analog overload.
5	Separate frequency coherence, epoch synchronization and administrative timekeeping.
6	Preserve raw measurement integrity and make every correction traceable.
7	Carry uncertainty and provenance with derived results instead of converting probability into fact.
8	Design diagnostics and BITE at the same time as the operational function.
9	Assume real cables, grounds, enclosures, USB links and power supplies will become part of the RF system.
10	Design the entire chain for the operational objective, not each subsystem for an isolated benchmark.

EXPERIENCE PROFILE

Where this depth is useful

Kostet is suited to assignments where the problem crosses several engineering domains, the behaviour is difficult to explain, or a complete instrument/system must be designed around a demanding RF or electromagnetic requirement.

Specialized antennas

Broadband/UWB concepts, GPR antennas, unusual installation environments and transient response.

GPR / time-domain systems

Pulse generation, antenna coupling, receiver recovery, timing and radar system architecture.

RF / microwave systems

Receivers, front ends, filtering, dynamic range, interference resilience and calibration.

SDR / DSP

Software-defined receivers, coherent processing, spectrum monitoring, demodulation and distributed sensing.

EMC / EMI investigations

Complex interference, coupling paths, shielding/bonding problems and measurement strategy.

Timing / localization

GNSS/PPS, hardware timestamps, phase measurement, TDOA/DF and uncertainty-aware fusion.

Prototype instruments

Purpose-built electronics, embedded/Linux systems, measurement equipment and proof-of-concept platforms.

System architecture

Complete hardware-to-operator design, integration, deployment, verification and technical documentation.

From nanosecond pulses and electromagnetic structures to distributed RF intelligence systems - understand the physics, preserve the measurement, engineer the whole chain.

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