

An aerial, black and white photograph of a dense city skyline, likely New York City, with numerous skyscrapers. Overlaid on the image are several blue, curved lines representing radio signals or data waves emanating from various points across the city.

NOWI : Enabling the Internet of Things

65th SASG meeting

Chris Juliano, VP Strategic Partnerships
Dr. Andre Mansano, Chief Technology Officer



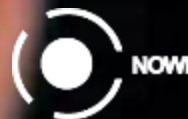


SMART
WATCH
BUILDING
ROAD
HOME
FACTORY



HOW TO BE SMART

SENSE THINK ACT



A close-up, high-resolution photograph of a human eye with a striking blue iris. The eye is looking slightly to the right. The skin around the eye is detailed, showing pores and fine lines. The background is dark and out of focus.

**A world that feels requires billions of
wireless sensors**





THE PROBLEM





- €5/meter cable
- Impractical
- Unpleasant



- €1-2 battery/change
- €10-35 labor cost /change
- Polutting /Hazardous
- **Impossible or unpleasant**

THE PROBLEM



‘Plug & Forget’ IoT device



Ultra-low maintenance



Ultra-low cost of ownership



Energy Harvesting



Radio Frequency



Solar PV



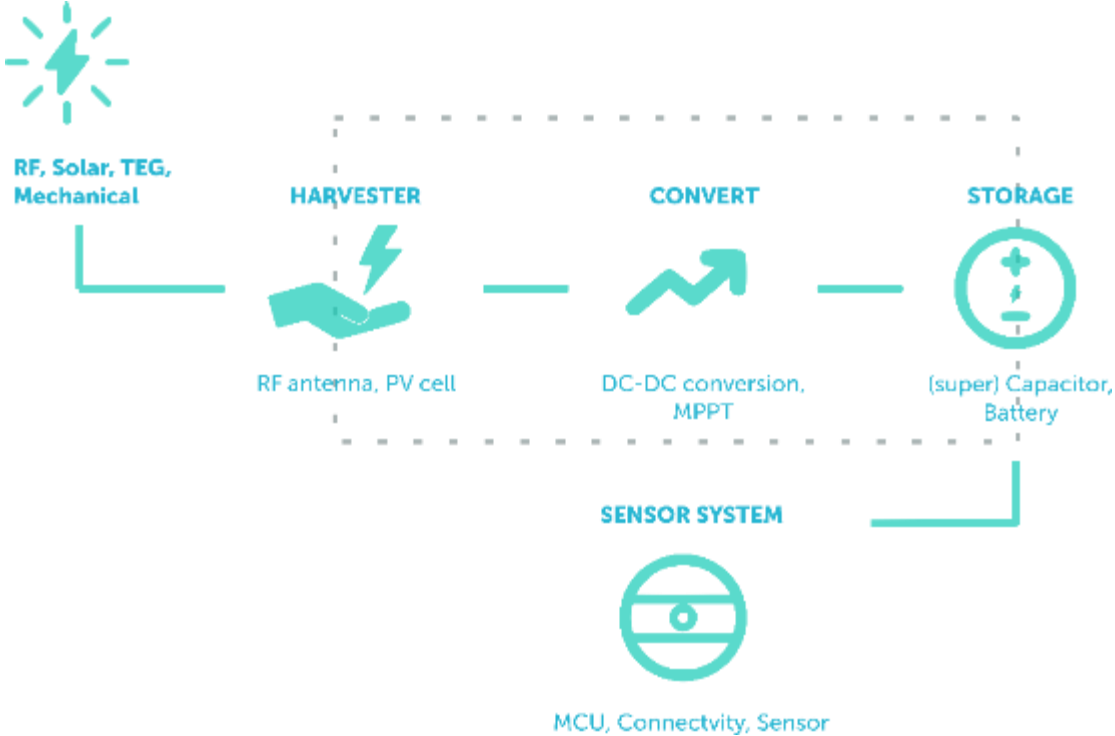
Piezo



TEG



Energy Harvesting



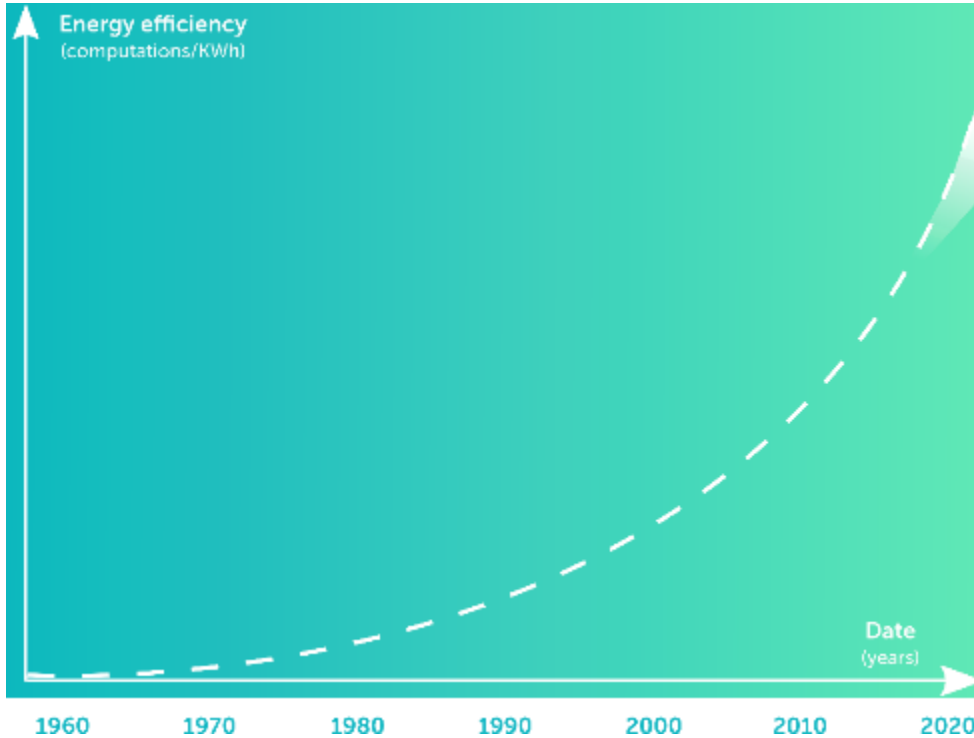
CHALLENGES



Historic problems in 'ambient' energy harvesting

1. Low-energy output (μW range)
2. Ultra-low Voltage output (20mV-500mV)
3. High amount of external components (8-15)
4. Large form factor on PCB (250-450 mm²)

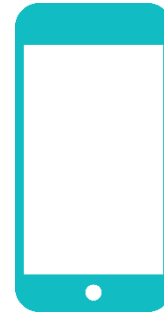
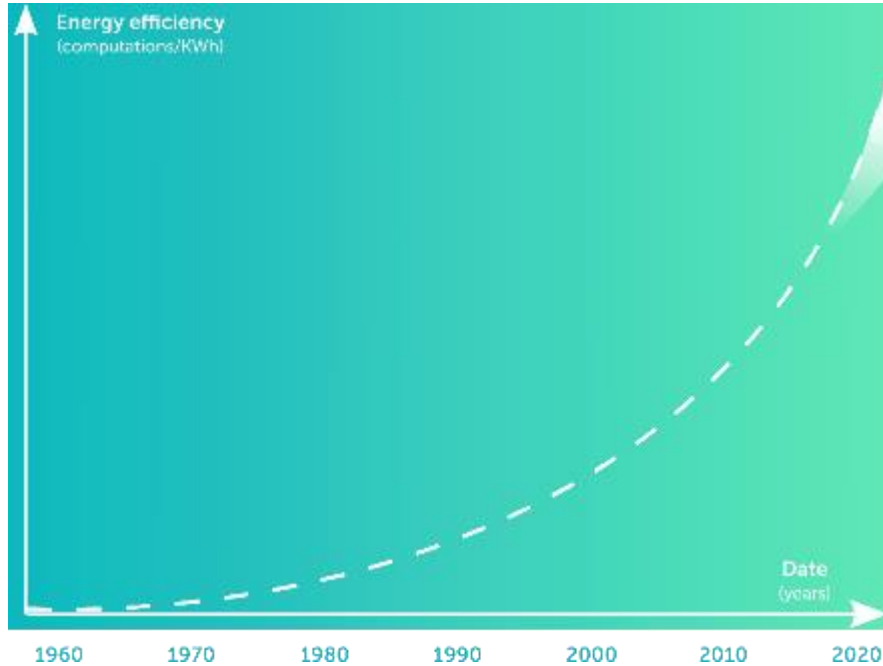
CHALLENGES (1/4)



