Active Antennas for Electronically Scanned Arrays

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Active Antennas

Radiator and RF front-end form one packaged unit

- Small size
- Up/Down conversion at radiator
- Simple RF feed (better gain, NF, efficiency, cost)

- Challenges
  - Good radiator AND electronics package
  - Interconnect, power, control lines take up space
  - ICs must be highly integrated (few external components)
No Wirebond BCB-Bump Interconnect

• Wells etched in Si for precise MMIC placement
• BCB film supports RF interconnect
• Bumps form vias
  - Bumps protrude through pre-cured BCB
  - Gold deposited after cure, photo-etched traces connect bumps
Cavity Backed Patch

- Compatible with fabrication technique
- Cavity used to improve bandwidth
- Alumina used as filler
- Resonant frequency 39.5 GHz
- 1.6 % measured impedance bandwidth
Hybrid Integration of Antenna and Downconverter

Extra bias lines included for diagnostic purposes
A Scheme for Larger Arrays

Challenges

• Barely sufficient room for radiators and active components
• Coupling between LO, IF, RF feeds
• Off-chip by-pass components
• MMIC insertion increases sidelobes
An Alternate Packaging Scheme: BGA radiator

Difficulty: insufficient space for radiator & electronics on one surface

T/R electronics located beneath the radiator saves space
BGA Laminate Package

• Features
  – 3 layer low cost laminate
  – BGA assembly : solder balls
  – Microstrip fed patch on high quality substrate
  – MMICs mounted on underside
  – Peripheral ground vias
  – Central short/via
Integrated Package
1X4 Array
Publications:

