
# NORA®

## Non-Rotating Array Technology

# Introduction to NORA®,
## Intersoft Electronics' Non-Rotating Array Technology

Non-rotating arrays, also known as Active Electronically Scanned Arrays (AESAs), have traditionally been associated with costly military radar systems. Intersoft Electronics is developing similar non-rotating array technologies aimed at offering advanced capabilities found in military systems to both military and civil radar markets but at a more competitive price point compared to the mechanically rotating antenna systems.

Intersoft Electronics' non-rotating array technologies are part of their modular Airport Surveillance Radar concept (ASR-M®). This concept allows for the integration of Intersoft's Next Generation Signal Processing (NGSP®) platform, offering a flexible and potentially phased approach to radar upgrades and replacements. This approach can integrate with legacy, new, or third-party PSR transmitters, SSR/IFF interrogators, and antenna subsystems. The non-rotating array technologies could serve as a final phase in replacing the PSR transmitter and antenna.

A key design objective for Intersoft Electronics is to make their non-rotating array technologies **available for the civil market**, such as non-rotating airport surveillance radars. These technologies aim to have **similar initial capital costs and reduced lifecycle costs compared to conventional mechanically rotating antenna systems**.

Intersoft Electronics is developing a range of non-rotating array solutions for:

- Operating in L- and S-Band
- Suitable for PSR and SSR/IFF systems
- Both civil and military applications
- Being both modular and scalable

Intersoft Electronics is developing non-rotating array technologies for S-Band primary (non-cooperative radar sensors) and L-Band SSR/IFF (cooperative) and L-Band primary (non-cooperative radar sensors).

- **NORA®** = Primary Radar L & S Band **No**n-**R**otating **A**rray antenna for land-based applications
- **L-IESA®** = Secondary Radar **L**-Band **I**ntelligent **E**lectronically **S**canning **A**rray antenna for naval IFF applications

Intersoft Electronics' ongoing development is providing opportunities for significantly improved capabilities and performance.

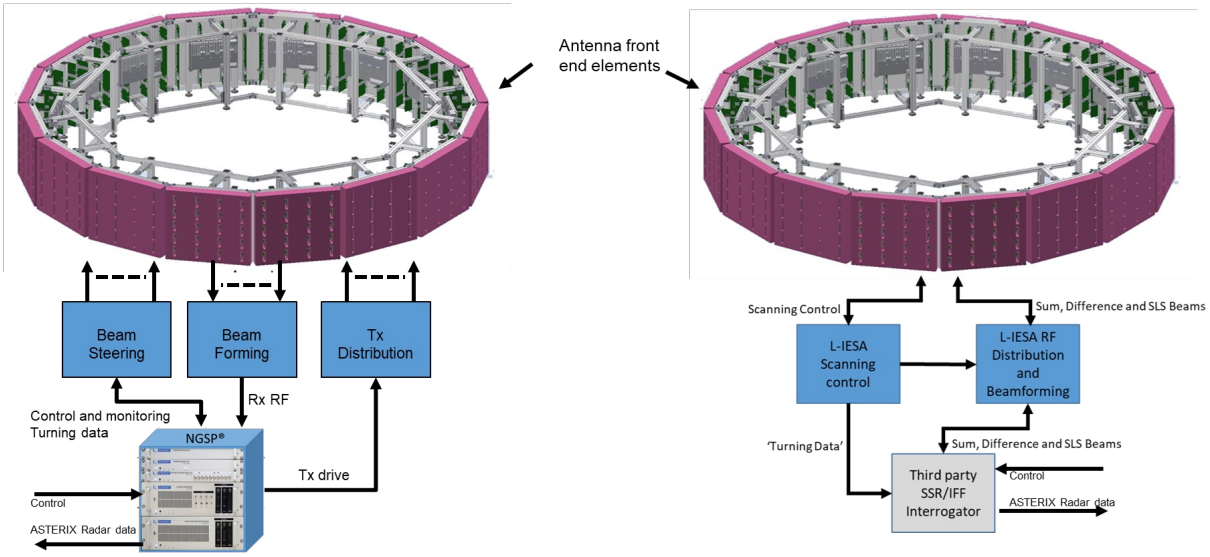
# CONCEPTS AND BENEFITS

## Circular arrays

Intersoft Electronics' non-rotating array concept is based on circular arrays rather than the more common, multi-faced planar (flat) arrays. This results in less beam degradation when the electronically scanned beam is pointed off the antenna boresight, maintaining near-equal performance at all azimuths.

