

Starting a High-Tech, High Growth, Entrepreneurial Venture

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Starting a High-Tech, High Growth, Entrepreneurial Venture

- **Founding of Ditrans**
 - Starting
 - Value Proposition
 - Technical Approach
- **Series A**
 - Goals/Approach
 - First Product Selection
- **Series B--Development of Receiver Product**
- **What Went Right/Wrong**
- **Summary and Recommendations**

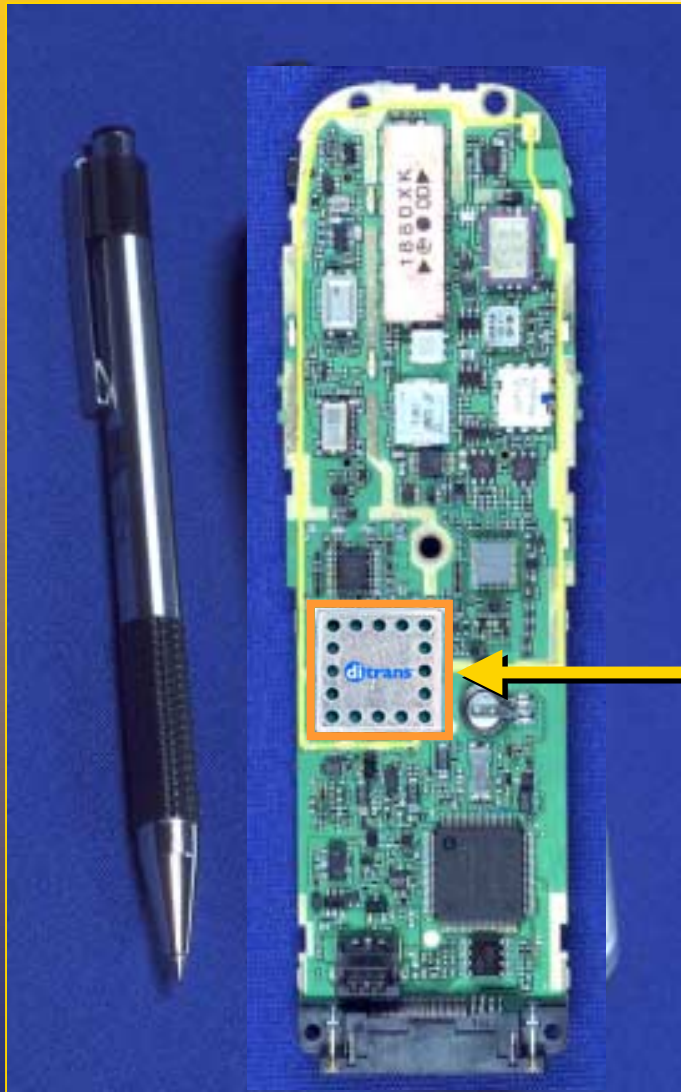
Founding of Ditrans

- **Started:** March 1999 (Incorporated: Oct. 1998)
- **Founders:** Bob Dixon(Chairman), Bill Drobish(President), Wes Masenten(CTO), Bob Dell-Imagine, Mike Perlongo, and Henry Moret
- **Product:** Digital Transceivers for CDMA Handsets
- **Strengths:** Previous Experience in: Semiconductor and Wireless Startups, Spread Spectrum Communication Systems, Microwave Circuits, and Adaptive Systems
- **New Risk:** Four Delta-Sigma/Mixed Signal Designers Chose not to Join the Company
- **Board:** Bob Dixon, Bill Drobish, Lanny Ross, Wes Masenten
- **Funding:** \$1.5M--Raised Internally During Series A Funding

Mission: To Be the Premiere Provider of CMOS Digital CDMA Transceivers for the Handset Market

