

# Why do I work with electronics, and why is it so complex?

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- Postdoctoral research fellow at NTNU
- Married with three kids
- Master of Science (2002) from NTNU, Ph.D. (2008) from NTNU

## Controlled study proves activity monitor and motivational website increase children's physical activity and improve health by making exercise fun



*Zamzee uses Nordic Semiconductor technology to encourage children to exercise*

The 'Zamzee' activity monitor, which includes a new Bluetooth Smart wireless version that employs Nordic Semiconductor wireless technology, encourages sedentary children to start enjoying the health and wellness benefits of physical activity by measuring performance and rewarding effort with virtual badges, "pointz", and virtual currency called "Zamz" which can be redeemed for prizes like toys and gift cards

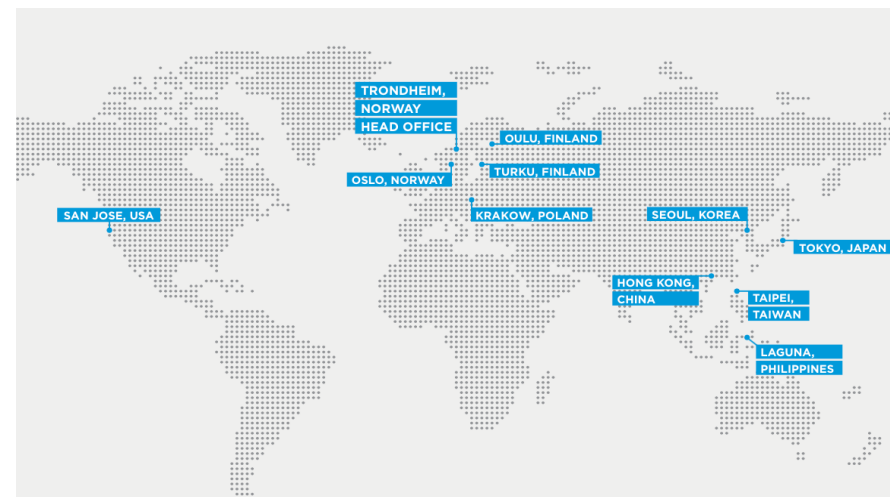
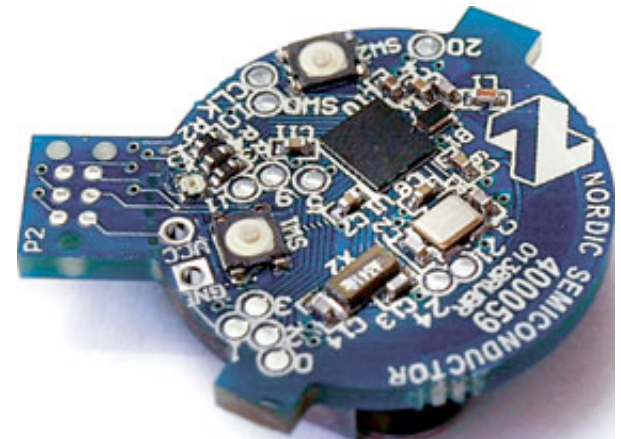
Oslo, Norway | 2014/08/26

Ultra low power (ULP) RF specialist Nordic Semiconductor ASA (OSE: NOD) today announces that U.S.-based non-profit research organization, HopeLab, has specified Nordic nRF8001 Connectivity ICs to provide the Bluetooth Smart® (previously known as Bluetooth low energy) wireless link in the latest wireless version of its 'Zamzee' activity monitor for children.

