HIFAS: Highly Integrated Full-custom Autocorrelation Spectrometer ASIC

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OMNISYS INSTRUMENTS

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Background

- Purpose of spectrometer:
  - Measure power spectral density of a signal over a wide frequency range.
- Radiometric spectra:
  - Noise-dominated
  - Integration times ranging from milliseconds to hours

Spectrometer Types

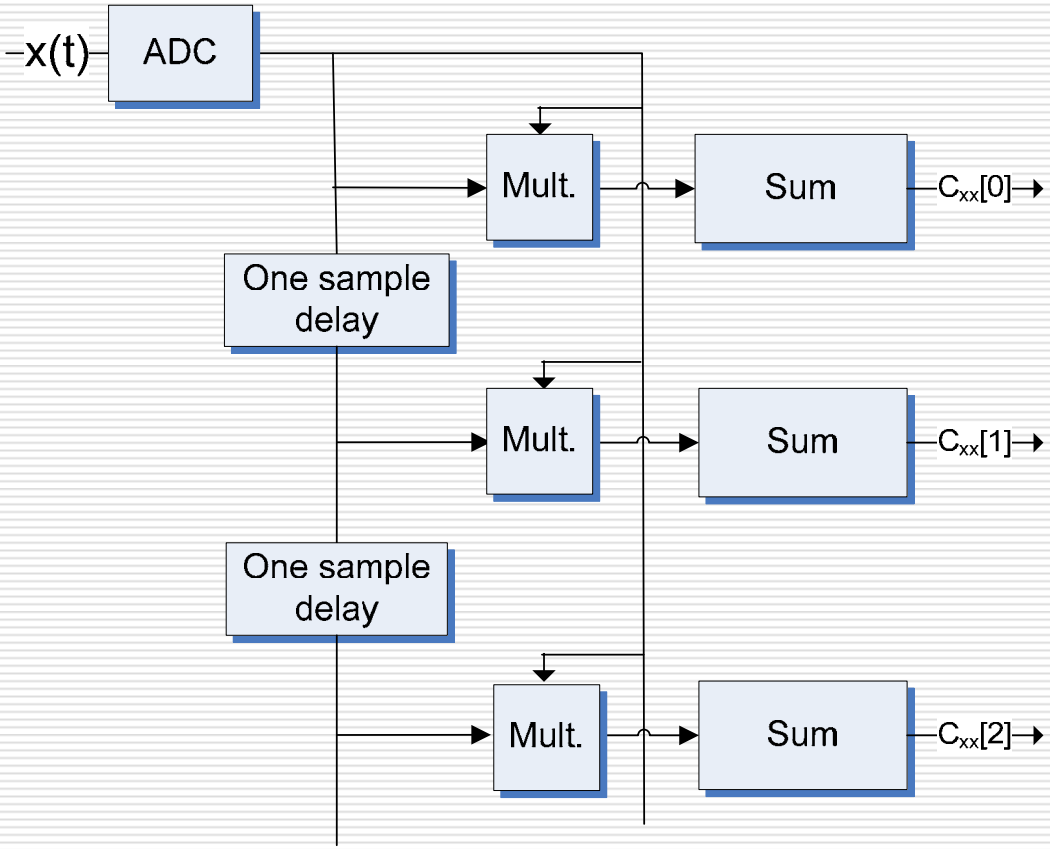
- Wide-band spectrometer types:
  - Correlator
  - FFT
  - Filterbanks
  - Acousto-Optical
- Trade-off between:
  - Bandwidth
  - Frequency resolution
  - Power consumption
  - Reliability
  - Cost

Autocorrelator principle

- Power spectrum = FT of the signal's autocorrelation function

- Correlator spectrometer: Measure the signal's autocorrelation function, then post-process afterwards to get power spectrum.

Digital Correlator



Multiply the signal with delayed versions of itself and average over time.

