



ROSUM
TV+GPS
Location and Timing

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The slide features the Rosum logo at the top, which consists of a stylized bar chart with a white curve passing through it. Below the logo is the text 'TV+GPS' and 'Location and Timing'. Further down, contact information for Todd Young is provided. The background of the slide is a city skyline at dusk or dawn, with a bridge in the foreground.

ROSUM Rosum = Location. Inside and Out.™

Rosum was founded by GPS architects to provide reliable in-building and urban timing and location where GPS fails.

The slide features the Rosum logo and the tagline 'Rosum = Location. Inside and Out.™'. Below this, a paragraph explains that Rosum was founded by GPS architects to provide reliable in-building and urban timing and location where GPS fails. At the bottom, there are four icons representing different devices: a white tower antenna, a laptop, a tablet, and a flip phone. The background is a city skyline at dusk or dawn, with a bridge in the foreground.



ROSUM Broadcast TV Provides Indoor, Urban Visibility

Advantages of TV over GPS:

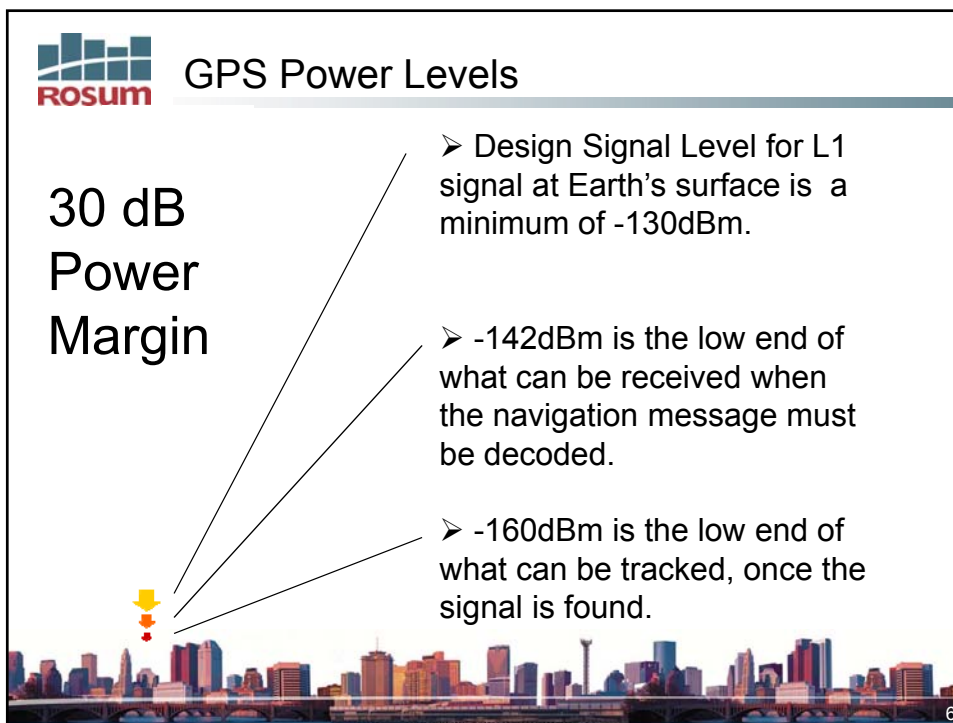
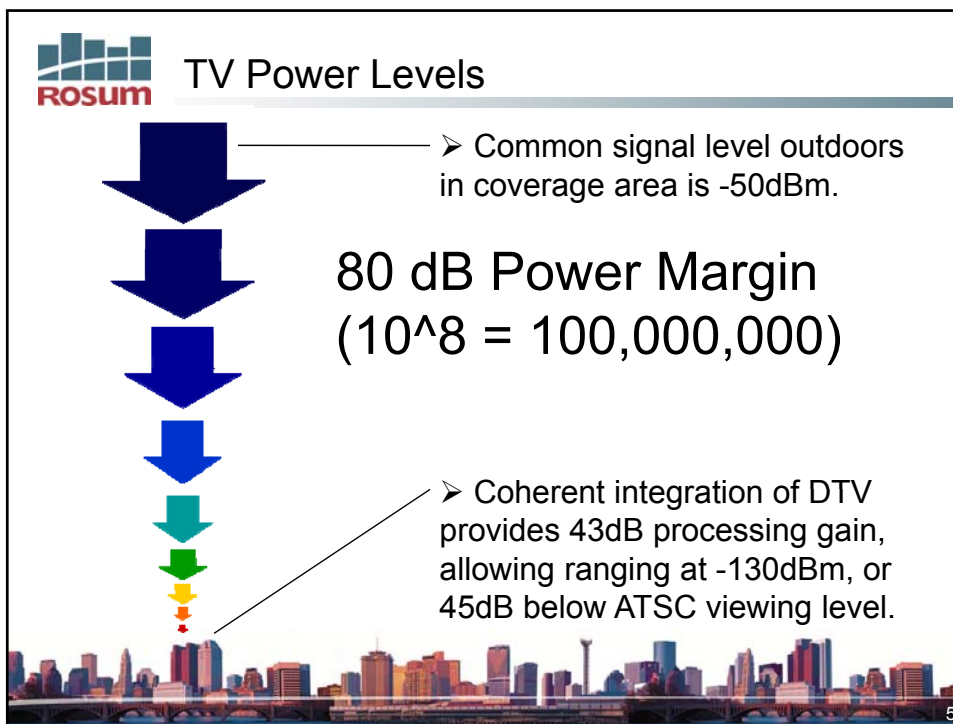
- High Power
1MW ERP typical (1000x GPS)
- Low Frequency
50-750 MHz (stronger indoor signals)
- Frequency Diversity
Clear 6MHz channels, multiple channels per tower
- Horizontal Signals
Less attenuation from walls than roofs
- Robust Infrastructure
EAS backbone, Katrina-proof