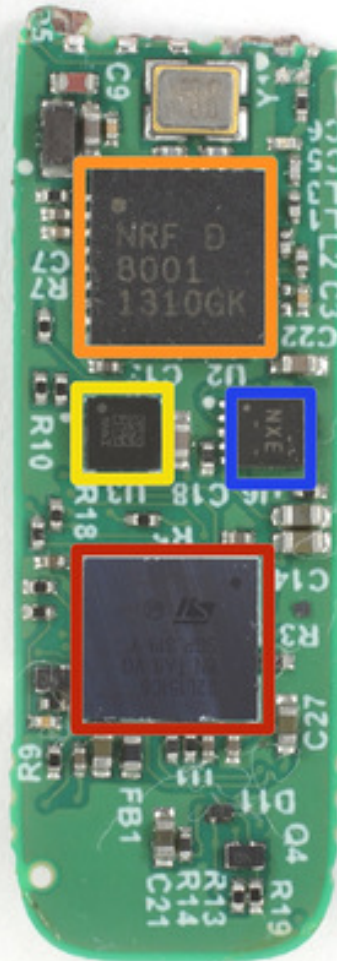
In a six-month randomized controlled trial of 448 subjects aged 11 to 14, Zamzee was proven to increase the weekly moderate-to-vigorous physical activity (MPVA) in children by 59 percent (equating to 45 additional minutes of MPVA per week) compared to a control group. (See "A summary of the behavioral and biological

# Who is Nordic Semiconductor?

- Norwegian company (1983 - )
- Main product
  - 32-bit ARM MCU with multi-protocol 2.4GHz transceiver (nRF51 & nRF52)