## Expanding mobile phone base station market

Due to the expanding mobile phone base station market, low-cost microwave transmitter and receiver modules are now available, this brings distributed transmit/receive-based systems within the budgets of civil primary radar users. Similarly, the availability of low-cost, high-performance microwave components permits high-precision, electronic scanning, to become affordable.




## Integrated TX/RX power amplifier

Integrated with the primary non-rotating array is a distributed transmitter/receive amplifier subsystem. This integration virtually eliminates feeder losses between the normally centralized and remote transmitter and receiver electronics resulting in less total transmitter power being required to achieve the same performance as a conventional mechanically rotating antenna radar with many times higher transmitter power output.

## Modular design

Due to the modular construction, the arrays are scalable in size (array diameter) giving a choice in antenna aperture and total transmit power. This in turn determines the accuracies/resolutions and detection range capabilities.

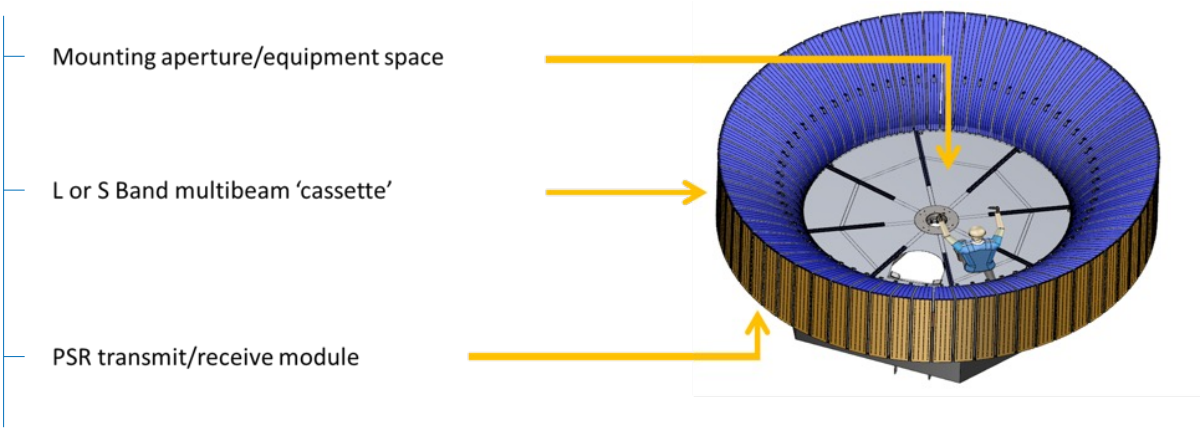
## Typical scalability

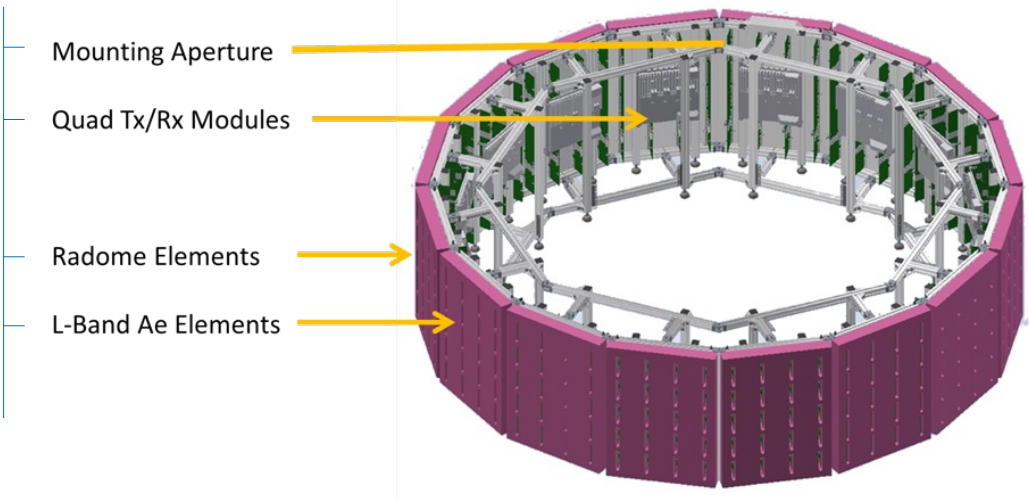
- 16-64+ ‘Antenna front end elements’
- 3-12m diameter
- Transmit power from 2kW to 32kW per beam

## Azimuth monopulse

For both primary and secondary radar applications, azimuth monopulse is utilized for increased azimuth accuracy.

