



Cellonics™ UWB Signal Generation and Recovery

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IDA UWB Seminar

Feb. 25, 2003

Nonlinear • Swift • Simple



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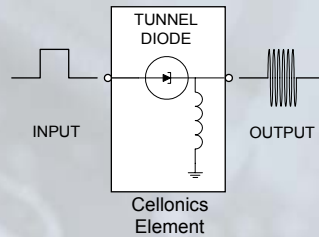
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Outline

- Cellonics™ UWB method
- Two schools of thought in using 3.1-10.6 GHz band for UWB
- Cellonics™ and other UWB methods in both schools of thought
- Business



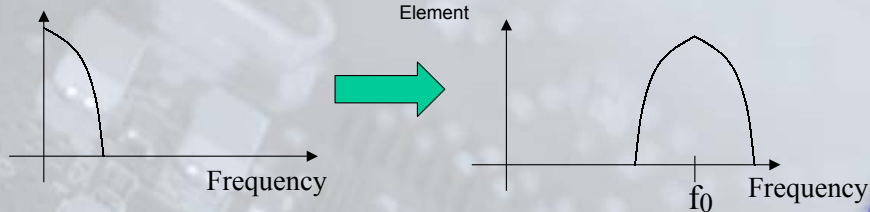
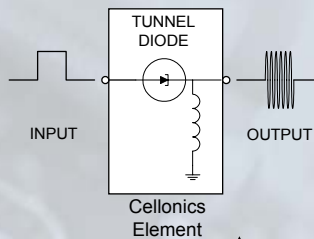
Cellonics UWB Method



- The oscillation starts and stops instantaneously when the pulse is “on” and “off” respectively
- A pulse is converted to a burst of oscillations
- We call this process “Frequency Translation”
- This method is useful for UWB transmitter
- It is also useful to generate correlating signal at UWB receiver



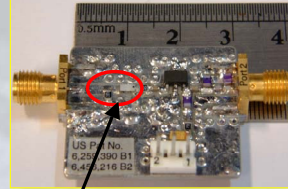
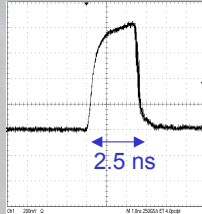
Frequency Translation



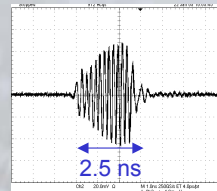
- Frequency translation is a non-linear process
- It looks like “up-conversion”



The Future of Communications **Cellonics™ UWB Transmitter Module based on Frequency Translation**



Cellonics™ Element



The Future of Communications **How to Utilize 3.1-10.6 GHz ?**

UWB definition (FCC R&O):

- To have more than 20% fractional bandwidth
- OR
- To occupy more than 500 MHz of spectrum

Because of the definition there are two approaches to utilize the spectrum:

- Single band
- Multi-band

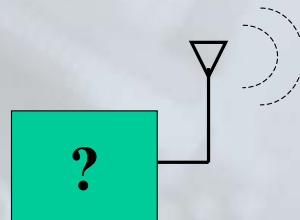


Single Band and Multi-band Approaches

Single Band	Multi-band
<ul style="list-style-type: none"> • Occupies the whole 3.1-10.6GHz • Utilizes sub-nanosecond pulse • Transmits serial data • Requires very high speed baseband to achieve high bit rate transmission (i.e. to achieve 500 Mbps, 1 bit/pulse, PRF is 2 ns) 	<ul style="list-style-type: none"> • Breaks into 500 MHz sub-band • Utilizes nanosecond pulse • Transmits parallel data • Requires moderate speed baseband to achieve high bit rate transmission (i.e. to achieve 500 Mbps, 8 sub-bands, 1bit/pulse, PRF is 16 ns)



UWB Tx Methods for Single Band



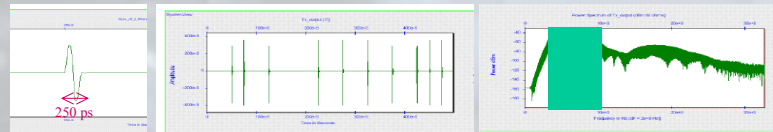
- Monocycle
- Up-Conversion
- Cellonics™ Frequency Translation



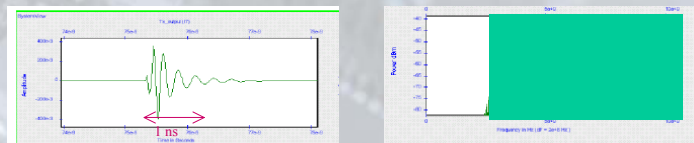
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Monocycle:

- The spectrum spans from DC to some upper frequency limit depending on the pulse width



- Requires HPF to remove spectrum below 3.1 GHz resulting in pulse spreading => limiting PRF

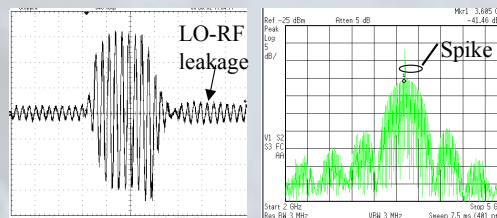
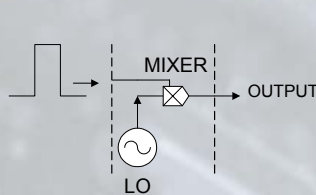