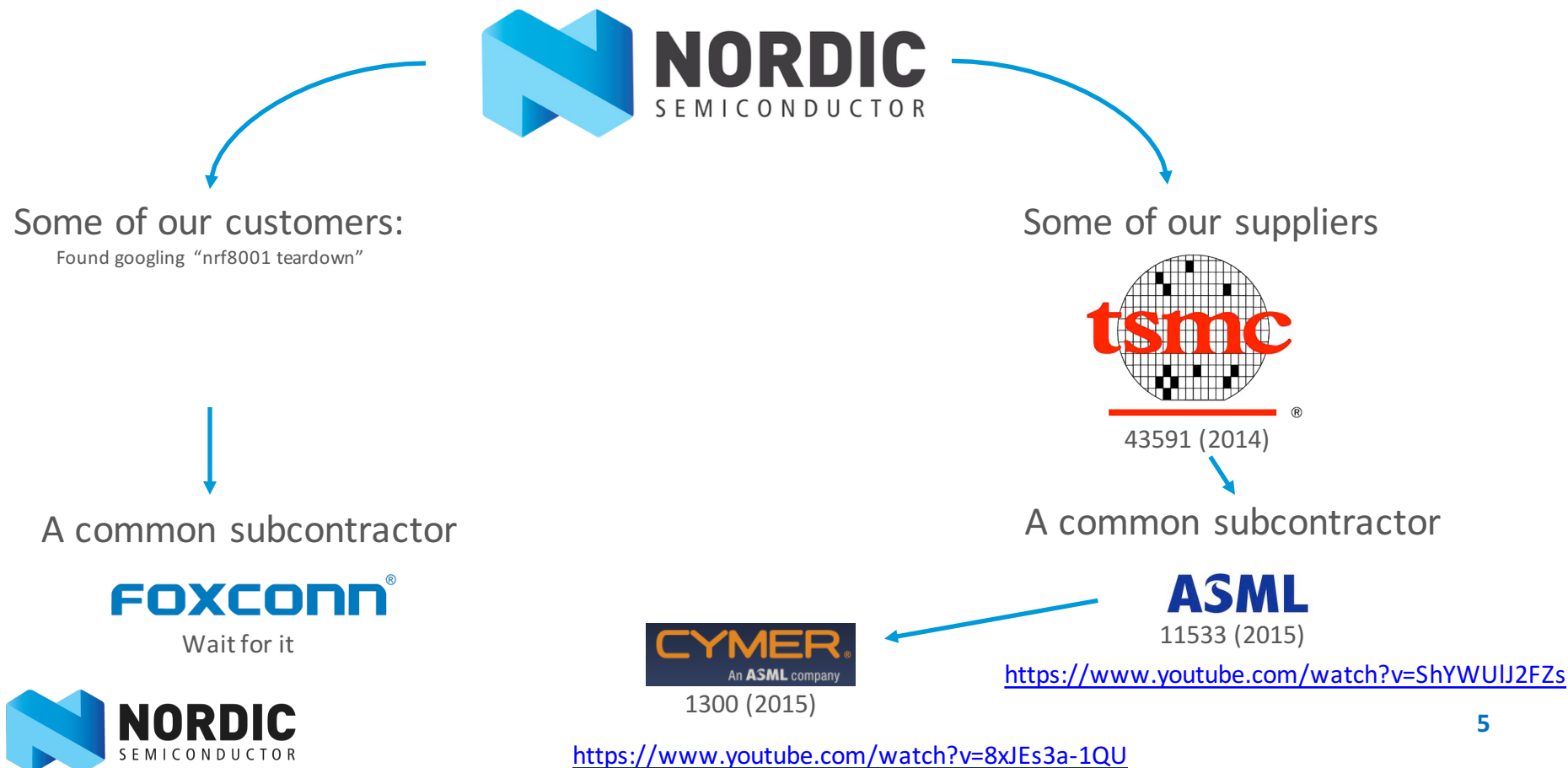


# End product example



IFIXIT

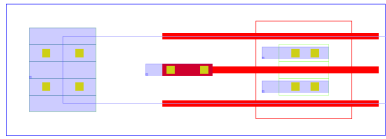
# How can a small Norwegian company rule the low-energy wireless world?



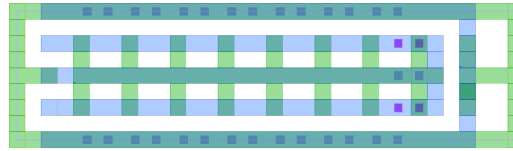
# Who makes electronic things?

Companies with the most employees in the world			
Rank ↕	Employer ↕	Country ↕	Employees ↕
1	Walmart	 United States	2,200,000
2	Hon Hai Precision Industry (T.A. Foxconn)	 Taiwan	1,090,000
3	Sinopec	 China	1,021,979
4	G4S	 United Kingdom	620,000
5	Tata Group	 India	602,000
6	United States Postal Service	 United States	601,601
7	Tesco	 United Kingdom	597,784

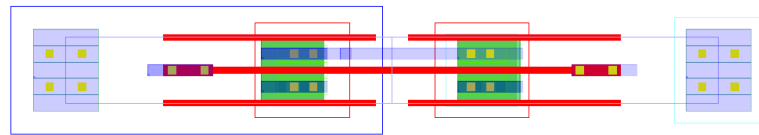
# Basic building blocks



Transistor (NMOS)

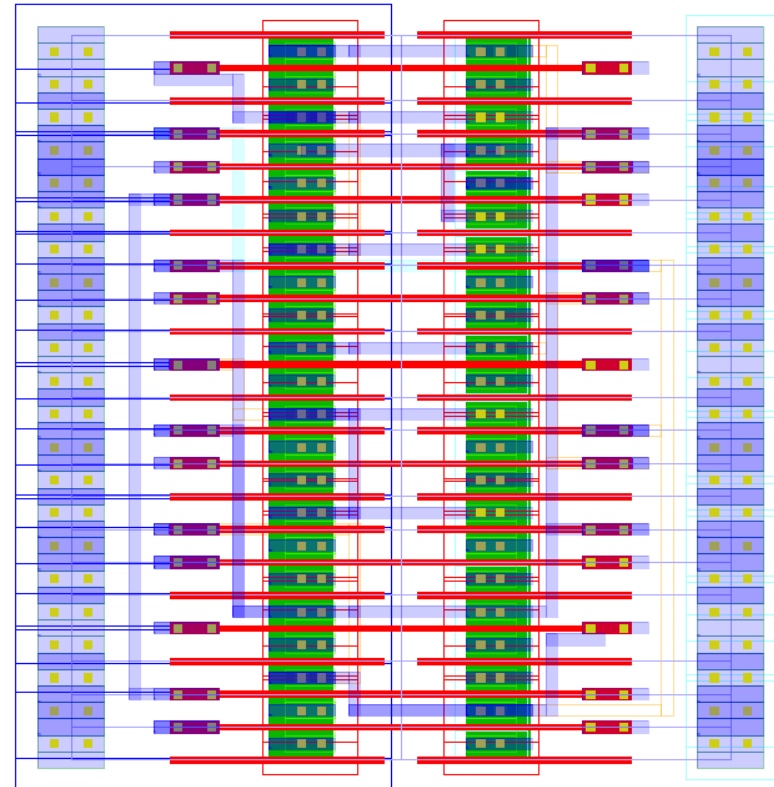


Capacitor (MOM)