Value Proposition

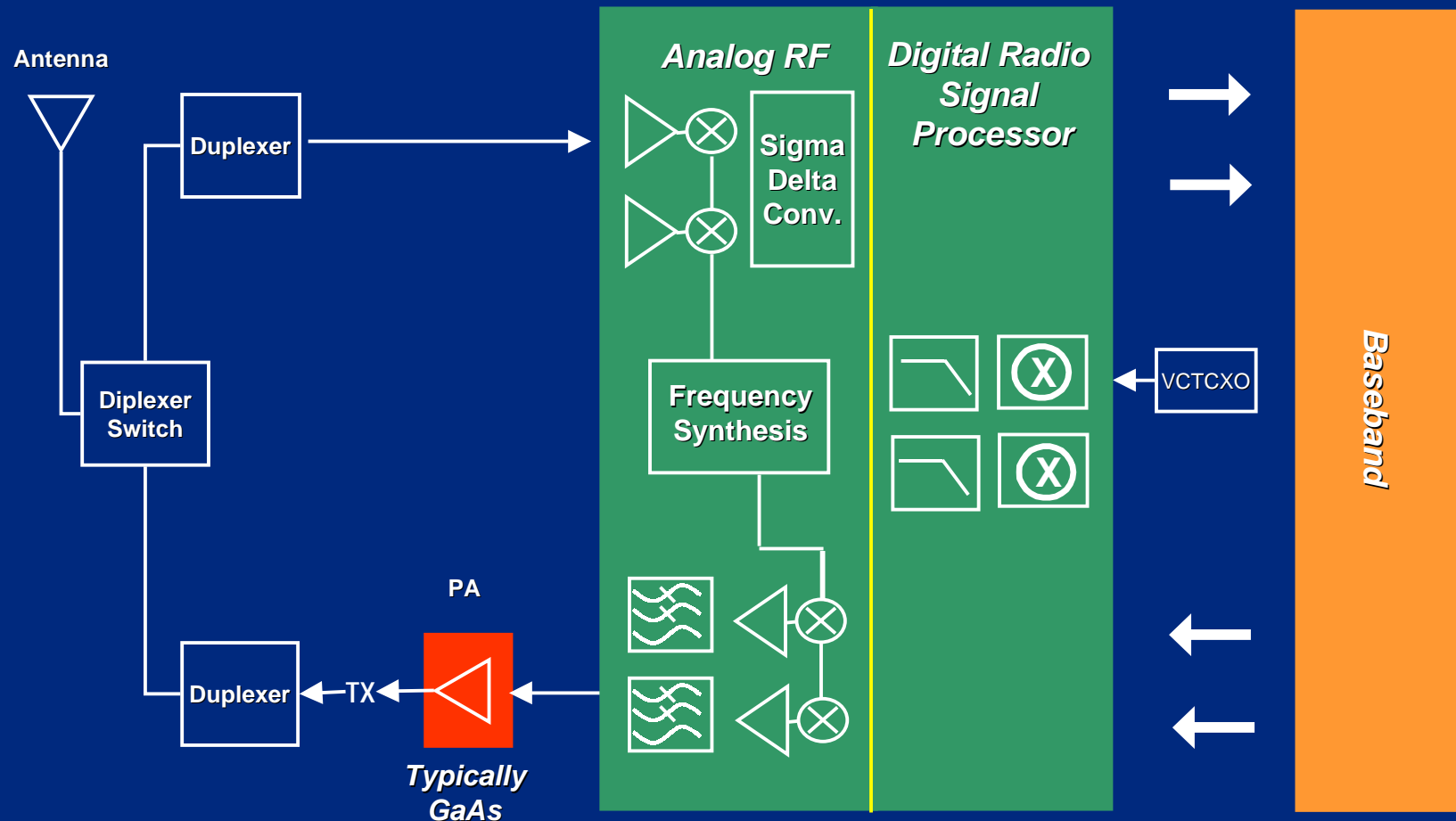
Ditrans Simplifies CDMA RF Design



- ✓ CMOS Digital Transceiver
- ✓ Integrates all Critical Transceiver Functions
- ✓ Single Package, Lower Board Area
- ✓ Simplifies RF Design Efforts
- ✓ Reduces BOM Cost and Count

Approach: Ditrans CDMA RF Transceiver Module is Highly Integrated, Lowers BOM

Highly Integrated, Digitally Intensive CDMA Transceiver



Ditrans Single Module Transceiver

Series A: Goals

Goal: Obtain Series B Funding by Demonstrating Viability of Architecture and Team Capabilities Using Feasibility Demonstration While Concurrently Starting Product Design

