GPS IP Centre – Daventry, UK

11 Nov2009

Our GPS Heritage

- GPS development since 1980
- First Product in 1983
- Formed “Navstar” in 1990
  - First Commercial GPS products launched
  - Sold our marine business in 1991
- Bought by a timing company in 1993
  - Became in house timing supplier
  - Continued in “professional” GPS
- Bought by an IP company in 2000
  - IP for mobile phone chips
- Spun out as a “start up” in 2006
  - Fabless semi model
- Bought by NXP in 2008

NAVSTAR SYSTEMS

Symmetricom

parthus
POWERING THE MOBILE INTERNET™

parthusceva
THE IP POWERHOUSE™

CEVA™
The DSP Powerhouse

GLONAV™

ST-NXP Wireless

NXP
founded by Philips

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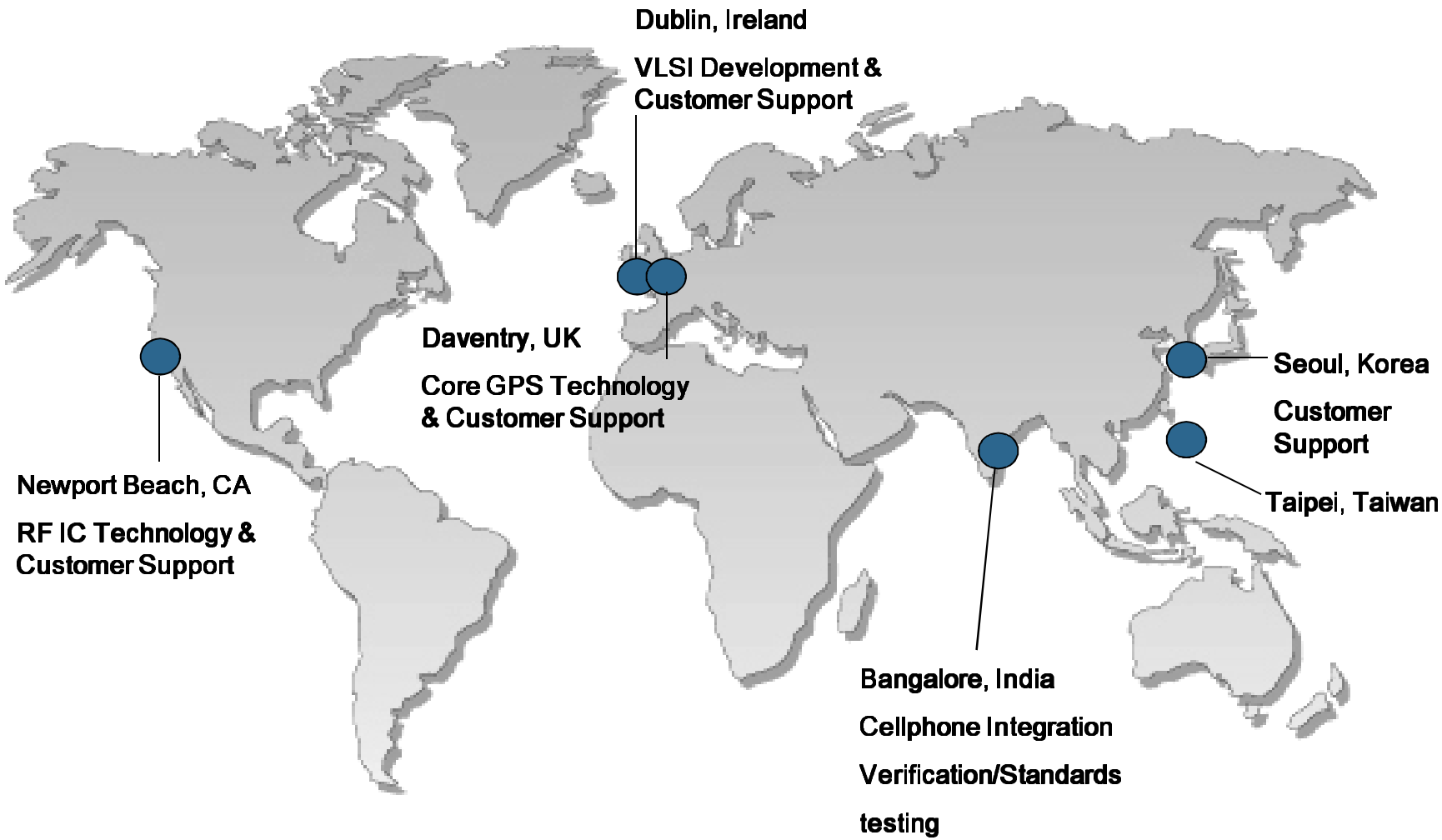
GPS Team Locations