Inverter

D-flip-flop with reset



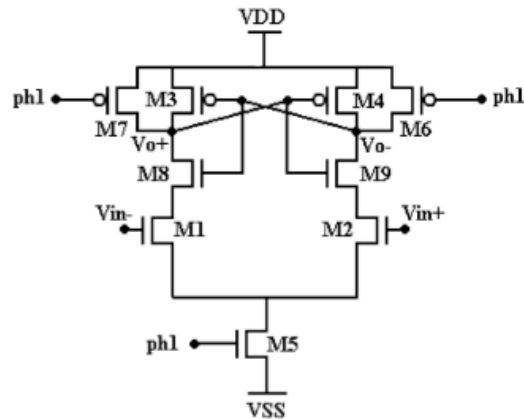
# Strong-arm comparator

```
.SUBCKT SARCMPX1_CV CPI CNI CP0 CNO CK_CMP CK_SAMPLE PWRUP EN DONE NC1 NC2 AVDD AVSS
XA0 AVSS TAPCELL_CV
XA9 CK_CMP CK_B AVDD AVSS IVX1_CV
XA10 CK_B CK_N AVDD AVSS IVX1_CV
XA1 CPI CK_B CK_N AVDD AVSS SARKICKHX1_CV
XA2 CPI CK_B CNO_I CP0_I N1 NC1 AVDD AVSS SARCMPHX1_CV

XA2a CP0_I CP0 AVDD AVSS IVX4_CV
XA3a CNO_I CNO AVDD AVSS IVX4_CV

XA3 CNI CK_B CP0_I CNO_I N1 NC2 AVDD AVSS SARCMPHX1_CV
XA4 CNI CK_B CK_N AVDD AVSS SARKICKHX1_CV

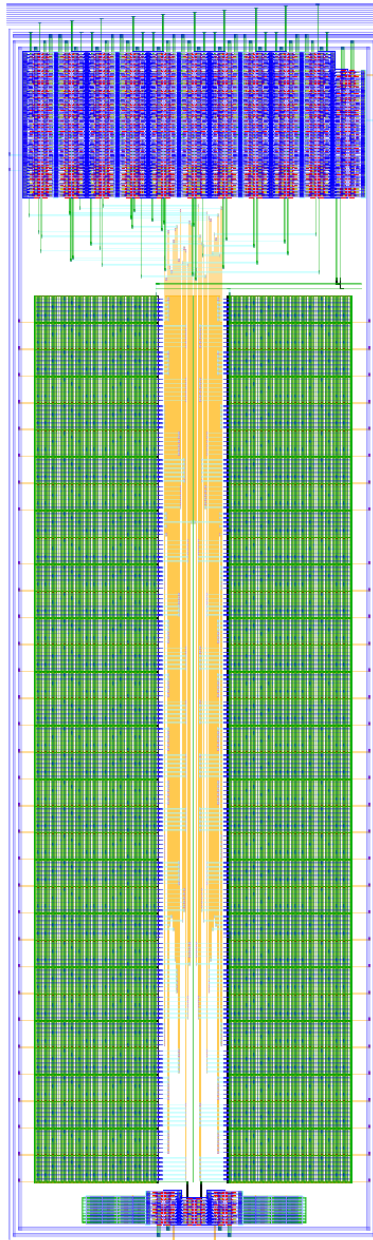
XA11 PWRUP CK_SAMPLE RST AVDD AVSS NDX1_CV
XA13 TIEH DONE RST NC3 NN1 AVDD AVSS DFRNQNX1_CV
XA12 TIEH AVDD AVSS TIEH_CV
XA14 NN1 RST EN AVDD AVSS ANX1_CV
XA15 AVSS TAPCELL_CV
.ENDS
```