Energy need low
power devices \leq
energy harvesting

“The right timing”

CHALLENGES (1/4)



Consumer electronics

+ efficiency
+ features
≈ consumption

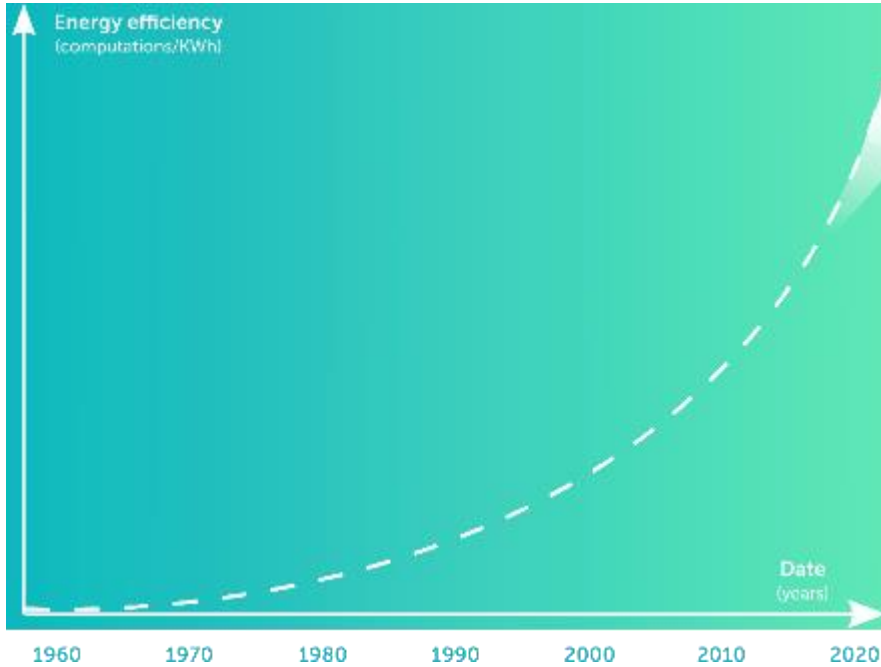


IoT connected devices

+ efficiency
≈ features
> consumption



CHALLENGES (1/4)



~~Consumer electronics
+ efficiency
+ features
≈ consumption~~



IoT connected devices
+ efficiency
≈ features
> consumption

CHALLENGES

NOWI Energy Harvesting PMIC

- 6 patents
 - 10 years academic research
 - 8 innovation awards
1. ~~Low energy output (μ W range)~~
 2. **Ultra-low Voltage output (20mV-500mV)**
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CHALLENGES

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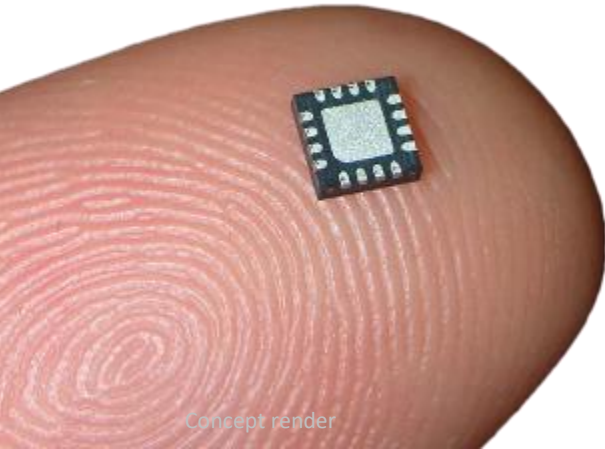


CHALLENGES (2/4)

Low Voltage output

- World's lowest Voltage boosting (40mV)
- World's highest boosting efficiency (92%)
- A.I. powered MPPT