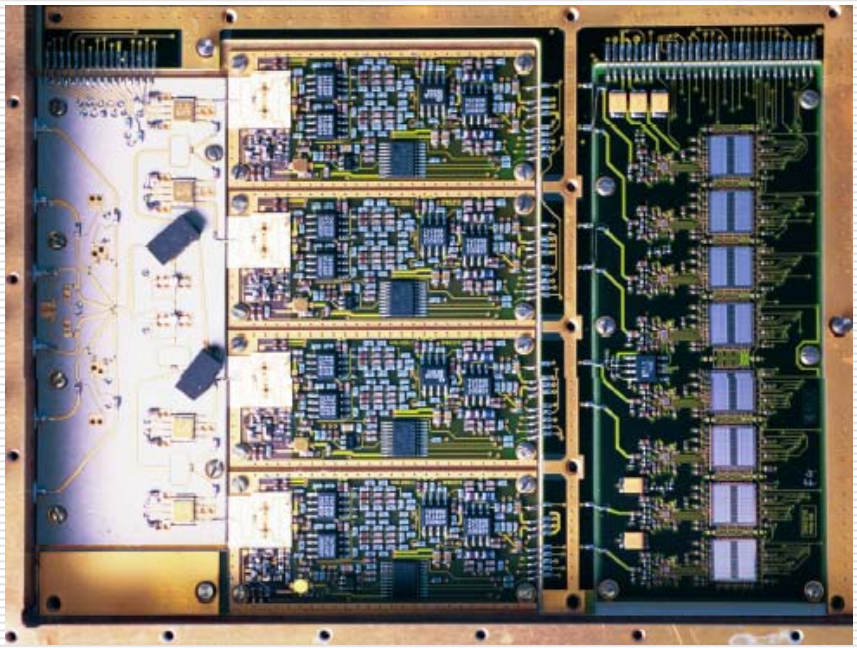
Very low resolution sampling

- Simplifies correlator logic
  - Reduced power consumption
  - Allows for imcreased sample rate
- On noisy signals, causes only minor degradation compared to ideal case
  - 3 levels ~ 90-94% measured efficiency (81% theoretical worst case)

Omnisys Background

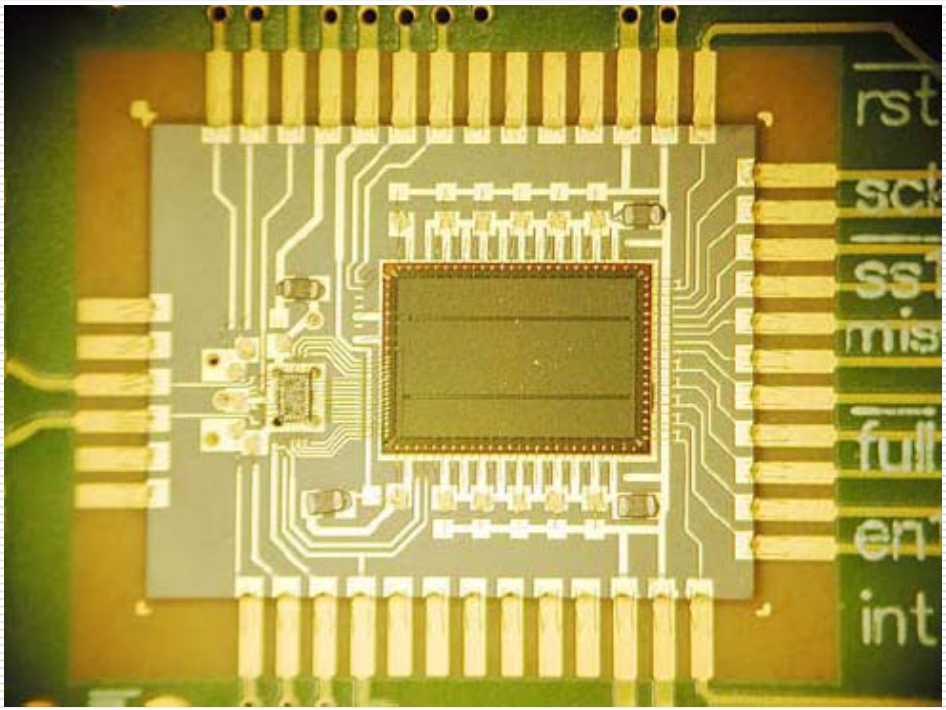
- Developing digital spectrometers for 15 years.
- Four correlator chip-set generations.
  1. 1993: (prototype)
  2. 1997: 100 MHz Bw, 96 channels, 0.4W
  3. 1999: 600 MHz Bw, 256 channels, 1.1W
  4. 2002: 2.0 GHz Bw, 1024 channels, 1.8W

Odin spectrometer



- Odin spectrometer.
- Omnisys 2nd generation chip
- 100 MHz bandwidth /chip
- In space operation since 2001 and still running.