Depending on the operating band and array diameter the antenna front-end elements may be flat panels or multibeam ‘cassettes’ as shown below.

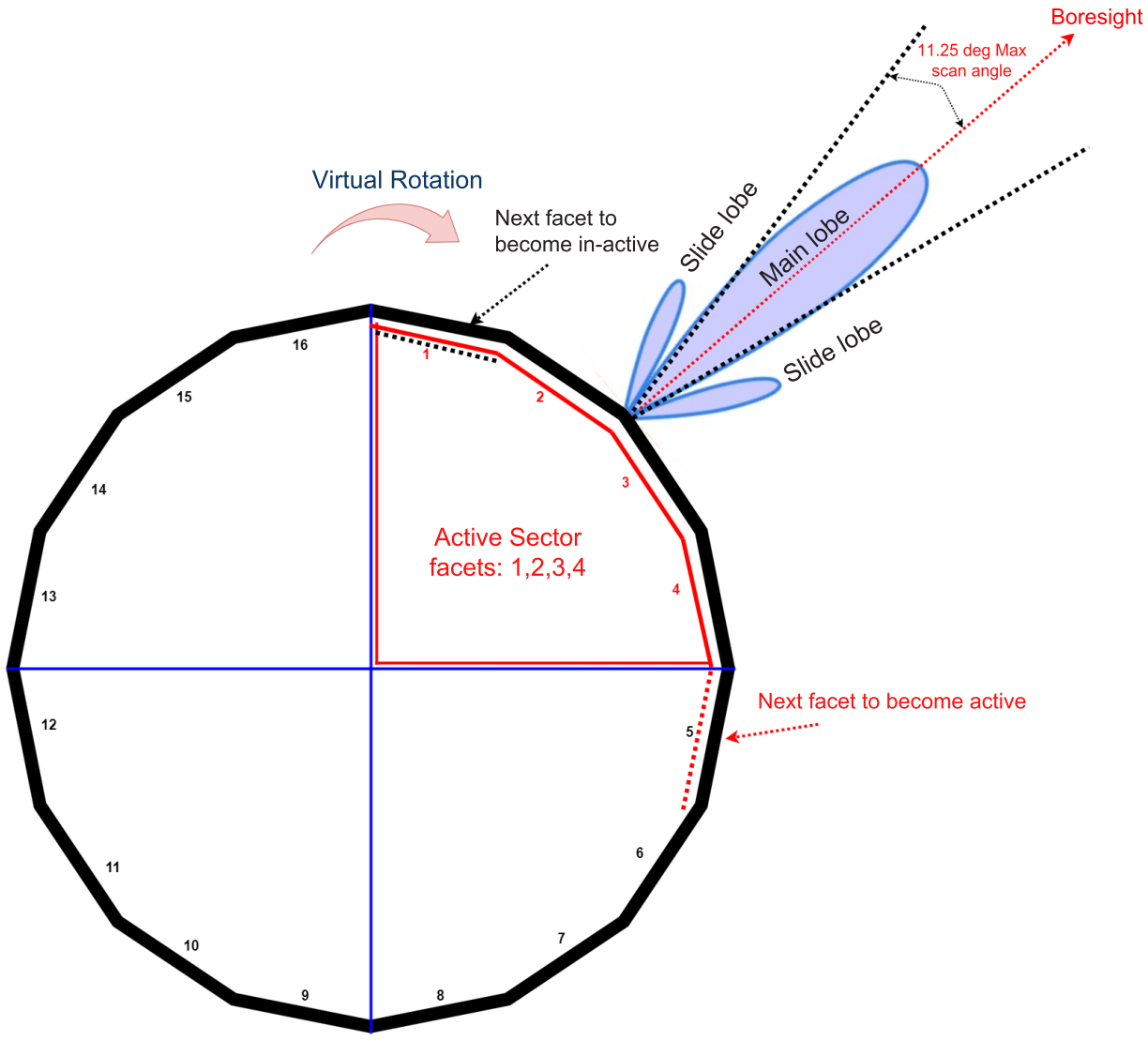


| CONCEPT | BENEFITS |
| --- | --- |
| Circular Arrays | Less beam degradation |
| Expanding mobile phone basestations market | Low cost, high performance microwave components |
| Integrated TX/RX power amplifier | Eliminate feeder losses |
| Modular design | Scalable arrays |
| Azimuth monopulse | Increased azimuth accuracy |