1. ~~Low energy output (uW range)~~
2. ~~Ultra low Voltage output (20mV-500mV)~~
3. High amount of external components (8-15)
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CHALLENGES (3&4 / 4)

PCB assembly area: 350mm²

Inductor based
energy harvesting PMIC's

*TI BQ25505 used as reference

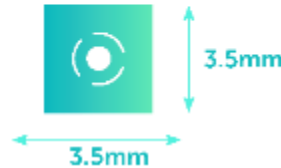
17.5mm

20.1mm

Fewest external components & smallest PCB area required

- Nowi requires 0 or 1 external components whereas alternatives require 8 to 15
- ~30x smaller footprint PCB area possible

PCB area: 12mm²



COMPETITOR OVERVIEW

	NOWI IC	TI BQ25505	ST SPV1050	MAXIM MAX17710	Analog Devices LTC3109	E-PEAS AEM10941
Size IC (mm ²)	12 mm ²	12 mm ²	9 mm ²	9 mm ²	16 mm ²	25 mm ²
PCB assembly size (mm ²)	12-16	350	250-350	250-350	250-350	132- 350
External components	0-1	8-15	8-15	8-15	8-15	7-13
min. input Voltage	40 mV	330 mV	150 mV	750 mV	50 mV	50-380mV
Boosting efficiency (%)	<92%	<92%	<90%	-	<55%	<90%
Adaptive Maximum Power Point Tracking (MPPT)	YES	YES ¹	YES ¹	NO	NO	YES ¹
Battery protection	YES	YES	YES	YES	NO	YES
Internal power consumption (nA)	>200nA	>510nA	>400nA	>625nA	-	-
Price (>10k units)	\$0.5 - 4.0	\$2,0 ²	\$1.53 ²	\$7.98 ²	\$5.0 ²	\$2,0-5.0

