CLAIMS

What is claimed is:

1. An apparatus comprising:

a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter.

2. The apparatus of claim 1, wherein the at least one TSV shielded sector further includes:

a first plurality of shielding TSVs; and

a subsequent plurality of shielding TSVs that is concentric to the first plurality.

3. The apparatus of claim 1, wherein the RF die active surface is coupled to a back-end metallization, and wherein the back-end metallization includes a through-metallization via (TMV) enclosure matching the shielding TSV perimeter.

4. The apparatus of claim 1, wherein the enclosure and the lid each have spacings and widths that obstruct radio- or electromagnetic interference.

5. The apparatus of claim 1, further including a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die.

6. The apparatus of claim 1, further including:

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die;

wherein the DP subsequent die includes a ground ring that is disposed in back-end metallization of the DP subsequent die and that forms a perimeter around a sector in the DP subsequent die; and

a bump ring disposed between the DP die and the RF die backside, wherein the bump ring shares the same perimeter as the ground ring.

7. The apparatus of claim 1, further including a mounting substrate that is mated to the RF die at the active surface thereof.

8. The apparatus of claim 1, further including a phased-array antenna coupled to the RF die through at least one signal TSV.

9. The apparatus of claim 1, further including:

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die; and

a mounting substrate that is mated to the RF die at the active surface thereof.

10. The apparatus of claim 1, further including:

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die;

a mounting substrate that is mated to the RF die at the active surface thereof; and

a phased-array antenna coupled to the RF die through at least one signal TSV.

11. The apparatus of claim 1, further including:

wherein the RF die active surface is coupled to a back-end metallization, and wherein the back-end metallization includes a through-metallization via (TMV) enclosure matching the shielding TSV perimeter;

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die, wherein the DP subsequent die includes a ground ring that is disposed in back-end metallization of the DP subsequent die and that forms a perimeter around a sector in the DP subsequent die;

a bump ring disposed between the DP die and the RF die backside, wherein the bump ring shares the same perimeter as the ground ring; and

a mounting substrate that is mated to the RF die at the active surface thereof.

12. The apparatus of claim 1, wherein the at least one shielded sector contains global-positioning-system (GPS) circuitry in a first sector of the first die, the apparatus further including:

one of 2G, 3G or 4G circuitry in a second sector of the first die;

WiFi circuitry in a subsequent sector of the first die;

at least one first TSV disposed in the first sector;

at least one second signal TSV disposed in the second sector;

at least one subsequent signal TSV disposed in the subsequent sector; and

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV.

13. The apparatus of claim 1, wherein the at least one shielded sector contains global-positioning-system (GPS) circuitry in a first sector of the first die, the apparatus further including:

one of 2G, 3G or 4G circuitry in a second sector of the first die;

WiFi circuitry in a subsequent sector of the first die;

at least one first TSV disposed in the first sector;

at least one second signal TSV disposed in the second sector;

at least one subsequent signal TSV disposed in the subsequent sector;

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV; and

a mounting substrate that is mated to the RF die at the active surface thereof.

14. The apparatus of claim 1, wherein the at least one shielded sector contains global-positioning-system (GPS) circuitry in a first sector of the first die, the apparatus further including:

one of 2G, 3G or 4G circuitry in a second sector of the first die;

WiFi circuitry in a subsequent sector of the first die;

at least one first TSV disposed in the first sector;

at least one second signal TSV disposed in the second sector;

at least one subsequent signal TSV disposed in the subsequent sector;

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV;

a mounting substrate that is mated to the RF die at the active surface thereof; and

a phased-array antenna coupled to the RF die through at least one signal TSV.

15. The apparatus of claim 1, wherein each TSV of the spaced-apart shielding TSVs is formed in a layer of insulating material.

16. A method of operating a radio-frequency apparatus comprising:

handling transceiver signals at a radio-frequency (RF) first die, wherein the RF first die includes a through-silicon via (TSV) shielded sector including:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around a sector in the RF die; and

a lattice lid disposed on the die backside and matching the perimeter; and

obstructing a radio- or electromagnetic interference (RMI) signal that is generated proximate TSV shielded sector, wherein the RMI signal has a

wavelength, λ, and the shielding TSVs have a center-to-center pitch spacing in a range from λ/20 to λ/1.

