



Co-funded by
the European Union

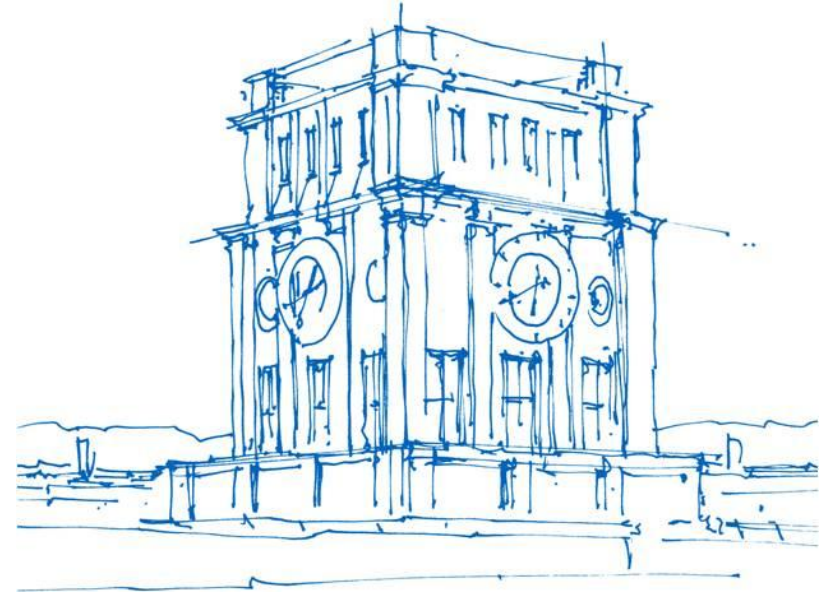


IoT Ecosystems & NEVONEX

Maximilian Treiber

Technical University of Munich

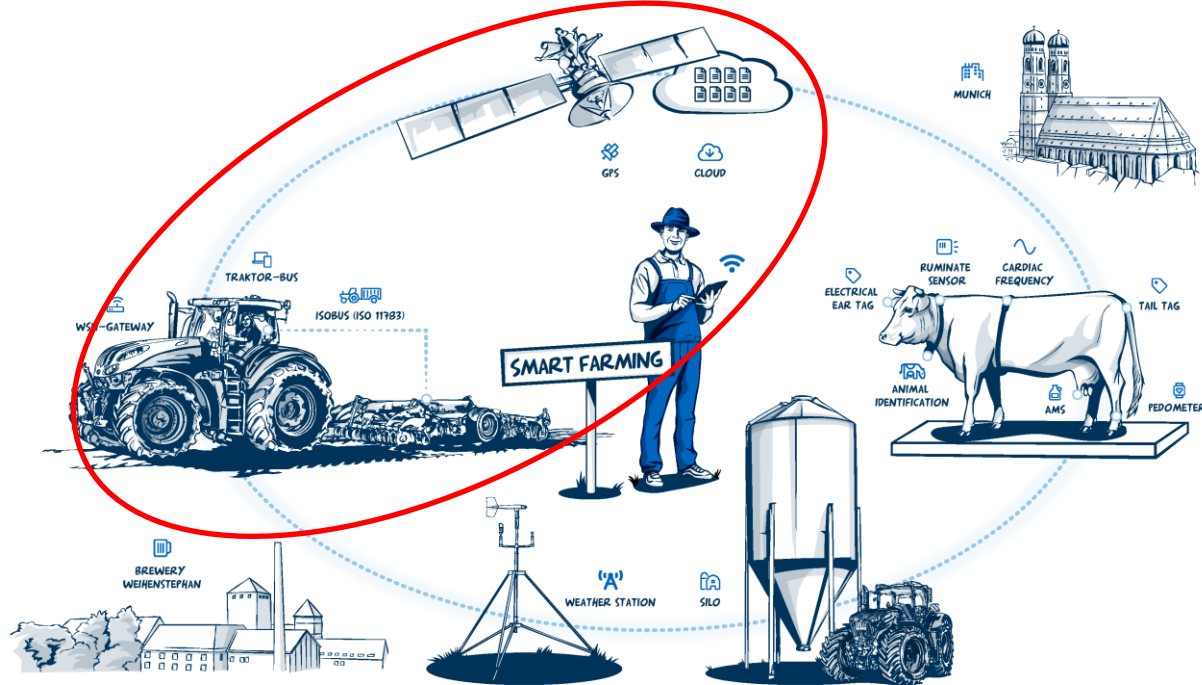
Agricultural Systems Engineering



Uhrenturm der TUM



Digital Transformation in Agriculture



Trends and Challenges of bringing Agricultural Machinery to the IoT



Co-funded by
the European Union



Trends



Source: Climate Corp.(2019)



Source: exatrek (2019)



Source: AgXtend (2019)



Source: Farmobile (2020)



Source: Topcon (2019)



Source: BHTronik (2018)



Challenges of bringing Agricultural Machinery to the IoT

(aka „the Internet of Tractors“)

- Tractors and implements are **complex control systems on their own**