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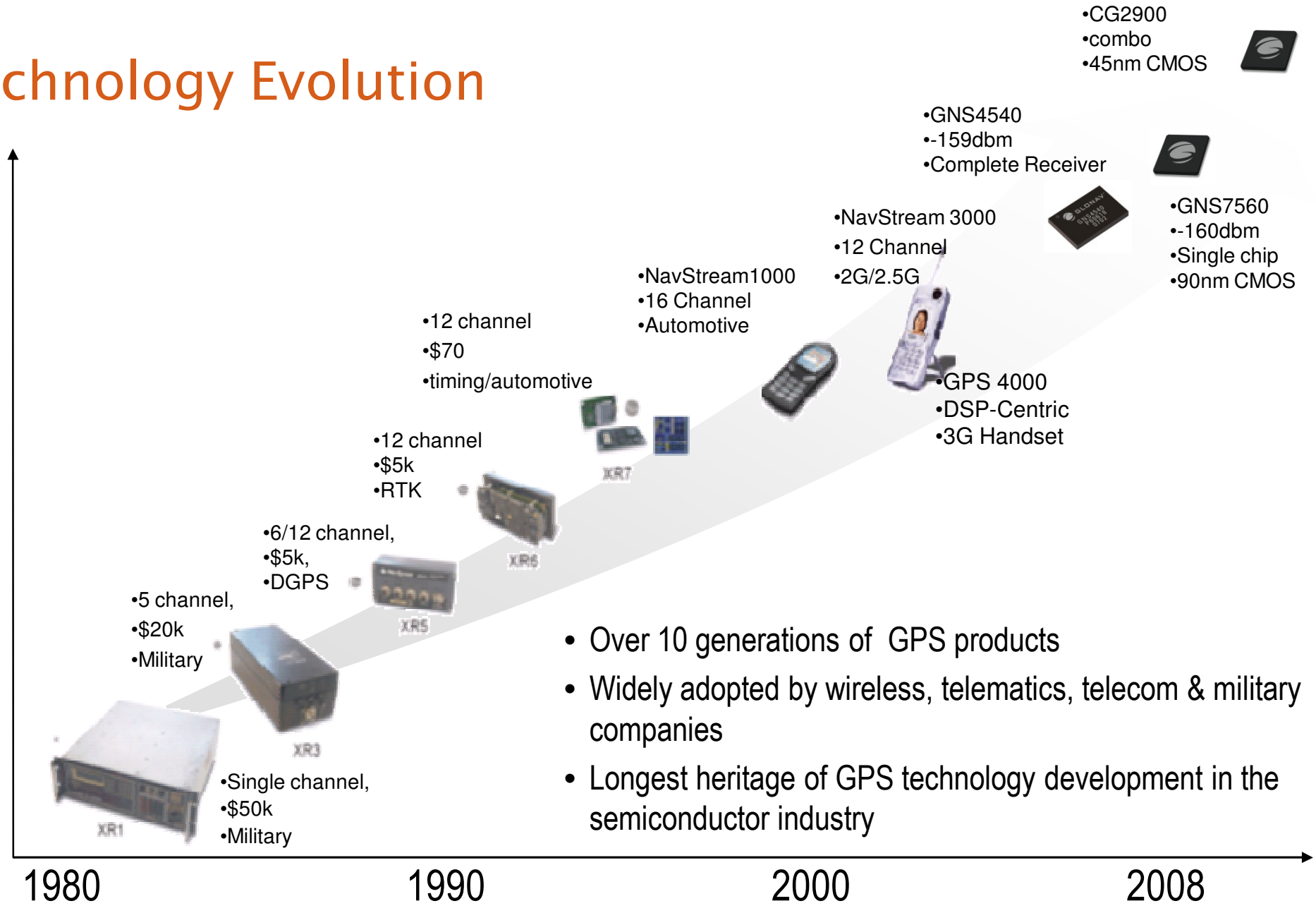
Technology Evolution



