

RF Packaging and Mobile SiP Technology

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2006. 10. 12



Telecommunication R&D Center

Outline

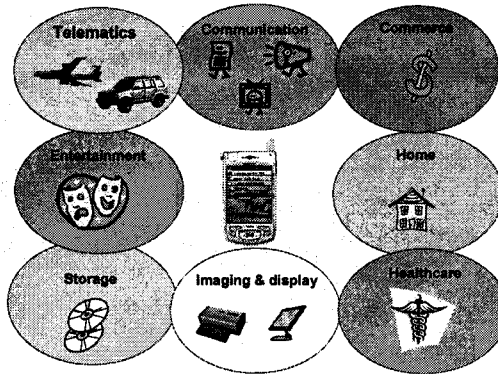
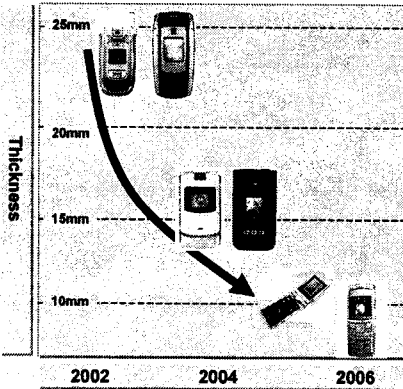
- Mega Trends of Mobile Phone
- Market Demands on Mobile Packages
- Mobile SiP
- RF SiP Trends and Technical Issues
- Summary

Mega Trends of Mobile Phones

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Slim

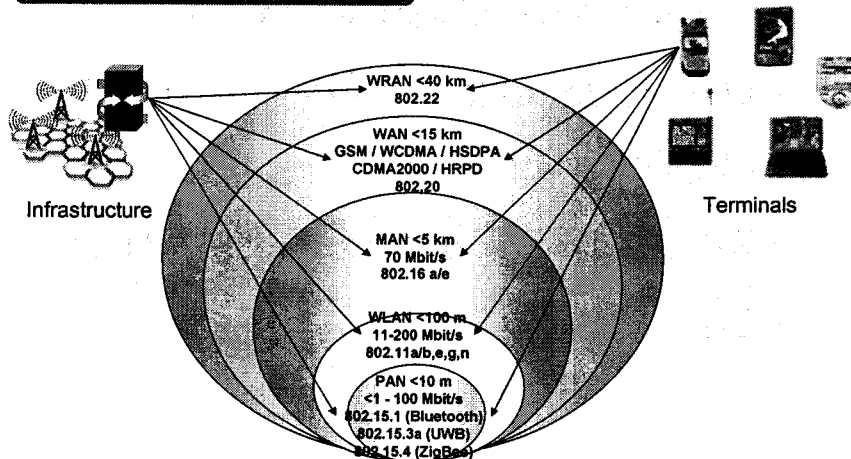
Added Functions



Mega Trends of Mobile Phones

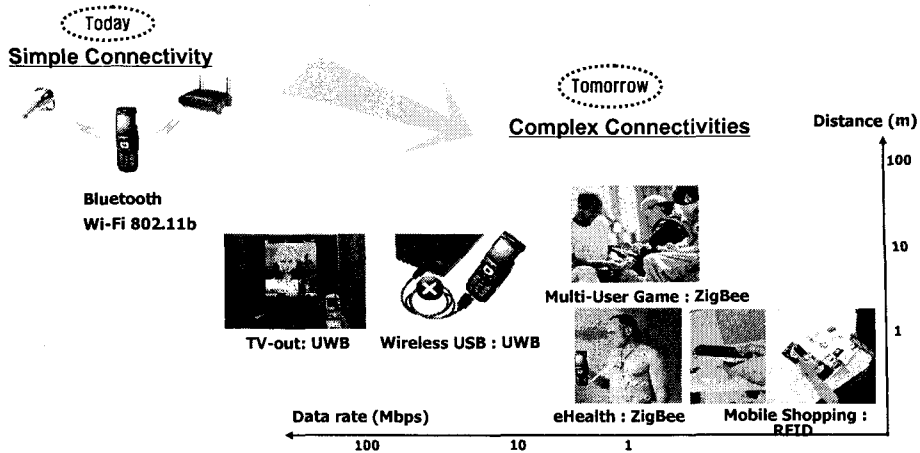
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Complex RF Configurations



Mega Trends of Mobile Phones

All RF in Phone



Market Demands on Mobile Packages

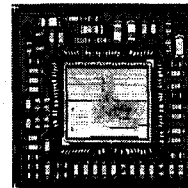
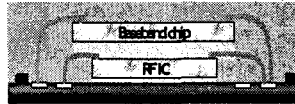
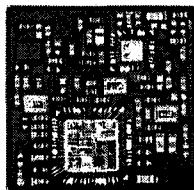
- Thinner package & Smaller footprint
 - Less than 1.4 mm thick
 - Discrete Mounted Module -> Si integrated SiP
- RF performance guarantee
 - Sensitivity, Noise, Crosstalk, EMI
- Lower cost
 - Ceramic substrate -> Organic substrate
- Quick Delivery
 - Time to market

□ Definition

- Both of actives or passives components are combined in a single package for mobile device application
- Mobile IC or RF IC + Memory + Passives + ...