# CONCEPT OF SCANNING OPERATION

The Intersoft Electronics non-rotating array technology typically utilizes 90° of the full array for a single set of elevation beams. In the typical example shown below, for continuous circular ‘beam’ rotation, the beam is electronically scanned ±22.5° about the current antenna boresight (compared with flat panel AESA systems that typically scan>±60° about boresight). After this fine electronic scanning the quarter array is advanced, ‘stepped’ one array element in the direction of the ‘beam’ rotation, and the fine electronic scanning is repeated. For non-continuous circular ‘beam’ rotation, (see later), the quarter array can be instantly directed to a new boresight and the electronic scanning can point the beam to any point within that quarter array direction.



## MULTIPLE ELEVATION BEAMS

As well as the scalability in array size (diameter), the arrays can provide two or more elevation beams.

The individual elevation beam vertical polar diagrams (VPD) are application-selectable but fixed per system.

Primary transmission can occur on the low beam or low and high beams. The latter supports beamforming in space and the Intersoft Electronics advanced vertical clutter cancellation (VCC2) technique.

The simultaneous processing of multiple elevation beams permits the application of Intersoft Electronics' NGSP® advanced processes including VCC, VCC2, and 3D primary height extraction.

## AZIMUTH/HORIZONTAL BEAM SCANNING OPTIONS

The flexibility in beam scanning and near instantaneous beam pointing permits a wide range of scanning regimes to be employed

These include:

- Continuous rotation – akin to a conventional scanning primary or secondary airport surveillance radar
- Continuous rotation with 'confirmation' look-backs, is typically used in military AESA primary radars to 'confirm' a potential detection or for a more rapid track report or clarify whether an initial detection is not a false detection
- Sector scanning – this permits focusing the radars' time/energy in a small sector to improve detectability such as in windfarm areas or runway areas for hazardous or increase the reporting (update) rate on a particular aircraft (such as a highly maneuvering aircraft)

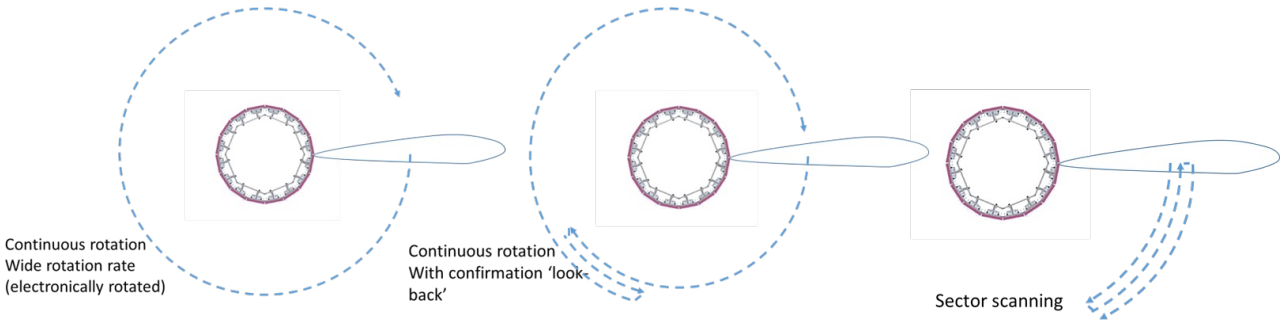



*figure 1 / Beam concept of operation*

## MULTIPLE SIMULTANEOUS BEAMS

One of the key benefits of the Intersoft Electronics non-rotating array technology is the potential to have multiple simultaneous beams, alongside the regularly scanned operation volume of airspace from a single surveillance beam we can have additional beams, such as a second surveillance beam which could:

- Permits double the dwell time for increased detection capability but maintaining the update/reporting interval (e.g. 4/5/10/12 seconds being typical)
- Alternatively maintaining the original update/reporting interval of a single surveillance beam with a second beam scanning at the same rate, due to the back-to-back nature of operation the combined update/reporting interval would be halved (e.g., 2/2.5/15/16 seconds)
- Or having a single surveillance beam and a second ‘tracking’ beam with the ability to have much more ‘time-on target’ for several targets of interest such as small and/or slow targets or highly maneuvering targets