- Low Power
500W ERP
- High Frequency
1.575GHz
- Limited Spectrum
Single shared frequency
- Vertical Signals
Greater attenuation from roofs and floors

>50 dB (10,000X) power margin advantage

ROSUM How TV-Positioning Works (TV Triangulation)

- 1) Broadcasts contain synchronization information which can be used to measure timing.
- 2) Rosum-enabled device receives TV signals and computes pseudoranges
- 3) Aiding data
Regional Monitor Unit covers 50-100km radius; sees same signals as mobile device
- 4) Device uses aiding data and passes measurements to Location Server
- 5) Location Server computes position





ROsum Every Wall/Floor Improves TV's Advantage

	Residential		Commercial (Apartment)	
	Wall (Brick-Faced Masonry)	Floor (Lumber, Sheetrock)	Wall (Concrete)	Floor (Steel-Reinforced Concrete)
500 MHz (UHF TV)	8dB	16dB	20dB	22dB
900 MHz (Cellular)	11dB	22dB	22dB	27dB
1.6GHz (GPS)	10dB	20dB	26dB	29dB
3GHz (WiMax)	29dB	59dB	46dB	50dB

Source: NIST Construction Automation Program Report No. 3, *Electromagnetic Signal Attenuation in Construction Materials*, National Institute of Standards and Technology, October 1997.

ROsum Apartment Building Attenuation

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TV Positioning Accuracy

Environment	Accuracy
Outdoor Line-Of-Site	5m
Open Outdoor	10m
Easy Indoor, Suburban Outdoor	20m
Moderate Indoor, Urban	30m
Difficult Indoor, Dense Urban	40m or more



Recent Milestones

- April 2007: Agreement with Trimble for S. Korean TV-enabled mobile device market: cellphones, Portable Media Players, Personal Navigation Devices
- July 2007: Announced results of third-party E911 compliance testing – 5 states, 5 PSAPs, 50% indoor testing, compliant with FCC Phase II Handset E911 specifications
 - October 2007: Announced collaboration with Intel for TV-enabled mobile devices
 - March 2008: Announced collaboration with 2Wire for femtocells
 - April 2008: Series B Financing (\$15M)
 - May 2008: DVB-H Positioning Demonstration in with UK Service Provider





Rosum E911 Compliance Testing

- Today the FCC requires no indoor E911 testing
- Testing by independent 3rd party OET-71 testing firm
- 5 PSAPs spanning rural to extreme urban
- 30 sites/PSAP, 50 position fixes/site
- 50% of testing indoors based on ATIS 0500011
 - Indoor tests must reflect macro environment
 - Dense Urban -> 35% of all tests deep in buildings, in parking garages, for example.
- TV-only positioning (no hybrid with GPS)
- Rosum compliant in all PSAPs
- Aligned with FCC's PSAP-level testing mandate