Project Background



Previous correlators had separate ADC and correlator chips

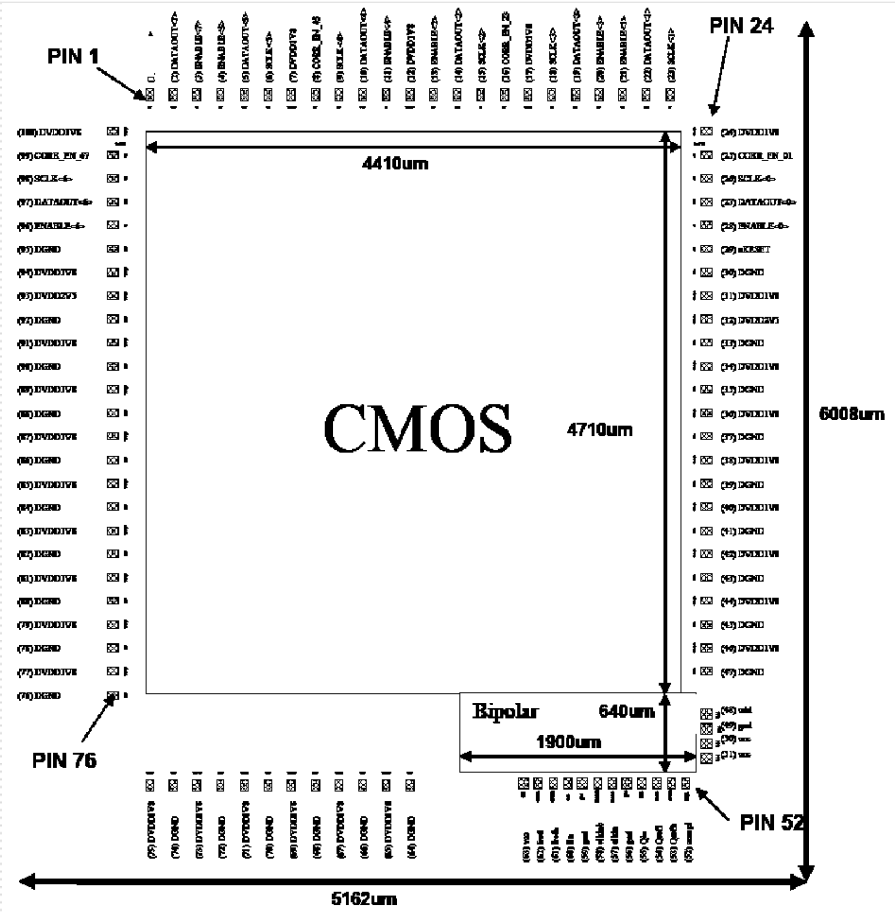
HIFAS Project

- Development of the 5:th generation of Omnisys's correlator chip
  - Integrating bipolar ADC and CMOS correlator core into a single ASIC
  - Bandwidth of 8 GHz (goal).
  - 1024 channels giving a resolution of 1/1024 of the bandwidth (7.8MHz at 8GHz BW)
- ESA contract

Work Performed

- Bipolar ADC designed from scratch
- Correlator core
  - Based on last generation chip's design
  - Expanded from time-div by 2 to time-div by 4
- Simulations
  - Schematic-level and electrical
- Testing preparations
  - PCB design

ASIC Description



- 5.2x6mm
- IBM 7WL SiGe BiCMOS process
- 0.5-3W (prel.) power consumption
- In production (expected March 2007)