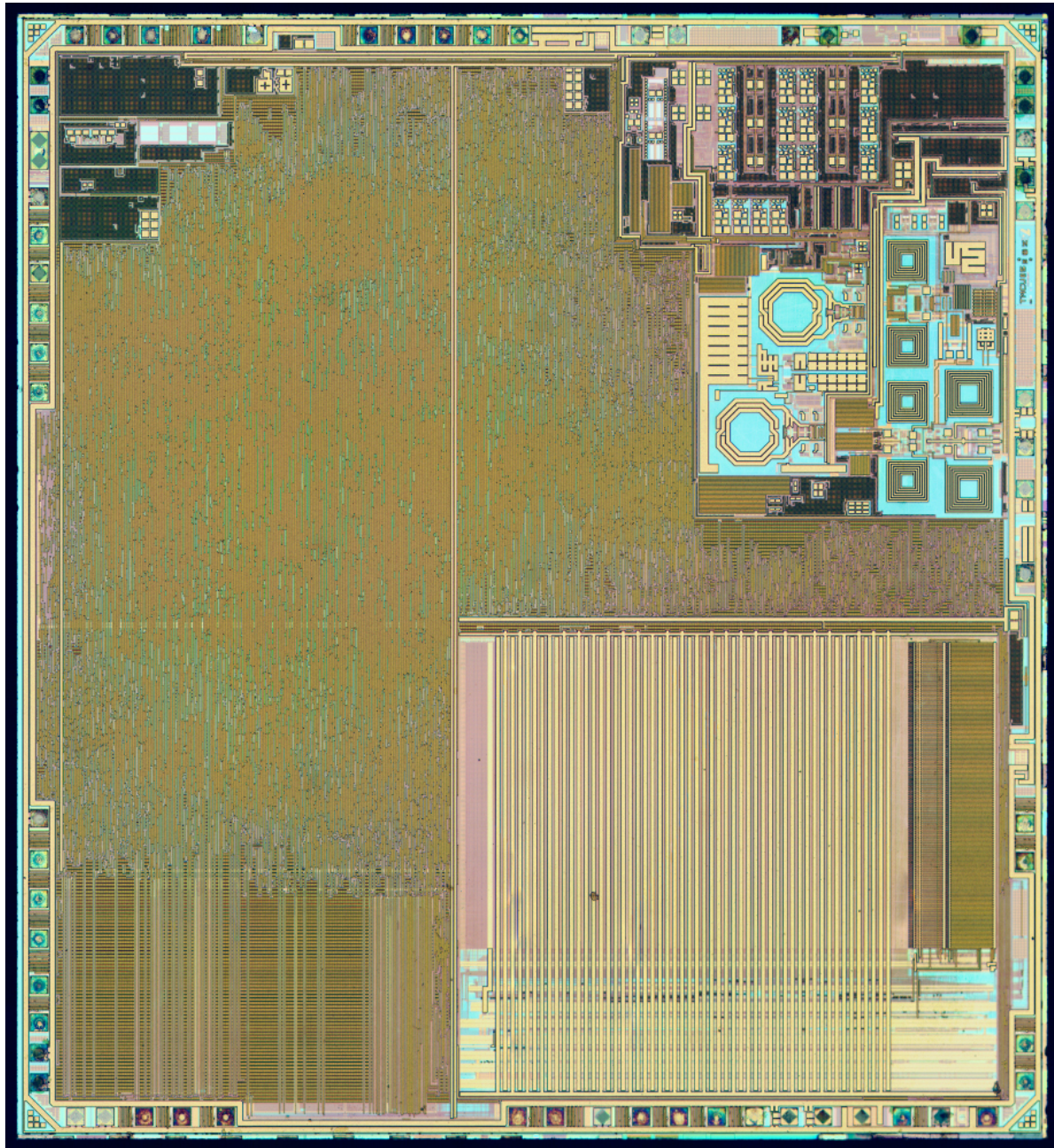
<http://www.designers-guide.org/Forum/Attachments/cmp.png>