- Over 10 generations of GPS products
- Widely adopted by wireless, telematics, telecom & military companies
- Longest heritage of GPS technology development in the semiconductor industry

From Product to IP to Chips

- Complete products
  - In house technology
- Modules and sub assemblies
  - For OEMS and systems
- IP
  - Designs for chip makers
- Fabless Semi
  - Single chip GPS
  - Combo chips

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The Road to the "Single Chip" GPS

1980	▪ First product built from catalogue parts and in house customer chips ▪ 8 boards, power supply, RF module	5 um
1986	▪XR3 chip set implements a single channel baseband on one chip ▪ RF is still discrete ▪The single chip GPS is a dream for the future	2 um 1.5um
1992	▪XR5 chipset implements 6 channel baseband on a chip, new partner RF chip ▪IF and ADC are still discrete ▪XR6 IF chip mops up most of the discrete radio parts	0.8um
1998	▪MCM technology builds a 1 inch square complete radio using the RF chips ▪XR7 chip implements a 12 channels baseband and microcontrollerr on a single chip ▪Plus a new single radio chip for the first time	0.35um
2000	▪The IP years	0.18um
2004		0.13um
2006	▪GNS4540 is a single device GPS receiver – 2 die on a single substrate ▪GNS7560 is a true single chip GPS	90nm
2008	▪ we went through the "single chip barrier" ▪Combos and still going	45nm 40nm

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GPS Chipset Evolution

1982 NCO

Frequency synthesiser
for DECCA navigation
receiver, <1000 gates
5µ technology (LSI Logic)

1984 battery backed

Z80 processor support
& real-time clock, i.e.
battery backed (50µA)
1400 gates, 5µ, (MCE)

1986 XR3 GPS digital chipset

National Semi. 32000
navigation processor
support for XR3 GPS
2µ (LSI Logic)

Single channel GPS signal
processor & MC68000 support
1 chip / channel or multiplexed.
1.5µ Used stand-alone in XR4

1986 PLL/synthesiser

Dynamically addressable
LO synthesiser/NCO for 2000
& Dinghy DECCA receivers
1.5µ compacted gate array

1988 Loran

Loran signal processing
plus Z80 support chip
with LCD serial driver.
1.5µ LMA9K (LSI Logic)

1992 GPS RF

ROC1 (Reciever on chip)
GPS RF front end mixer
VCO & AGC chip
Avantek / HP process

1992 XR5 GPS digital

6 channel GPS signal processor
with MC68020/68000 support
2 UARTs, parallel & serial ports,
pulse-per-second, 0.8µ (Toshiba)

1994 XR6 IF

ROC2 GPS IF,
& digitiser chip for
use with ROC1

1998 XR7 GPS MCM

ROC3 bonded to substrate &
supplied as a tested multi-chip
module complete with SAW filters

1999 XR7 System on Chip

12 channel GPS microcontroller
with ARM7 cpu core, RAM, ROM
library, UARTs, parallel & serial ports
timers analogue & RTC. 0.35µ (VLSI)