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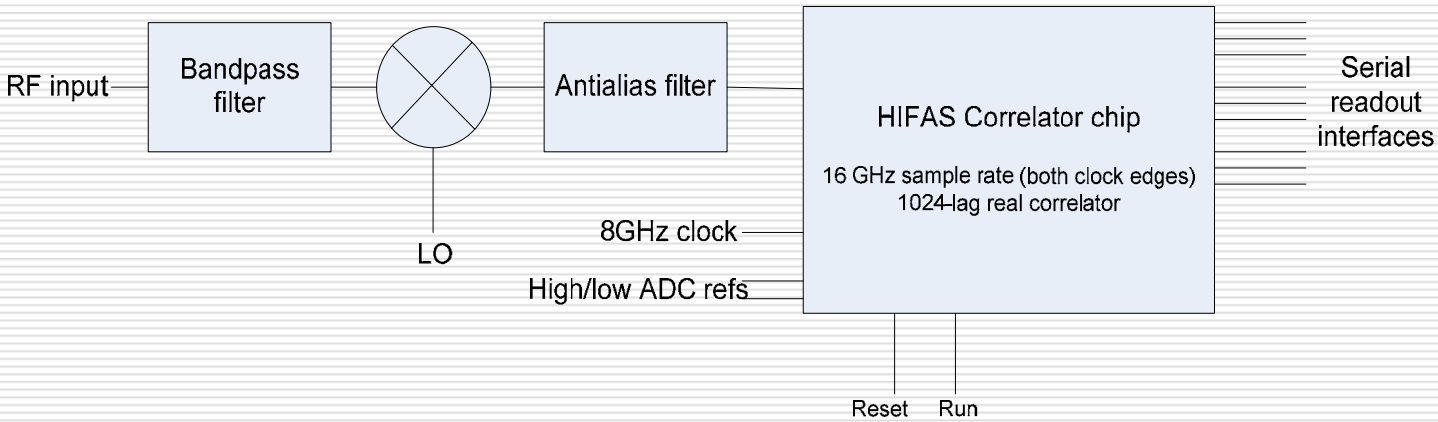
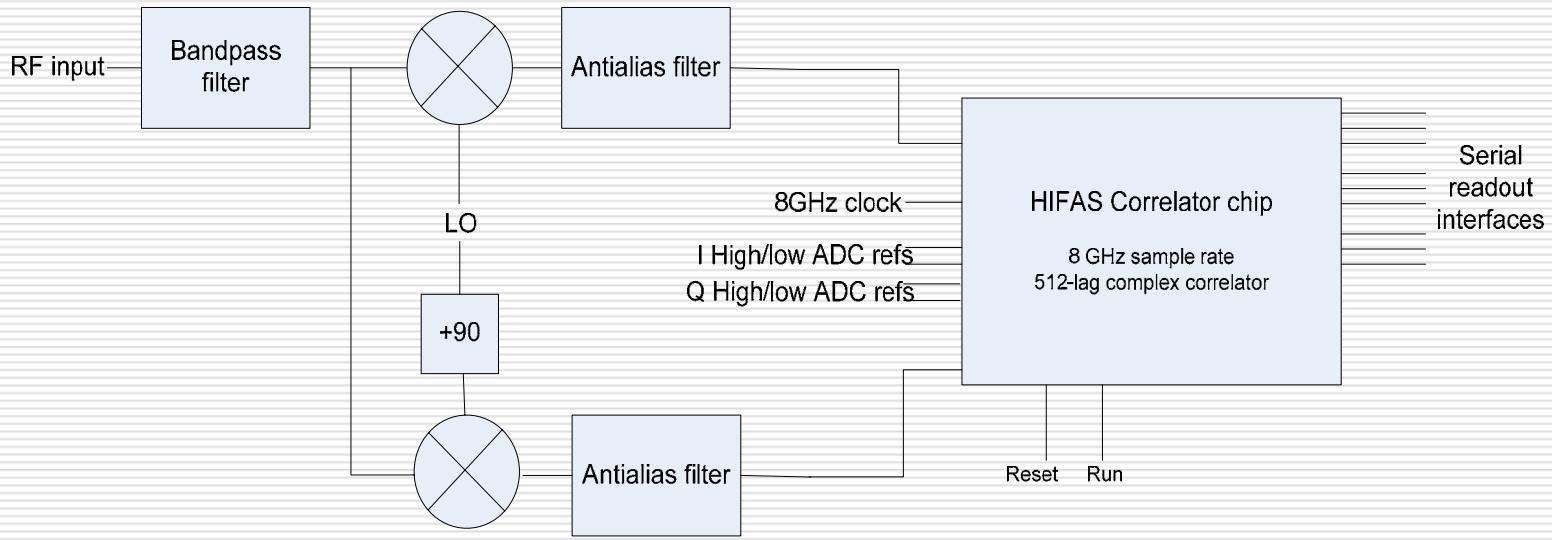
ASIC Operating Modes