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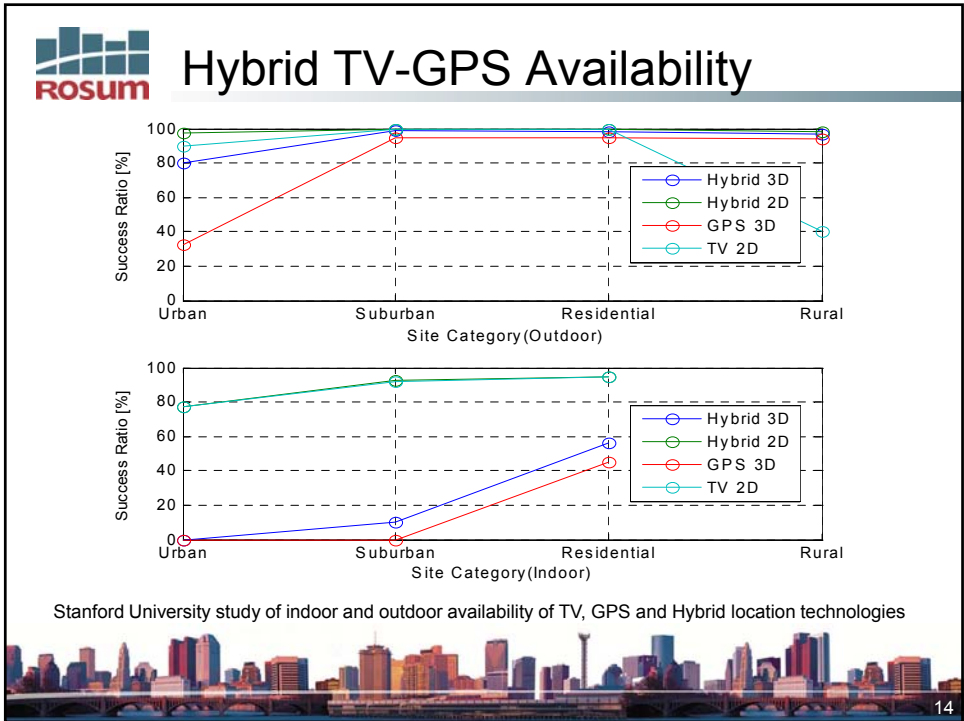
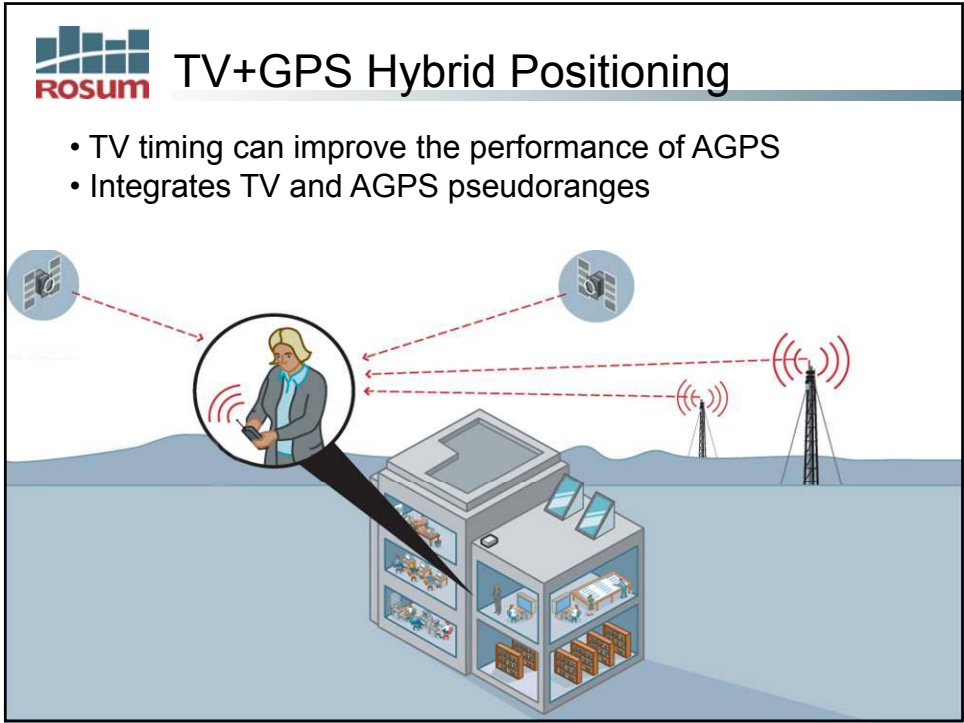


E911 Compliance Testing Results

PSAP	Environment	Overall Accuracy			Compliant?
		Mean	67%	95%	
Nashua, NH	Rural-Suburban	23m	31m	66m	yes
Needham, MA	Rural-Suburban	27m	33m	63m	yes
Santa Clara, CA	Suburban-Urban	28m	36m	65m	yes
Washington, DC	Urban	37m	49m	86m	yes
Edison, NJ	Suburban-Urban	38m	50m	83m	Yes
FCC Requirement		NA	50m	150m	