# A complete ADC



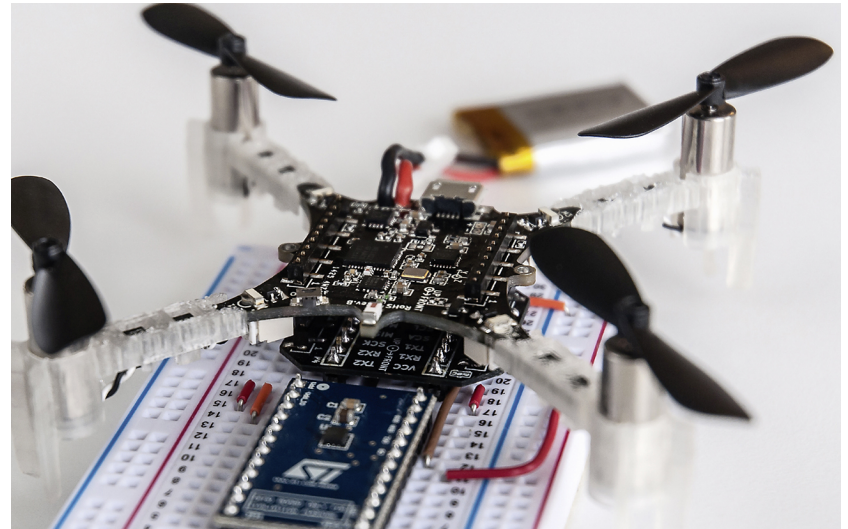
# nRF51



Google : nRF51 die photo

# Enabling devices

- High sales of smartphones enable rapid development of products
  - 500 million iPhones (2014)
  - 100 million Samsung Galaxy (2013)
- Fun projects
  - Open source [quadraicopter](#)





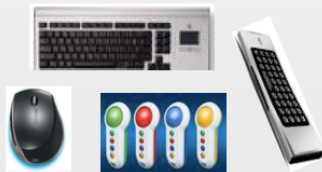
# Nordic market segments - Q2 2011

## PC / Media controllers

Wireless PC mouse / keyboard,  
Media center remote control,  
Game controller

Q2 Revenue: MUSD 28.6 (MUSD 31.2)

- *PC Peripherals:* Strong growth potential, particularly in low cost category (emerging markets and replacement of wired devices)
- *Media remotes:* New market for remote controls for connected TV's based on mouse/keyboard designs
- *Game controller:* Designs for new interactive controllers currently under development



## Sports / Health monitors

Heart monitors, foot pods, watches

Q2 Revenue: MUSD 1.8 (MUSD 1.8)

- Production issue impacts Q2 sales. Very strong order backlog for Q3.

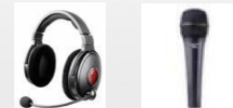


## Audio devices

Wireless audio streaming,  
microphones, gaming headsets

Q2 Revenue: MUSD 0.1 (MUSD 0.3)

- Slow market ahead of launch of new Nordic audio product



## Other applications

RFID, Toys, etc.

Q2 Revenue: MUSD 4.0 (MUSD 3.0)