- On Tractors & Implements:
 - CAN BUS communication
 - Many different sensors & actuators
 - big amount of data with high sampling rates
- Tractor Implement combinations are **on the constant move** while executing their tasks
 - selective availability of high data-rate upload opportunities
 - edge computing capacity/buffering
- **Read & Write** access to BUS systems hindered:
 - Complex & proprietary protocols
 - Huge amount of necessary interfaces
- **Functional safety** is crucial

IoT Ecosystems for Agricultural Machinery

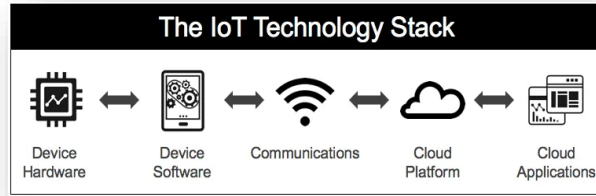


Figure 1

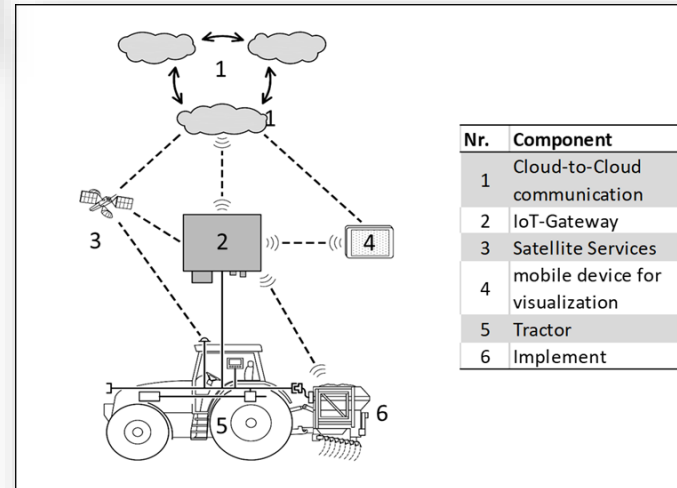


Figure 2

What's the idea behind NEVONEX?

NEVONEX

One Box for Everything.
Future Proof.