2000 XR7 RF

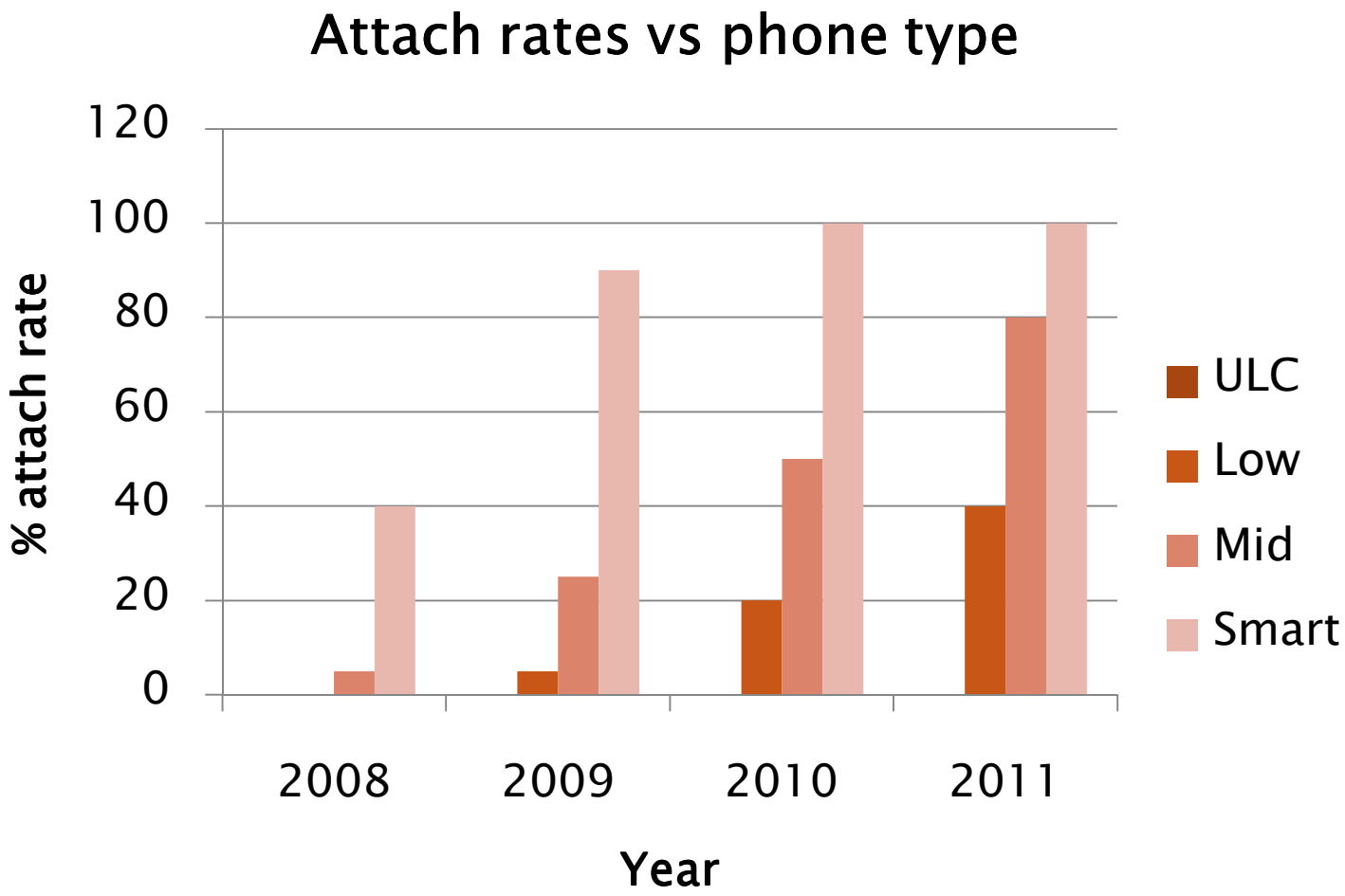
ROC3 as a packaged chip
Integrated GPS RF solution.
(LNA, VCO, mixers, agc amp)
in a QFP (Maxim process)

Enabling Applications and "Location Aware"

- LBS applications are beginning to appear
  - Mapping and Navigation – turn by turn instructions
  - Find a friend
  - Nearest ATM, Pizza, Burgers, Fuel etc
  - Dating
  - Sports – running, workout, cycling
  - Location based advertising

- Location Aware Applications
  - Phonebook
  - Local Favourites – restaurants, theatres, gym ....
  - Buying Guides
  - Localised info – traffic, tourism, radio stations ....

