Commercializing Wireless IP

(Or… things I wish had been covered in class)

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So you've got some IP, now what?

- IP lets its owner create a monopoly
- Value depends on
  - Size of market
  - Substitutable products
  - Ability to capture market
- No money unless without a business as IP does not sell itself
  - If it's revolutionary, then it's by definition new and unknown
  - Which means it's virtually impossible for outsiders to properly evaluate
  - Need some means to demonstrate value
- To start a business, you have to identify
  - Product / service
  - Market
    - Frequently a market that does not exist yet
  - Potential customers
  - Funding to move IP from a concept to a product
  - The right team (many may be external to the company)
- All highly inter-related and tied into the specific IP

Typical Wireless Startup Products

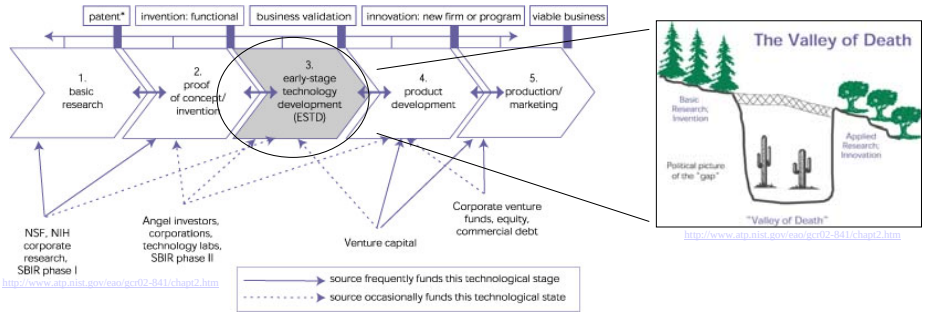
- End Product
  - Equipment –Vanu, Cognio, Garmin
  - Stand-alone service – Spectrum Bridge
- Intermediate products
  - Chip sets - Airgo
  - Software – Skyhook
- Direct licensing
  - InterDigital, Qualcomm
- Value captured generally inversely related to distance from user who "cares" about the technology
- Generally a mix of products types are used and evolve over time

1) Largest potential revenues
2) Largest startup costs
3) Works best when a proprietary solution is feasible
4) Useful when creating new market or selling into existing market
5) Need most sophisticated team
6) Partnerships less important

1) In between for most things
2) Need to sell into existing market

1) Generally lowest costs, great variance in profits
2) Need to sell into existing market
3) Partnerships critical
4) Extremely difficult with revolutionary technology
5) Team skewed to engineering + legal

Financing and Product Development



- VC tends to acquire promising firms, not build them from scratch
  - Does happen with the right team
    - Generally successful entrepreneurs
- Funding sources generally focused on basic and applied R&D
- Valley of Death leads to creative cash flow solutions
  - Engineering services / consulting
- Partnerships help to smooth transitions
  - Customers as investors (InterDigital, Flarion)
- Infrastructure is just as important as cash
  - Not just development equipment, but personnel, customers, key technologies

Typical Paths for IP to Enter the Wireless Market

- Go-it-alone
  - Easiest for products that appeal to the masses
    - Garmin
  - Harder for smaller markets (in terms of # of decision makers)
    - Vanu
- Standards
  - Find a way to get your technology into a standard and extract royalties
    - Hard for a new player with a new tech to break in (IS-136 & Qualcomm)
    - Partners help (InterDigital & Nokia)
    - Sometime possible to sneak in without submarining (CSIRO)

Typical Paths for IP to Enter the Wireless Market (Partnerships)

- Sponsored Development
  - Corporate funds integration / development
    - May serve as customer or as a technology champion
  - Ex: InterDigital for Nokia (WCDMA TDD)
- Spin-Out
  - Company spins out technology outside of core-compentency or for which it lacks adequate attention
  - Most famously the Fairchild 8: Bell -> Shockley -> Fairchild -> Intel
  - Parent company frequently a customer and may help line up contracts when an investor
- Spin-In
  - Parent serves as investor, customer, provides key infrastructure, and then may completely buy out the startup
  - Ex: Nuova-Cisco (Gigabit ethernet switching)
    - http://www.cio-today.com/story.xhtml?story_id=0220025VSP2M
  - Advantage to parent: easy integration, shared risk/capital for development