■ **Flesh Out Business Plan**

- Assess and Select Specific Market Opportunities
- Develop Roadmap to IPO

■ **Select First Product: Receiver Module**

- Complex IF Architecture with High Sampling Rate Delta-Sigma Converters.
- Shifted from SiGe to CMOS Chip Mounted on LTCC Substrate
- Targeted Prototype to Customers by 4Q 2001

■ **Conduct Feasibility Demonstration**

■ **Solidify IP via Patents**

- 1. Receiver Calibration *-Coherent Adaptive Calibration System and Method*
- 2. Receiver Design WO 0079706 *-Direct Conversion Delta-Sigma Receiver*
- 3. Digital Implementation of a Smart Antenna Array *Digital Modular Adaptive Antenna and Method*
- 4. Transmit Cancellor *-Method Apparatus for Canceling a Transmit Signal*

Series A--Approach

■ **Minimize Cash Requirements**

- Founding Members and Early Recruits Worked for Combination of Cash and Stock--Some for Stock Only
- Utilized Low Cost Facilities, ASIC Design Tools, and Leases for Equipment

■ **Feasibility Demonstration**

- Validate Core Concepts and Architecture
- Utilize off the Shelf Components

■ **ASIC Design of Critical Elements**

- RF Front End and A/D Converter
- Utilized Known Consultants to Augment Team

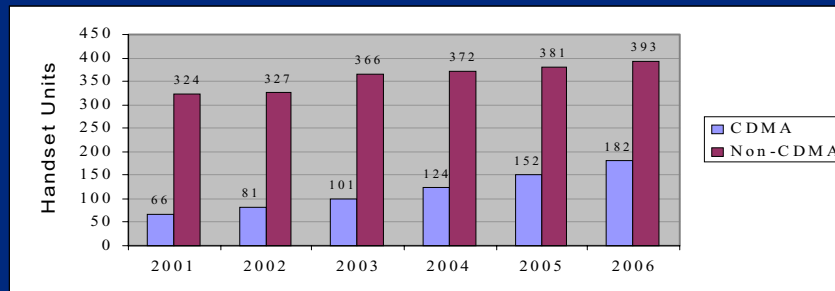
■ **Marketing**

- Add Marketing and Sales VP--Andy Mindlin
- Research Competition/Opportunity for CDMA Receiver

First Product--Dual Band CDMA/AMPS Receiver Presented the Best Opportunity

- Higher Value Product

- Growing Market



Source: Average of Shosteck 10/ 02, Gartner 7/ 02, Strategy Analytics 6/ 02, EMC 3/ 02
 Non CDMA includes UMTS/ W-CDMA projections

- Many GSM Players, Fewer CDMA

Risk
 Qualcomm Zero-IF

	GSM	CDMA
Discrete, Semi-integrated	Nokia, ST, Ericsson, RFMD, Agere, Sony, SDE, Fujitsu, National SiRiFIC	Nokia, ST, RFMD, Maxim, Skyworks, Samsung, Triquint, GCT, SiRiFIC
Integrated	Hitachi, Infineon, Philips, Motorola, Skyworks, Ericsson, ADI, Silicon Labs, RFMD, Maxim, TI, Qualcomm	Qualcomm Ditrans,

Series B: Product Development

■ **Series B Funded November 2000**

- US Venture Partners and Kansas City Equity Partners provided \$13.3M
- Additional Support by Cadence
- **Funding Came Six Months Later than Planned Due to Slippage in Feasibility Demonstration Schedule**