- Real operating mode:

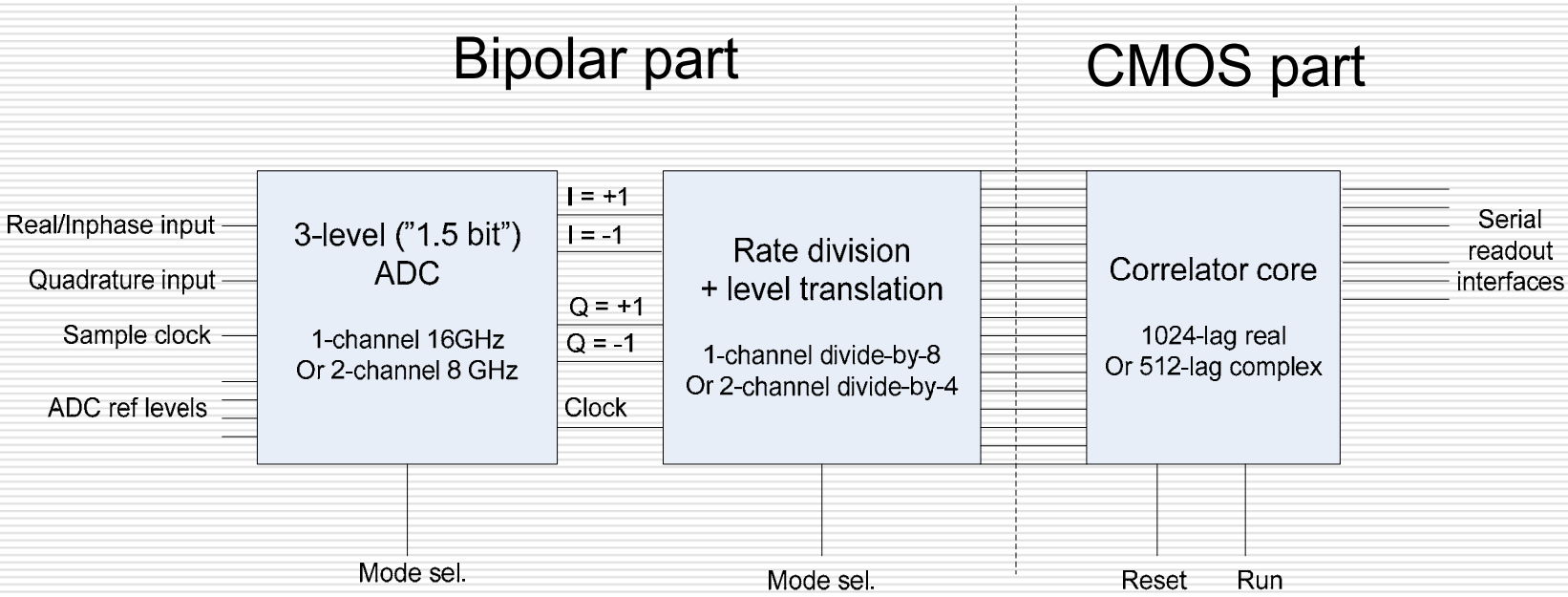


ASIC Operating Modes

- Complex (I/Q) operating mode:



ASIC Description



Remaining work

- Tests to perform
  - Spectrum quality (channel shape, crosstalk, noise)
  - Maximum sample frequency
  - Recommended supply voltages
  - Power consumption
  - Maximum readout frequency
  - Production yield