¹ pre-set / non-adaptable MPPT
² Exact pricing unknown at high volume

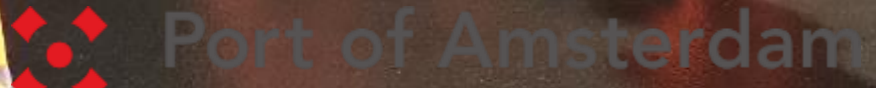
**PROGRESS COMES FROM
GIVING MEANING TO
TECHNOLOGY**



Asset Management in Amsterdam



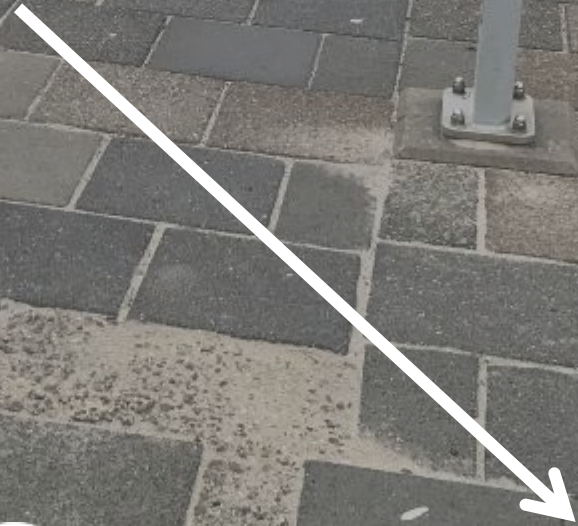
- ✘ Gemeente
- ✘ Amsterdam
- ✘ Zuid



Asset Management with Prorail

ProRail

T-Mobile



Office Climate Management



Complete Hybrid Watch Module from MMT using Nowi PMIC tech



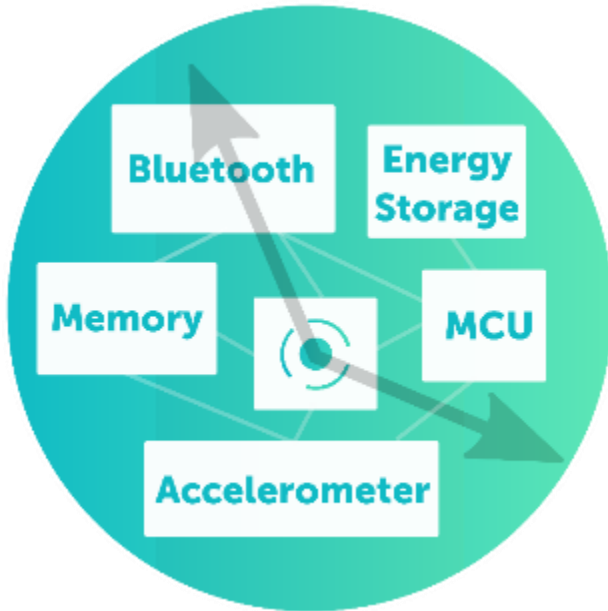
Plug & Forget Wearable



John
47 years



Plug & Forget Wearable



- Activity tracking
- Calorie counting