□ Categories

- RF SiP : RF ICs (PA, LNA, TRx) + Passives (BPF, R, C, L)



- Mixed Signal SiP : RF Components + BB+ Memory ...



Product Differentiation

- ✓ Coordinator to develop mobile SiP with different ICs and suppliers
- ✓ Customized product development

Small Form Factor and Low Cost

- ✓ Stacking to minimize footprint
- ✓ Relatively low development cost using matured packaging technologies

Quick Delivery

- ✓ Shorter development cycle than SoC
- ✓ Straightforward integration of heterogeneous technology

RF SiP Trends

- Module -> Single Package
 - Discrete mounting -> Bare die packaging
 - Thinner package (1.4 mm thick)
- Ceramic Substrate -> Organic Substrate
 - LTCC -> PCB
- Adoptions of New Components and Materials
 - RF MEMS (Switch, Duplexer, Filters), Low loss PCB
- Quick Delivery
 - Time to market

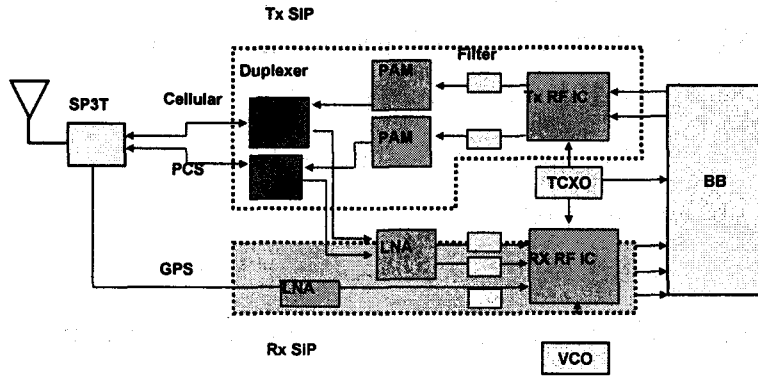
Technical Issues in RF SiP

- Design Complexity
 - Know-How, Experienced design skill for RF matching
- Known Good Die Verification
 - Wafer level test coverage
- Test and Responsibility
 - Difficult to obtaining in good final test program
due to different IC suppliers
 - Failure Analysis
- Yield and Cost-up
 - Sensitive to packaging process

Example : Dual Band CDMA RF SIP



Block Diagram



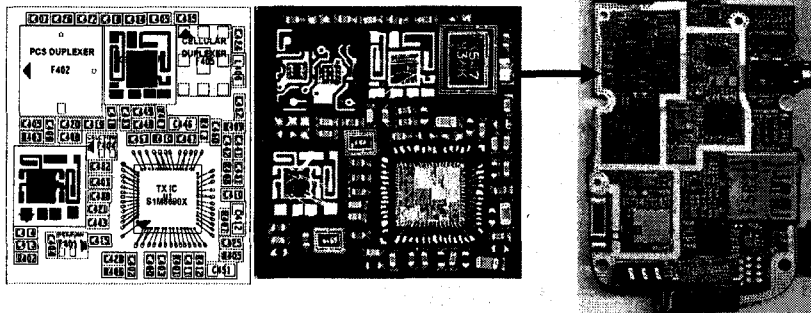
- US PCS Tx:1850~1910MHz/ Rx:1930~1990MHz
- Cellular Tx: 824 ~ 849MHz/ Rx: 869~ 894MHz
- GPS 1575.42MHz

Dual Band Tx SIP



□ Features

- Passives : Surface Mounted
- Actives : Die level packaging
- Form Factor : 11.2 X 11.5 X 1.4 mm³
- Footprint : 128.8 mm² (~ 70 % reduced)

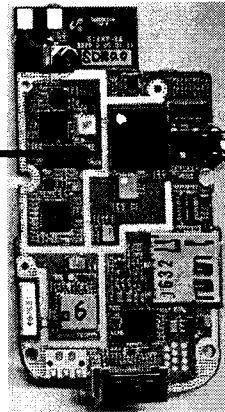
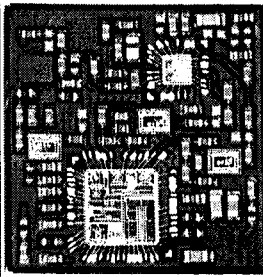
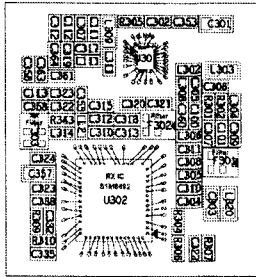


Dual Band Rx SiP

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□ Features

- Passives : Surface Mounted
- Actives : Die level packaging
- Form Factor : 10.6 X 11.4 X 1.44 mm³
- Footprint : 120.8 mm² (~ 54 % reduced)



Summary

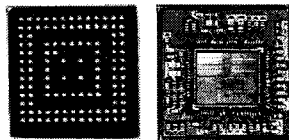
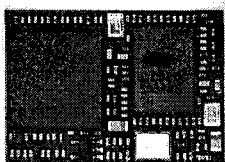
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□ Mega Trends

Year ~ 2004

2005 ~ 2007

2008 ~ 2010



□ Ceramic Based Module -> PCB Based SiP

□ Mobile SiP decreases footprint more than 40 % than discrete