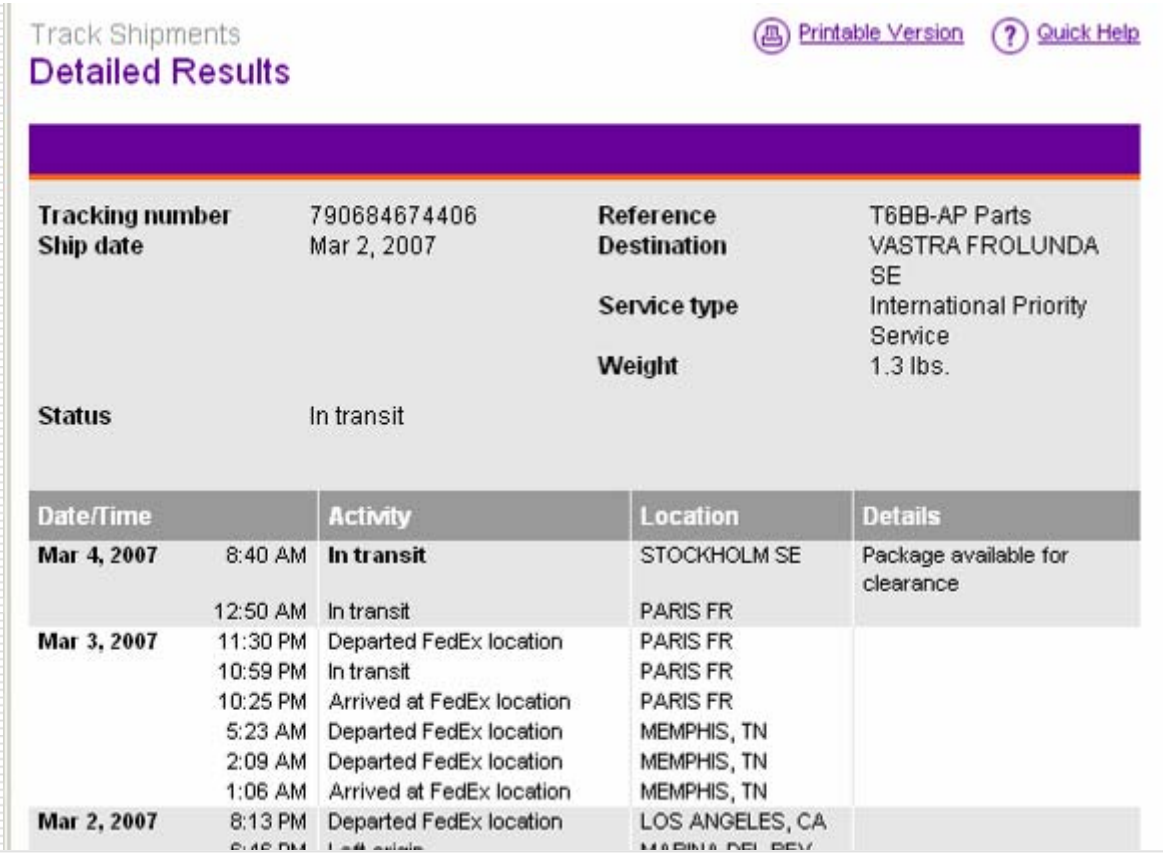
Targeted uses

- Boxed ”standard” spectrometer products
- STEAMR Radiometer
- Future spectrometer projects for space and ground

Summary

- 8GHz spectrometer in a single ASIC
  - Widest bandwidth single spectrometer available on the market
  - Most spectrometer bandwidth/resolution/watt available on the market

The End



Track Shipments

Detailed Results

Printable Version Quick Help

Tracking number	790684674406	**Reference**	T6BB-AP Parts
Ship date	Mar 2, 2007	**Destination**	VASTRA FROLUNDA SE
		Service type	International Priority Service
		Weight	1.3 lbs.
Status	In transit		

Date/Time		Activity	Location	Details
Mar 4, 2007	8:40 AM	**In transit**	STOCKHOLM SE	Package available for clearance
	12:50 AM	In transit	PARIS FR	
Mar 3, 2007	11:30 PM	Departed FedEx location	PARIS FR	
	10:59 PM	In transit	PARIS FR	
	10:25 PM	Arrived at FedEx location	PARIS FR	
	5:23 AM	Departed FedEx location	MEMPHIS, TN	
	2:09 AM	Departed FedEx location	MEMPHIS, TN	
	1:06 AM	Arrived at FedEx location	MEMPHIS, TN	
Mar 2, 2007	8:13 PM	Departed FedEx location	LOS ANGELES, CA	

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