- Sleep tracking
- Auto time/date updates

Requires **31 uW** on average

Plug & Forget Wearable



Full functionality, will never run out of power



SCRATCHING THE SURFACE



Medical applications



Wearables



Smart logistics



Industrial IoT



Smart Building



Smart Road

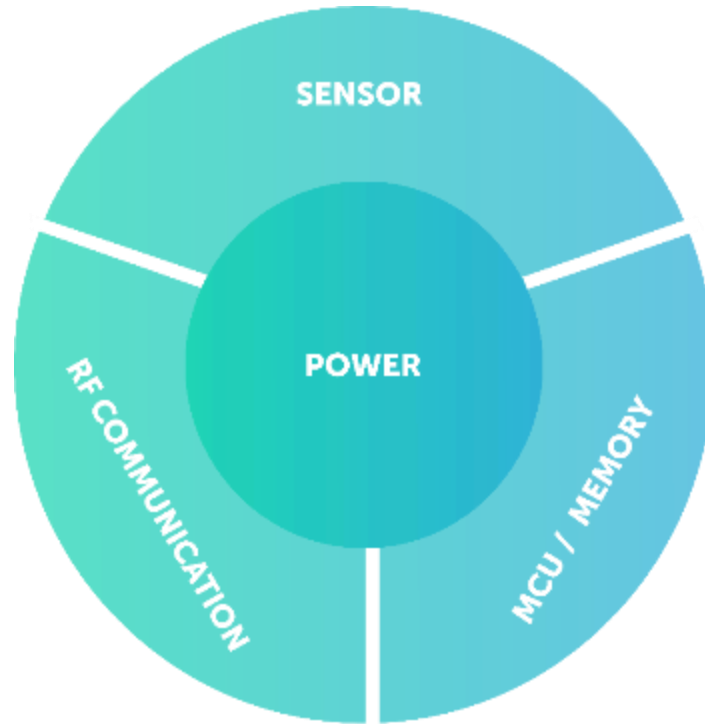


Asset Tracking



Smart Home

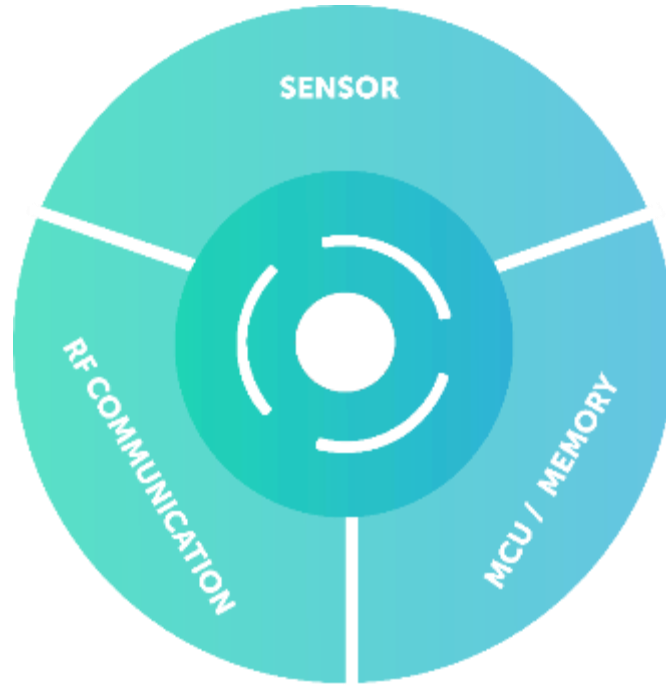
DIFFERENT PRODUCTS SAME DEVICE



SENSOR SYSTEM OVERVIEW



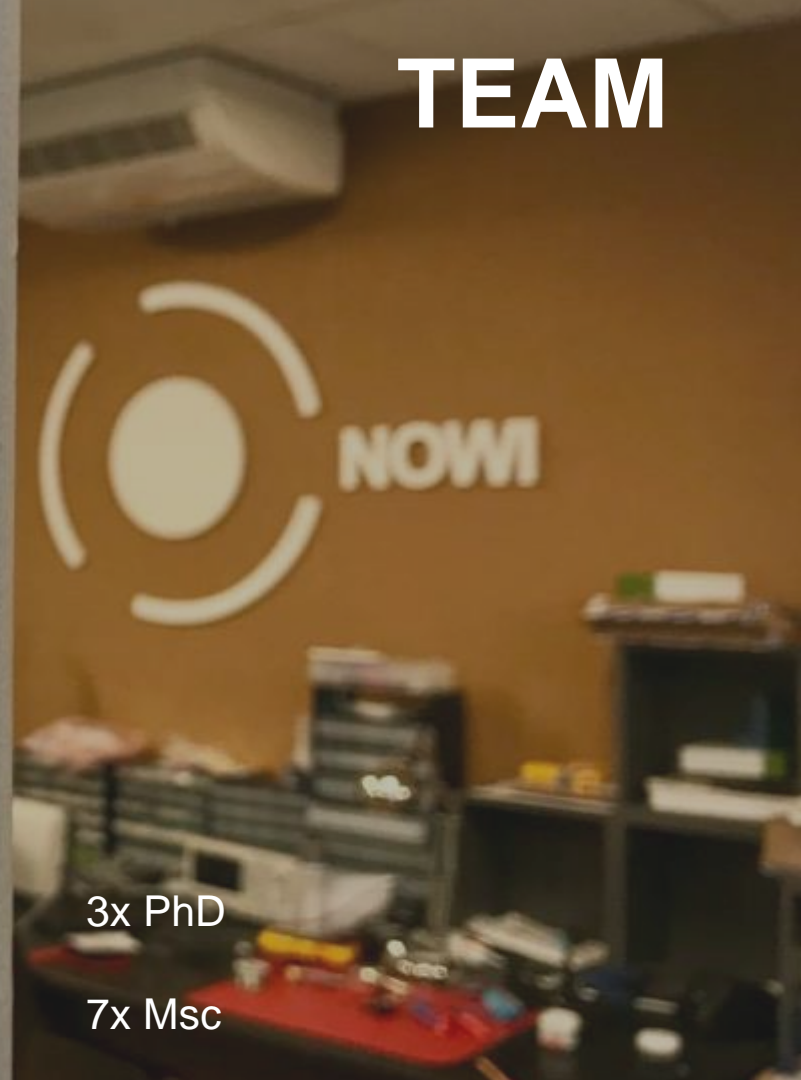
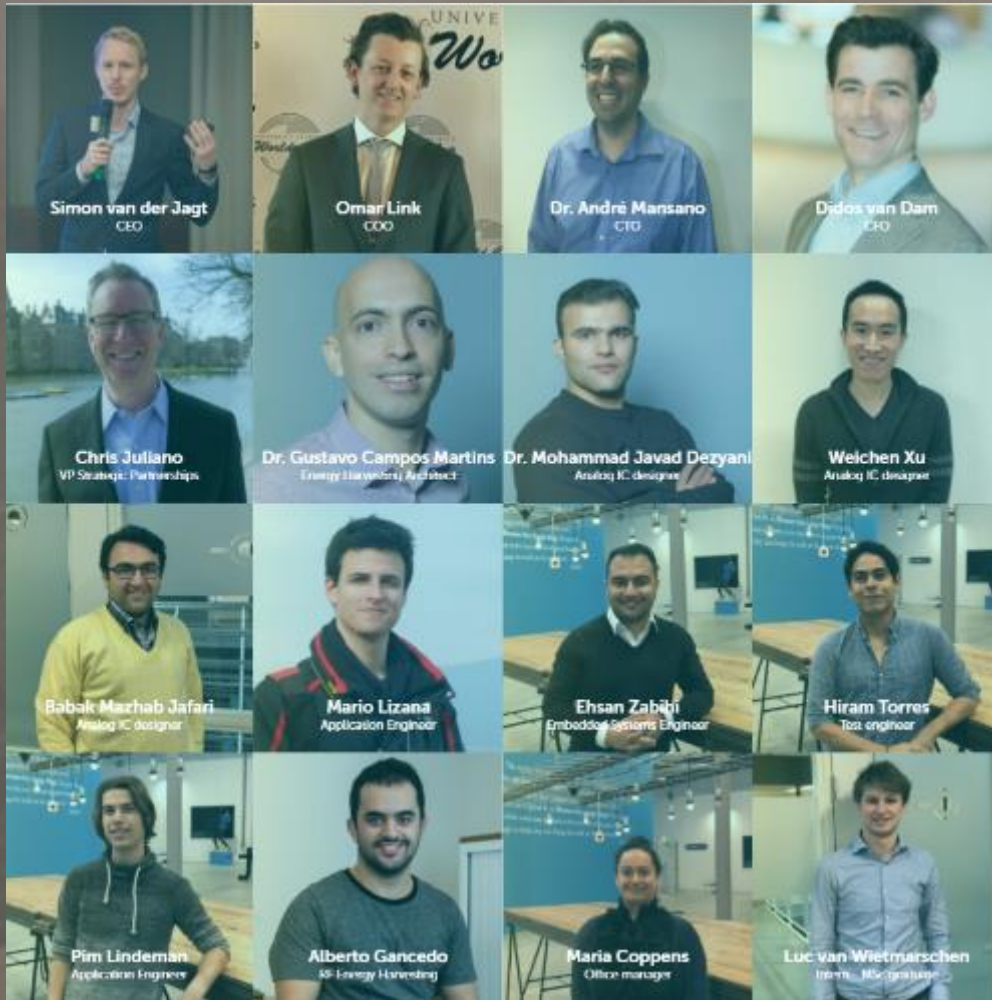
DIFFERENT PRODUCTS SAME DEVICE