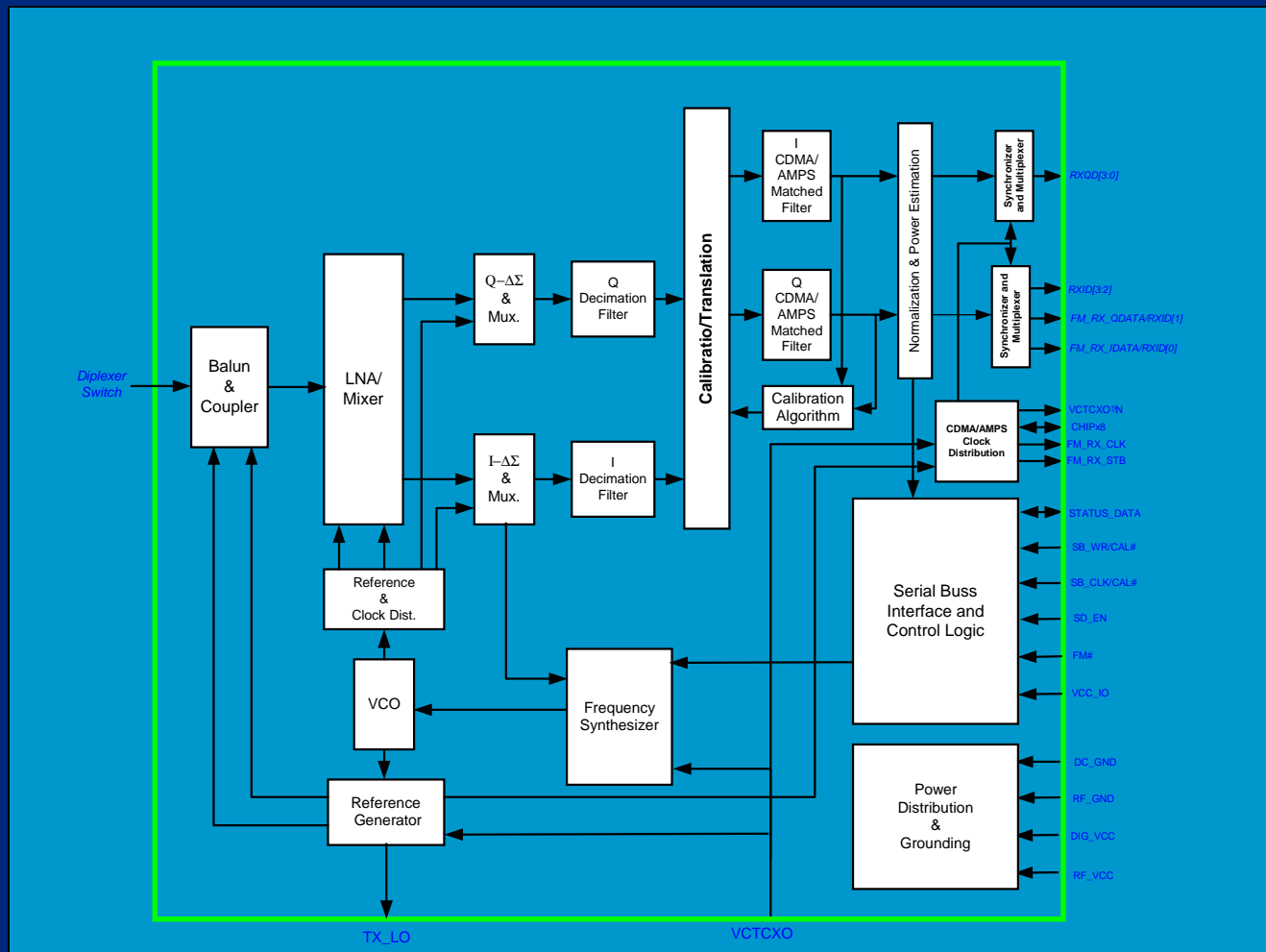
■ **Goals**

- Develop CDMA/AMPS Receiver Module
- Put in Place Manufacturing/Testing Capability
 - Chip
 - LTCC
 - Assembly & Testing
- Complete Design of Prototype Transceiver
- Establish First Customer

Receiver Development

- **Architecture**
- **Key Technical Features**
- **Prototype Description**
- **Innovations**
- **Management Team**