- New toy design, RFID product and other new devices drive growth



## ASIC components / consulting

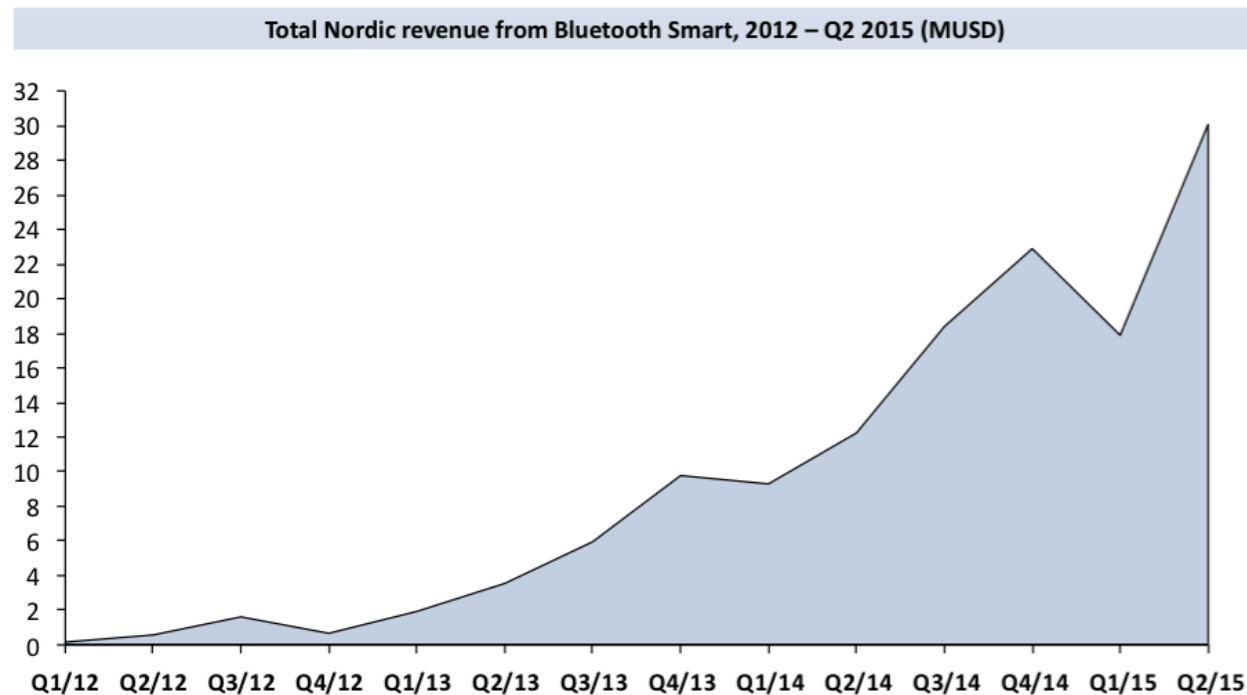
Wide sector span

Q2 Revenue: MUSD 4.0 (MUSD 5.7)

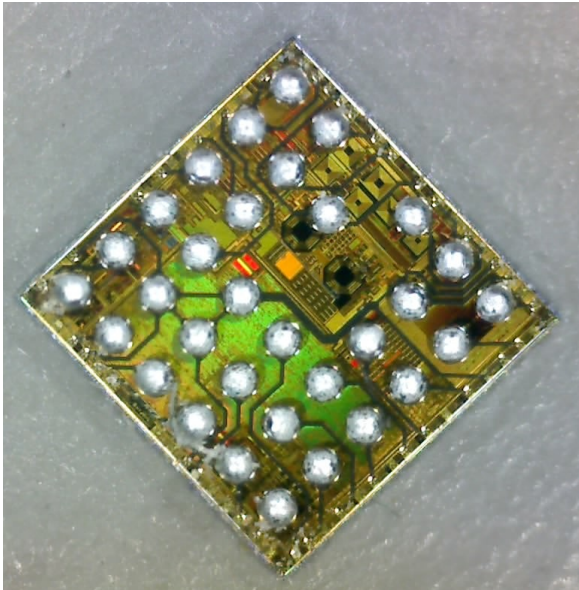
- Recent release of an end product with a Nordic ASIC design driving revenues



# Nordic market segments - Q2 2015



# Research & development takes time



Software design  
Acoustics  
Signal processing  
Computer design  
Radio Systems  
Circuit- and systems design  
Electro-optics  
Electronic Devices and Materials

Time to market  
Months  
Years  
Decades

# Divide and conquer

- Break complex stuff down into smaller pieces
- Ignore the difficult stuff, and try to get an approximate understanding, then add in the difficult stuff
- Don't be afraid if something is difficult
- Don't think your stupid and won't be able to understand
- Don't think that everybody else is smarter than you

# When you don't understand

- Ask someone
- Don't be afraid to show that you don't know something, not knowing is OK (except on the exam, and in a job interview)
- Use wikipedia



# What you need to teach yourself

- Ability to work hard (constant speed)
- Programming
- Report writing
- Explaining things to other people
- Convincing people that your right through persuasive arguments

Questions?

# Things you should know about

## Software:

Scripting (Bash, Perl, Python, Ruby, TCL, LISP)

Programming (C, C++)

Editors (Emacs)

Math software (Matlab, Maple, Octave)

## Information sources:

<http://ieeexplore.ieee.org>

## Where to buy electronic supplies:

[www.digikey.no](http://www.digikey.no)

[www.mouser.com](http://www.mouser.com)