17. The method of claim 16, wherein the at least one shielded sector contains global-positioning-system (GPS) circuitry in a first sector of the first die, the apparatus further including:

one of 2G, 3G or 4G circuitry in a second sector of the first die;

WiFi circuitry in a subsequent sector of the first die;

at least one first TSV disposed in the first sector;

at least one second signal TSV disposed in the second sector;

at least one subsequent signal TSV disposed in the subsequent sector;

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV;

a mounting substrate that is mated to the RF die at the active surface thereof; and

wherein handling transceiver signals includes operating the DP subsequent die and the GPS circuitry simultaneously with at least one of the WiFi circuitry and the 2G, 3G, or 4G circuitry.

18. A computer system comprising:

a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter; and

a foundation substrate that supports the first-level interconnect substrate.

19. The computer system of claim 18, wherein the foundation substrate is part one of a mobile device, a vehicle, and a television.

CLAIMS

What is claimed is:

1. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, wherein the at least one TSV shielded sector further includes:

a first plurality of shielding TSVs; and

a subsequent plurality of shielding TSVs that is concentric to the first plurality.

2. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, wherein the RF die active surface is coupled to a back-end metallization, and wherein the back-end metallization includes a through-metallization via (TMV) enclosure matching the shielding TSV perimeter.

3. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, further including a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die.

4. The apparatus of claim 3, further including:
wherein the DP subsequent die includes a ground ring that is disposed in back-end metallization of the DP subsequent die and that forms a perimeter around a sector in the DP subsequent die; and

a bump ring disposed between the DP die and the RF die backside, wherein the bump ring shares the same perimeter as the ground ring.

5. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, further including a phased-array antenna coupled to the RF die through at least one signal TSV.

6. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, further including:

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die; and

a mounting substrate that is mated to the RF die at the active surface thereof.

7. The apparatus of claim 6, further including:
a phased-array antenna coupled to the RF die through at least one signal TSV.

8. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, further including:

wherein the RF die active surface is coupled to a back-end metallization, and wherein the back-end metallization includes a through-metallization via (TMV) enclosure matching the shielding TSV perimeter;

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV, disposed in the RF first die, wherein the DP subsequent die includes a ground ring that is disposed in back-end metallization of the DP subsequent die and that forms a perimeter around a sector in the DP subsequent die;

a bump ring disposed between the DP die and the RF die backside, wherein the bump ring shares the same perimeter as the ground ring; and

a mounting substrate that is mated to the RF die at the active surface thereof.

9. An apparatus comprising:
a radio-frequency (RF) first die including several through-silicon vias (TSVs):

an active surface and a backside surface;

a plurality of sectors in the RF first die;

at least one TSV that transmits one of signal, power, and ground (signal TSV); and

at least one TSV shielded sector among the plurality of sectors, where the TSV shielded sector includes:

a shielding TSV enclosure of spaced-apart shielding TSVs that form a perimeter around at least a part of the TSV shielded sector; and

a lattice lid disposed on the die backside and matching the perimeter, wherein the at least one shielded sector contains global-positioning-system (GPS) circuitry in a first sector of the first die, the apparatus further including:
one of 2G, 3G or 4G circuitry in a second sector of the first die;

WiFi circuitry in a subsequent sector of the first die;

at least one first TSV disposed in the first sector;

at least one second signal TSV disposed in the second sector;

at least one subsequent signal TSV disposed in the subsequent sector; and

a digital processor (DP) subsequent die coupled to the RF first die through the at least one signal TSV.

10. The apparatus of claim 9, the apparatus further including:
a mounting substrate that is mated to the RF die at the active surface thereof.

11. The apparatus of claim 9, the apparatus further including:
a mounting substrate that is mated to the RF die at the active surface thereof; and

a phased-array antenna coupled to the RF die through at least one signal TSV.