Case Study: Qualcomm

CDMA

Qualcomm really began with Linkabit

- Linkabit founded as academic startup in 1968 by Irwin Jacobs, Andrew Viterbi, and Leonard Kleinrock (left/fired in 1969 when he got more involved with ARPANet)
  - Really intended to pool consulting
- Little to no patents filed (pre-GSM)
  - Actually advised to not file patents on Viterbi decoder
- Products / services
  - Lots of defense consulting
  - Chips for Viterbi decoder
  - VSAT – digital PSK spread spectrum system
  - Coding schemes for NASA / JPL (Viterbi connection)
  - Security for military comm
  - First D-AMPS handset
  - Videocipher (HBO scrambling)
  - Spread spectrum modems for the Air Force
- Bought by M/A COM
  - Which fell apart later and lots of Linkabit employees left
  - Including Qualcomm – Jacobs, Viterbi + 5 Linkabit employees

Qualcomm Pre-CDMA

- Formed in 1985
  - Initially went after military and satellite contracts
- Key early contract was OmniNet (product became OmniTRACs)
  - Low cost spread spectrum satellite comm for communication with trucks
  - Still a major Qualcomm product
  - OmniNet went under in 1988 and Qualcomm had to buy them out
- Key insight:
  - They were doing mobile spread spectrum communications, just had to figure out how to make it work in a cellular environment

Qualcomm CDMA Plan

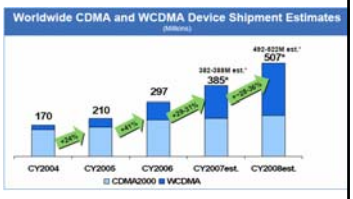
- Key IP –Solving problems associated with cellular spread spectrum
  - Power control, handoffs, adaptive vocoder
- Product:
  - Equipment for cellular spread spectrum
  - Expand into licensing
- Initial status: theory, history of similar products
- Financing: Mix of traditional investors and telecom companies
- Strong team
  - Previous business successes, leading researchers
  - Timing right (move to digital was clear)

Execution

- Early Financing:
  - 1989: Funding from Pacific Telenesis, NYNEX, Ameritech for initial CDMA Trial (on NYNEX system)
    - Augmented out to $30 million
  - 1991 IPO for $53 million
- Open standard to increase revenues (licensing IP)
  - 1989 tried to get into IS-54, but went TDMA
  - 1992 IS-95 started
  - 1993 IS-95 completed with only minor changes to Qualcomm implementation
  - Later became basis of 3G standards
- Market Penetration
  - Early licensing/development agreements with Nokia, Motorola, Nortel
  - AT&T & NYNEX early deployers
  - Created CDMA partnerships to foster deployment in other markets
  - Roll out delayed for PCS allocation and a few patent disputes
  - 1994 Joint venture with Sony to manufacture/market phones
  - 1995 (by then a sure thing):
    - 11 of 14 carriers in US
    - 12 phone suppliers licensed, 6 BTS manufacturers
    - Another $500 million public offering
- Later
  - 1999 sold off infrastructure manufacturing to Ericsson
  - Investments in foreign service providers who would deploy CDMA networks

Qualcomm Now

- Variety of products
  - CDMA / OFDMA / Flash OFDM
  - BREW
  - Media-FLO
  - Omni-TRACS (never licensed, but smaller market)
  - Q-chat (Push-to-talk for Sprint)
- 2007 Stats
  - $8.87 billion revenue up 18% over 2006
  - 145+ licensees for CDMA



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Qualcomm CDMA Summary

- Flexible Business model:
  - Research to manufacturing
  - Transitioned to an Research to IP licensing company
  - Diversified (but related) technologies (cept for Eudora)
  - Tried several models before finding ones that worked
- Key IP: Technical hurdles to cellular spread spectrum
  - Power control, adaptive vocoders, handoffs
- Market Entry
  - Potential Customers as investors
  - Built end-product
  - Used standard and licensing to expand market
- Financing
  - Initial internal development
  - Proof-of-concept from investors
  - Deployment from IPO
  - Cash flow from OmniTracs and other projects
- IP was critical to revenues and success, but created political problems later
- Bottom line: Having the right team, a flexible business model, and strong IP can help you adapt to the changing competitive environment