GPS Attach Rates vs Phone Type



Combo chips

- Standalone GPS chip are becoming too small!
  - 45nm process means <1/2 the area of current chips
  - Can't get the balls onto a single GPS die
  - Have to make it bigger to form a product (too expensive!)
- Same problem affecting other "connectivity" chips
- So combine FM, Bluetooth, WiFi etc with GPS
  - Has some interesting problems to solve
  - Connectivity
  - Cohabitaion

State of the Art

Combo “BGF” chip

~9 million transistors

Full FM Rx/Tx with RDS
- dedicated FM processor

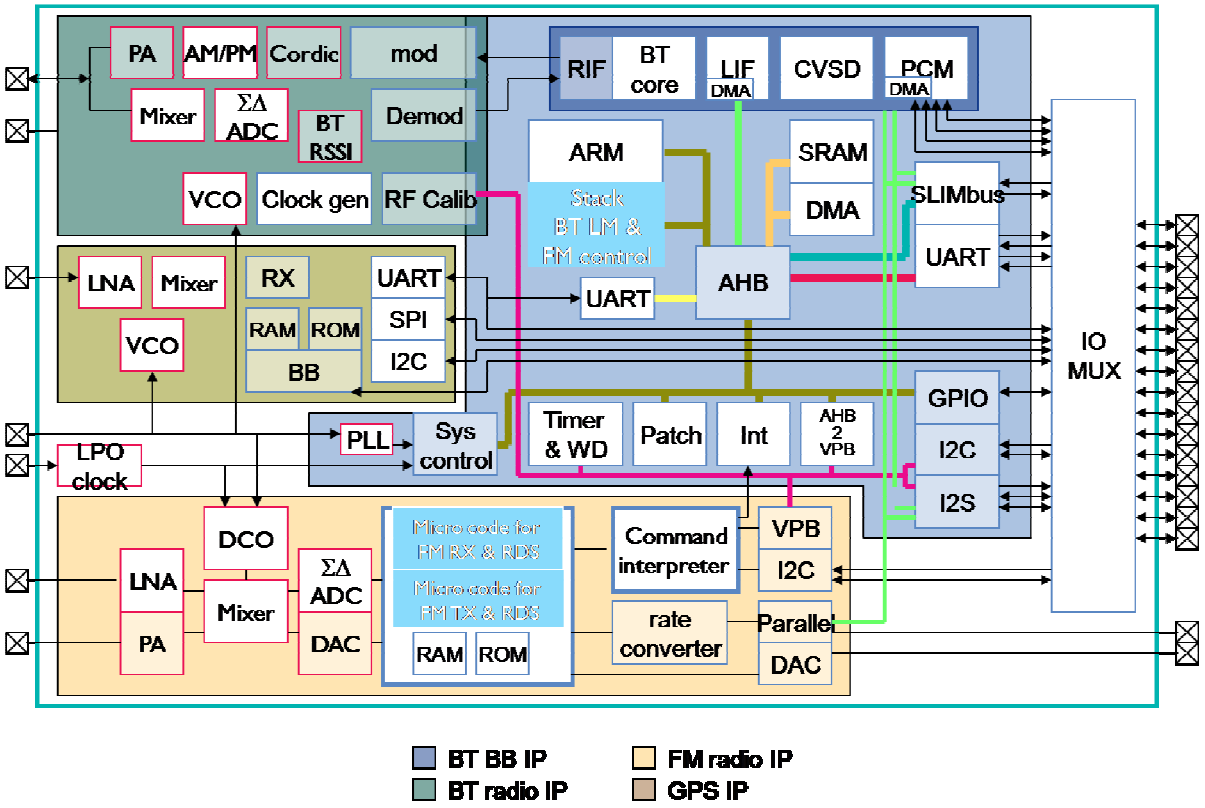
Complete GPS measurement engine
- dedicated GPS DSP

Bluetooth with ULP mode

ARM controller runs BT stack
- also manages cohabitation issues

45nm low power process

On board power regulators and power controller



Is this the end of stand alone GPS chips?

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Following the GNSS curve

- GPS has been stable for >30 years
- New GPS signals coming – can we use them?
  - Modern signals will be good form multipath and low signal environments
  - Another frequency is not popular – wait for L1?
- SBAS – limited use for cellphones
- GLONASS is with us (again)
  - Signals are free, on L1 and enough SVs to make a difference
  - FDMA has some advantages but need a different radio
- Galileo is coming (still)
  - L1 band will be compatible
  - Modernised signals are good
  - Need more MIPS, memory, power etc
- QZSS, Compass, Gagan, ...

THANK YOU!

and Good Luck to GRACE!

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