Pictures on this page taken from Elanix (System View) website



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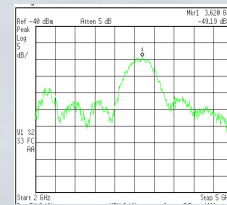
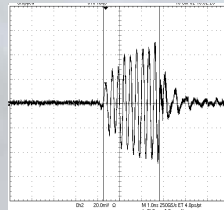
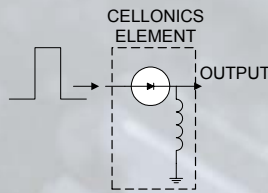
Up-Conversion:



- The spectrum is easily fitted into the frequency mask
- No pulse spreading
- There is LO-RF leakage when pulse is “off”, appears as a spike in frequency domain
- The peak of the spike has to be below FCC part 15 => Range reduction (3 dB above main lobe corresponds to 30% range reduction)



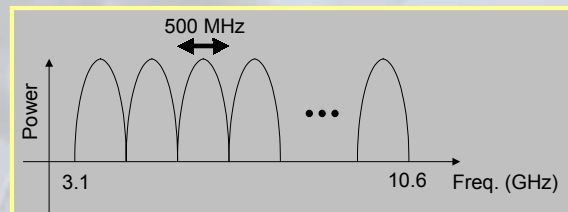
Cellonics™ Frequency Translation:



- The spectrum is easily fitted into the FCC mask
- No pulse spreading
- No LO-RF leakage associated with it
(make full use of FCC allowed power density)
- No oscillator required => low power consumption
(Power consumed approx. 1/5 of that of Up-conversion)



UWB Tx Methods for Multi-band

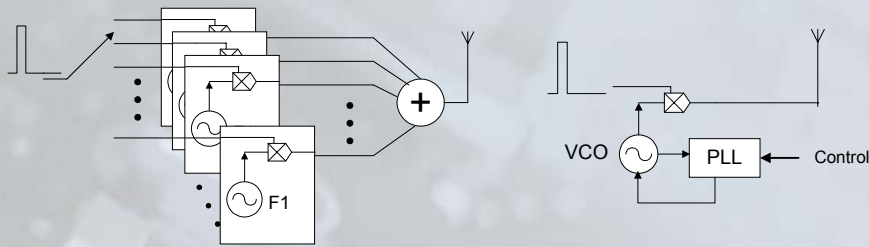


- Monocycle => Unattractive
- Up-conversion
- Cellonics™ Frequency Translation



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Up-Conversion:

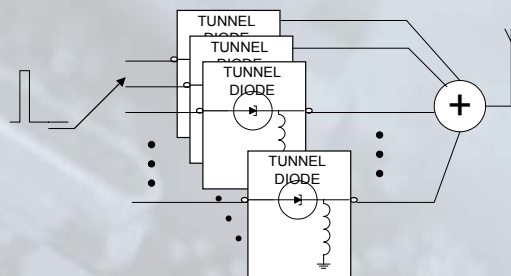


- Use a number of oscillators
=> high power consumption
- OR
- Use PLL
=> Fast switching PLL (in order of few ns)



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Cellonics™ Frequency Translation:



- Use a number of Cellonics™ Elements tuned at different centre frequencies
=> low power consumption is maintained,
implementation remains simple
(One Cellonics™ Element consists of only a few components)



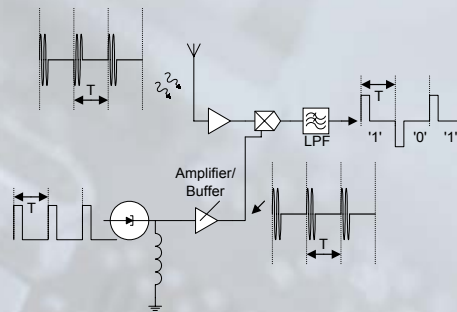
Quick Review

	Monocycle	Up-Conversion	Cellonics Frequency Translation	Remarks
Spectrum				
No pulse spread		✓	✓	Pulse spread limits PRF
No LO-RF leakage	✓		✓	LO-RF leakage reduces range due to power emission limit
Applicable in Single Band	✓	✓	✓	
Applicable in Multi-band	?	✓ (challenging)	✓ (simple)	



Cellonics™ UWB Receiver

Correlator:



Challenge:
Require high precision pulse delay mechanism to achieve good synchronization

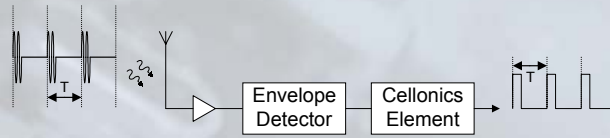


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Cellonics™ UWB Receiver⁺

Non-correlator:



- Easier to implement compared to that of correlator
- Applicable only to OOK and PPM modulations



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Interested in Cellonics™ Technology?

- Strategic Partnership to develop killer applications
- Licensing
- Samples of Cellonics™ modules



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