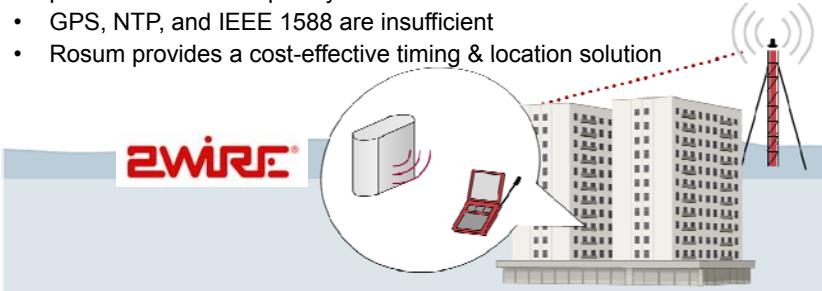
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TV Provides In-Building Timing for Femtocells

- Residential telecommunications assets such as femtocells require precise time and frequency reference
- GPS, NTP, and IEEE 1588 are insufficient
- Rosum provides a cost-effective timing & location solution




2WIRE

- Frequency stability to 10 ppb
- Absolute timing to 1 μ s
- E911-compliant location

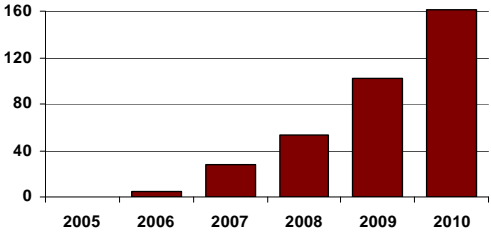


Mobile TV Networks Worldwide

- 160M TV-capable handsets to be shipped annually by 2010; 446M by 2011 (IMS research)
- Korea, Japan in lead in terms of penetration – 40% of new cellphones shipped
- US: MediaFLO for now; ATSC Mobile to come online in US in 2009
- Driving down tuner cost and power consumption
- Rosum is a software-only solution for TV-capable devices




TV Tuner-enabled Mobile Devices (M)



Year	TV Tuner-enabled Mobile Devices (M)
2005	0
2006	~5
2007	~25
2008	~55
2009	~105
2010	~160

ABI Research





Rosum is now a Software Company

SOFTWARE
HARDWARE

TV ANTENNA	TV TUNER, DEMOM OR WIDEBAND TUNER	NTSC ATSC DVB-H Rosum Location Engine
HOST PROCESSING PLATFORM		

HOSTED

TV ANTENNA	TV Tuner	A/D NTSC ATSC DVB-H TV BB ASIC	Rosum Location Engine	Application
HOST PROCESSING PLATFORM				

STAND-ALONE

Rosum Mobile TV Positioning

- JDA – Integrates Rosum’s solution onto Intel Mobile Computing Platform Reference Designs
- Trial with UK Service Provider shows indoor location accuracy on par with DTV positioning.
- Mobile TV providers can offer location-based advertising, LBS
- SFN -> 1-second fix rate
- Synchronized broadcasts -> no monitoring required (and stand-alone, on-device positioning possible).
- T-DMB positioning w/ for S. Korea.



19 Patents Issued; 60 In Process

- Positioning and Timing with Ambient Signals
 - ATSC Digital, NTSC Analog TV
 - ISDB-T Digital TV
 - DVB Digital TV (DVB-H, DVB-T)
 - Non-TV Broadcast Signals
 - Other Synch Codes for Analog TV
 - Integration with GPS for Time Transfer and Positioning
 - OFDM signals
- Integration with Cellular Infrastructure
- Local Augmentation Systems (beacons)
- Frequency Stability and Time Transfer
- Signal Detection



Rosum Leadership

Management Team

- Dr. Jim Spilker, Chairman, Founder**
 Founder and former CEO of Stanford Telecom.
 GPS Architect.
- Skip Speaks, CEO**
 Former CEO of Triton Communications, Kyocera
 Wireless
- Dr. Matthew Rabinowitz, CTO, Founder**
 Founder of Panop.com,
 Awardee, 2006 MIT Technical Review TR35
- Dimitri Rubin, COO**
 DSP Group, VLSI Technology, Wheels Of Zeus
- Matthew Lewis, CFO**
 CFO of Mobilink Telecom (sold to Broadcom)
- Todd Young, VP Marketing**
 Bell Labs, NTT and Palm
- Jon Metzler, Director of Government Affairs
 Development**
 Tokyo Broadcasting, CBS, Launched
 AtomShockwave and Prophet in Japan

Board of Directors

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 Co-architect of GPS, founder and CEO of Stanford Telecom
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- Bill Tai, Board Member**
 Partner, Charles River Ventures
- Lara Druyan**
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- Perry LaForge**
 Founder and Director of CDMA Development Group, co-founder inOvate
- Per Enge**
 Director of Stanford GPS Research Laboratory
- Marco Thompson**
 Founder Doctor Design, CTO Wind River Services,
 Founder & past President, San Diego Telecom Council