Ditrans Receiver Architecture

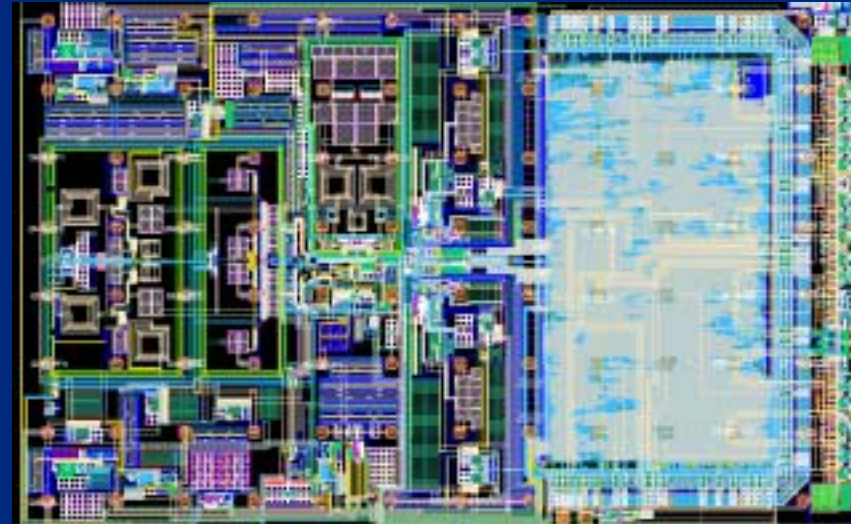
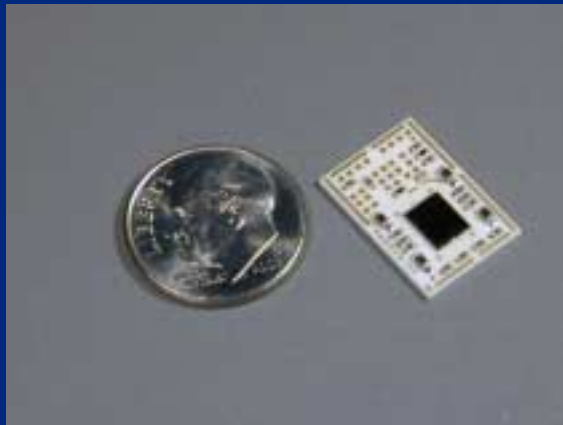


Key Technology Benefits

- **Digital IF**
 - All Digital Filtering , Programmable Filters
 - Moves More RF Functionality into the Digital Domain
- **Adaptive Image Cancellation**
 - Enables Low-IF Design for CDMA Systems
 - No Image Reject Filters
 - Eliminates DC Offset, 1/F Noise Problems
- **Wideband IF Sampling Architecture**
 - Reduces or Eliminates Front End Filter Requirements
 - Supports Both Wideband and Narrowband Channels
 - Easily Extensible to Integrated Multimode Handsets
- **Supports T.I. Open CDMA Initiative**
 - No Proprietary Radio / Baseband Interface Required

Receiver Prototype

- **Fully Integrated Single Chip Receiver Module in 0.18u CMOS**
- **CDMA 1X and AMPS Compatible**



Module Includes D-S Converter, Full Digital Processing Section, VCO , Synthesizer, Dual LNA and Mixers

Innovations in Ditrans Approach

- **Total System Approach—Optimized as System**
- **Early High Dynamic Range Digitization of Signal**
- **Processing of Signal Through Matched Filtering**
- **Elimination of All External Analog Filtering After Duplexer—Replaced with Digital Filtering**
- **Generation of All Receiver Frequency References Except VCTCXO and 8 x Chip (optional)**
- **Effective Multifunctional Use of LTCC Integrated with Single CMOS Chip for Receiver**

Experienced Management Team

- **Mark Chapman** **President, CEO**
 - V.P. and G.M. Comarco Wireless Technologies, Formerly with Rockwell Semiconductor

- **Bruce Warren** **CFO**
 - CFO at MicroSim, Big-5 CPA, M&A and IPO Experience

- **Dr. Wes Masenten** **Founder & CTO**
 - Consultant, Hughes, Northrop, Technical Director, MILSTAR Program

- **Dr. Keith SooHoo** **VP System Engineering**
 - Aerospace Corporation, Hughes, Adjunct Associate Professor at USC

- **John O'Connor** **VP Design Engineering**
 - Division Director-IC Design Conexant Systems, Manager-Analog & RF ASIC Devel. Group PCSI

- **Matt Hoppe** **VP Operations**
 - Responsible for GaAs Production at TRW and Technology Transfer to RFMD

- **Kyle Martin** **VP Sales**
 - Director of Sales, Silicon Wave, Managing Director EEsof, KK (Japan) – now Agilent