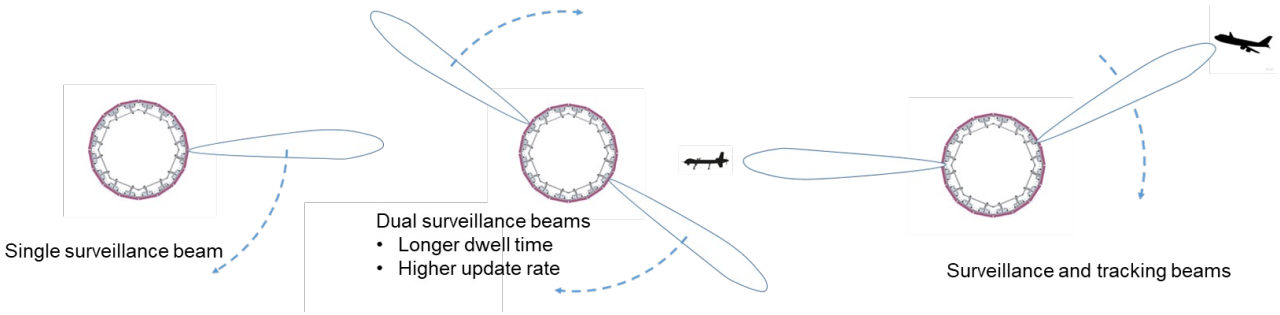



*figure 2 / Beam concept of operation*

The Intersoft Electronics non-rotating array technologies have a number of benefits and advantages over radar systems incorporating mechanically rotating antennas.

## BENEFITS and ADVANTAGES

**Capital cost** is similar to a mechanical rotating antenna and primary radar transmitter subsystem

Lower **lifecycle costs** as there are no mechanical moving parts that wear and have 'lifed' items such as bearings, rotary joints, and motors which will require replacement a number of times during the planned lifetime of the system. Thus reducing lifecycle costs and requiring reduced preventative maintenance

**Lightweight** for ease of transportation and installation and reduced antenna mast/tower requirements

Having a high level of redundancy with **no single points of failure** e.g. bearings, feeders, Rotary joints, etc.

Modular design, **reducing LRU stock needs** and allowing easy access for maintenance

Lower overall power requirements including **reduced transmit power requirement**

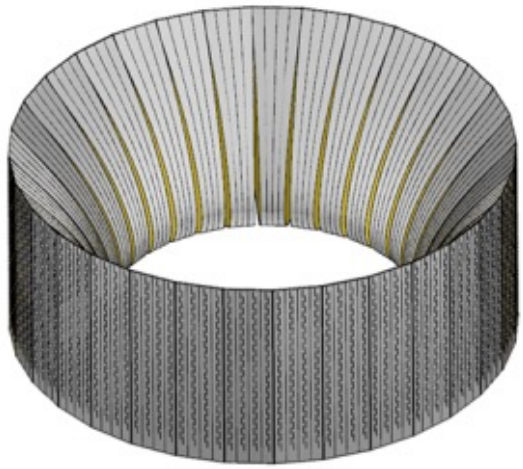
Multiple simultaneous beams e.g. **dual scan, scan & track, scan and reinforce**

Potentially high scanning/beam pointing rate allowing for **improved update rate**

**Customizable beam patterns** designed for specific operational coverage needs

Use of azimuth monopulse techniques to improve **azimuth accuracy**

Improved performance and a wider **range of applications**



## SYSTEM INTEGRATION

As a final key benefit, the system integration capabilities of Intersoft Electronics' non-rotating array technologies should be highlighted. Thanks to the modular design, not only of the antenna but the whole of the ASR-M® concept, non-rotating antennas offer a potential last phase in a service life extension program.

Primary radar systems, used in conjunction with the Intersoft Electronics Next Generation Signal Processor (NGSP®) will fully realize the processing benefits available from the Intersoft Electronics processing platform.

For secondary radar systems can integrate the Intersoft Electronics non-rotating array with virtually any standard SSR/IFF interrogator.

Intersoft Electronics' non-rotating array technologies add unprecedented value to operators of primary and secondary radar operators and system integrators.

By eliminating mechanical antenna rotation, single points of failure such as bearings, feeders, and rotary joints are removed.

New scanning modes of operation become available for better target detection, addressing the challenges of a changing National Air Space environment.

The non-rotating array technologies offer a potential last phase replacing the PSR transmitter and antenna in service life extension programs, based on the modular airport surveillance radar concept (ASR-M®), improving a system's performance with the Next Generation Signal Processing (NGSP®) platform.

INTERSOFT ELECTRONICS

We make the sky safer