Case Study: Flarion

Flash-OFDM

Flarion Overview

- Key Technologies: Flash-OFDM ("Radio-Router")
  - Fast-hopping subcarriers to make OFDM behave like a spread spectrum system
  - All packet-based, all IP backbone cellular network
  - Relatively narrowband (1.25 MHz)
  - In theory, cheaper high speed data
- Founding Team:
  - Initially developed in Digital Communications Research Department of Lucent Wireless Research Center
    - Led by Dr. Rajiv Laroia (here today!)
  - Department spun out in 2000 from Lucent New Ventures Group with Dr. Laroia as CTO and founder
- Quick analysis:
  - Strong team, strong industry ties
  - Filling huge emerging niche
  - Well protected IP
  - Need for large amount of capital
  - Not the best immediate market (cellular equipment manufacturers were taking a bath at the time), but could change over time

Flarion Business Model

- Goal: Cellular equipment vendor with proprietary standard
- Market entry
  - Leverage various contacts to get initial field trials with service providers
    - Demonstrate superiority of solution
    - Target smaller markets initially
  - Position technology as key player in open standard (802.20)
  - Form industry alliance to promote technology Encourage investment by potential customers (e.g., T-Mobile, SK Telecom)
- IP Protection - Patenting + Licensing from Lucent
- Financing - Lots of VC from the start
  - $12.5 million 1st round Feb 2000 Bessemer, Pequot, Lucent, Charles River

Flarion: Excellent Execution

- Numerous deployments
  - Seoul 2003 Seoul (SK Telecom)
  - Washington D.C. Sept 2004 (Motorola)
  - Blacksburg 2005 (Citizens' Wireless)
  - Raleigh-Durham 2004 (Nextel)
  - July 2005 Japan (Japan Telecom)
  - Slovakia 2005 (T-Mobile)
- 2004 Launched 802.20 for an open standard
  - Flarion leading technology
  - Qualcomm leading vote holder
- Created "Flarion Alliance Program" to facilitate industry partnerships

Flarion's Model sorta Failed

- Convergence of problems
  - Sprint-Nextel merger knocked out its first big customer
    - Sprint didn't want to maintain two networks
    - Then went with WiMAX
  - Mobile WiMAX gave the appearance of coming up faster than expected
    - Why use a proprietary standard (a la Qualcomm IS-95) when an open standard is available
  - Effort to insert technology into open standard (802.20) got waylaid
    - Qualcomm / Intel fight slowed it down considerably
    - First time an 802 group got suspended (actually after Flarion was no longer independent)
  - Probably could have continued, but revenues were going to flatten
- Bought out by Qualcomm in 2005 for $600 million to $1.5 billion
  - Helped to preserve usefulness of Qualcomm's CDMA patents as Cellular transitions to OFDM

Flarion Summary

- New proprietary cellular technology with the promise of revolutionizing cellular industry
- Approximately the Qualcomm model
  - Significant early financing
  - Strong team
  - Significant # trials, small deployments
  - Emphasis on crafting alliances
  - Went for open standard
- Bottom Line:
  - You can do everything right, and still have not achieve your business objectives because of external actors
  - However, having a strong IP portfolio can still give you a nice exit

Case Study:
Cognitive Radio Technologies, LLC

Distributed Cognitive Radio

CRT Overview

- Key Technology:
  - Low complexity, stable distributed network optimization
  - Big capacity gains, simpler deployment
  - Lower cost cognitive radio
  - Most useful in mobile ad-hoc settings
- Founding Team
  - (2007) James Neel & Jeff Reed
- Quick analysis
  - Leading academics in cognitive radio but little business experience
  - Important niche, market size to be determined
  - IP not well suited for end-product, but could be applied to virtually every wireless network

CRT Business Model

- Goal: Research to integration
- Market entry
  - Partner with established players on research proposals to “spin-in” IP
  - Targeting military and vehicular networks
- Financing
  - SBIRs, consulting
  - Extensive partnering on government research proposals
- Bottom line:
  - Not going to be a Qualcomm or even a Flarion, but could be a Linkabit

Presentation Summary

- IP does not commercialize itself
  - Need a business
- Many routes to commercialization
- Appropriate business model function of many factors
  - IP, team, market, products, funding, customers
- Unless you're selling to consumers, it helps tremendously to partner with your customers
- Flexibility helps commercialization
  - First path / product / market will likely not be the winning combination
  - Necessary to evolve business as technology matures
- IP
  - Often the only thing of value in a startup
  - Has to be demonstrated to show value
  - Keeps company viable after value demonstrated
  - Smooths transitions