What Went Right

■ Initial Business Plan and Startup

- Briefing Based Business Plan
- Strong Board and Series B and B+ (\$7M+) Funding

■ Marketing and Sales

- Customer Identification and Commitment
- Market Understanding

■ Early and Often Prototyping

- Provided Validation of Design and Simulation Models
- Speeded up Development of Design Flow

■ Technical Team

- Excellent Consultants--Utilized Over 10
- System Design and Test, RF/ LTCC, & Digital Implementation

Summary---What Went Wrong

■ **Time to Market**

- **Feasibility Demonstration: was Late, Diverted Resources from Product, and Delayed Funding**
- **Delays in Getting First Prototype to Customers**
- **40% Reduction in Selling Price per Year over Last Two Years**
- **Competition From Baseband Manufactures**

■ **Technical Issues**

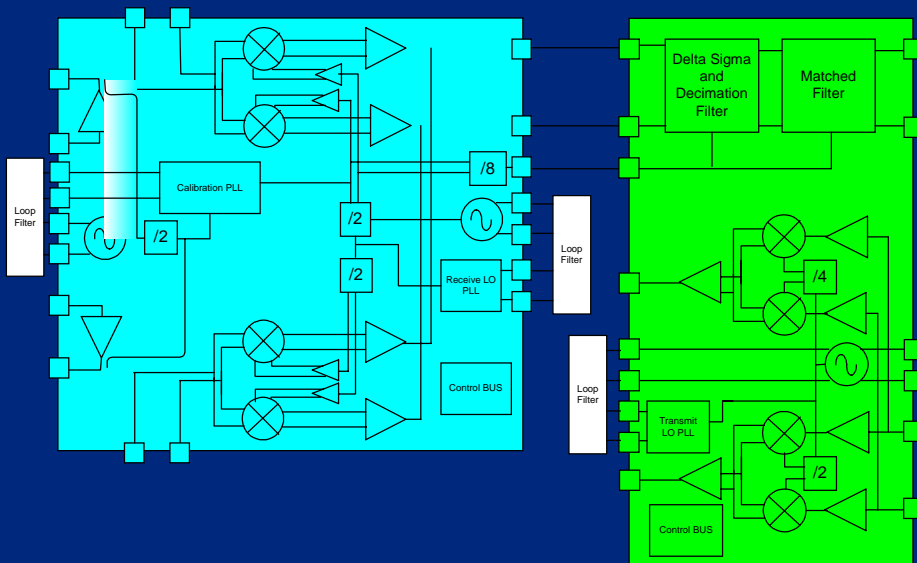
- **Sensitivity Limitations due to High Level of Integration**
- **Initial Single LNA/Mixer Approach**
- **Delays in Finding A/D Converter Solution**
- **Height and Cost--Needed Integration with Baseband Supplier**

And Then the Money Ran Out

■ Performance

- Sensitivity and Power Consumption Still Outside Requirements

■ Alternate Approaches--Too Close to Competition



- Two chip solution: Complete RF-to-Digital Conversion
- Low Noise 0.35um Si Ge Bi CMOS Front End
- Low Power 0.18um Pure CMOS Back End
- Based on Low *Digital* IF Architecture
- High Dynamic Range A/D (>97 dB)
- Proprietary Adaptive Image Cancellation

■ Transceiver Necessary For Marketplace

- **Ditrans Attempted to Merge with Another Startup that Had an Innovative Transmitter Design They Unfortunately Chose to Go With QUALCOMM**
- Integrates LNA/Mixer, VCO, Digital Filtering, Up Converter, PA driver
 General Baseband Interface
 High Integration Available

Summary---Recommendations

■ **Shared Vision**

- **Common Goal Clearly Communicated**
- **Each Person Needs to Understand His Participation**

■ **Initial Business Plan and Startup Phase**

- **Strong CEO/President and “Supportive” Board**
- **Well Defined Product and Market--Little Time to Change Direction**
- **Realistic Product Development Roadmap and Risks Amelioration**

■ **Time to Market**

- **Development of “Critical Mass” Is Imperative**
- **Assess Market and Execute Plan Quickly**