Nowi Power Module IC
as heart of Sensor system



TEAM



TEAM ADVISORS



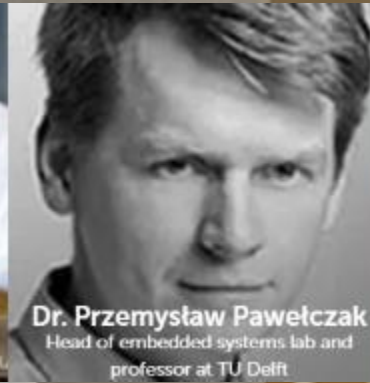
Ad Scheepbouwer
Investor and advisor

Investor in Wehkamp,
FoxIT etc. former CEO
KPN telecom



prof.dr.ir. Wouter Serdijn
Full professor at Delft University of
Technology, where he heads the Section

Head of bioelectronics lab
TU Delft, full professor



Dr. Przemysław Pawełczak
Head of embedded systems lab and
professor at TU Delft

Head embedded system
lab TU Delft



Ivo de la Rive Box
Founder and CEO of Quby B.V.

Founder of Quby (Toon)
smart thermostat



Jan Willem Klerkx
CCO Scyfer

Founder Uvision and
Scyfer, both acquired by
Qualcomm



Bob Stassar
Partner at PNO, Managing Director
Stadsburgreeve

Founder P&O one of the
largest financial
consultancies in NL

INNOVATION AWARDS



CHINESE ADVANCED SEMICONDUCTOR
ASSOCIATION (CASA) 2018

WINNER



ABOUT NOWI

A small green plant with several leaves is growing out of a pile of coins. The coins are stacked and scattered, with some showing the '1' and '2' denominations. The background is a blurred, light-colored surface, possibly a table or desk.

- **Founded in 2015**
- **~€3m invested in product development**
- **6 patents filed**
- **Located in Delft, the Netherlands**

INNOVATION THAT ENABLES THE NEXT WAVE OF INNOVATION



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