INNOVATION
AWARD

AGRITECHNICA

SILVER MEDAL



Co-funded by
the European Union



NEVONEX

explained



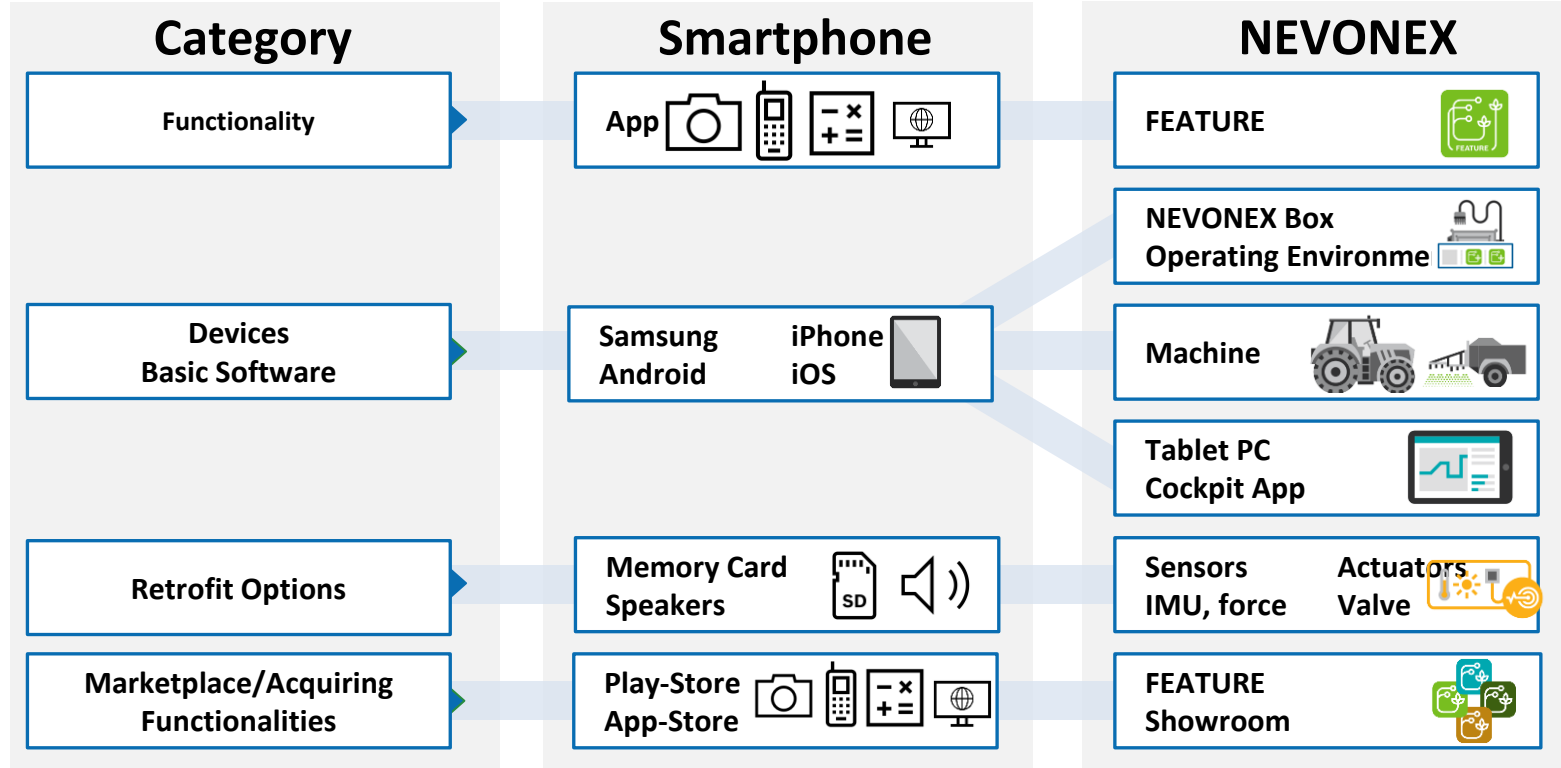
Powered by



BOSCH



- Compare it to the world of Smartphones





Digital Services:

- ✓ App-like Software
- ✓ Run manufacturer-independent on farm machinery
- ✓ Optimize processes in tractor-implement combinations & self propelled (e.g. combines)
- ✓ Improve Interoperability & data-availability & -quality
- ✓ Developed & sold by different providers (OEM/agrichem/dealers/startups/FMIS etc.)

Digital Services offer new opportunities in automation

Example: Tire-pressure control system

without NEVONEX

Proprietary controller

Farmer/operator has to press button to
change pressure manually



With NEVONEX: Digital Service



Central UI for different TPC-systems

Optimum pressure derived on the edge from:

- Soil properties -> watershed model
- Recommended tire pressures from manufacturer (e.g. Michelin)
- Tractor data: e.g. ISOBUS working/road, ballastation etc.

Digital Service controls tire pressure automatically
in the background

Farmer doesn't need to press buttons

Always right pressure

Documentation available for subsidies

Saves cost

Protects soil from compaction

Digital Services offer new opportunities in automation

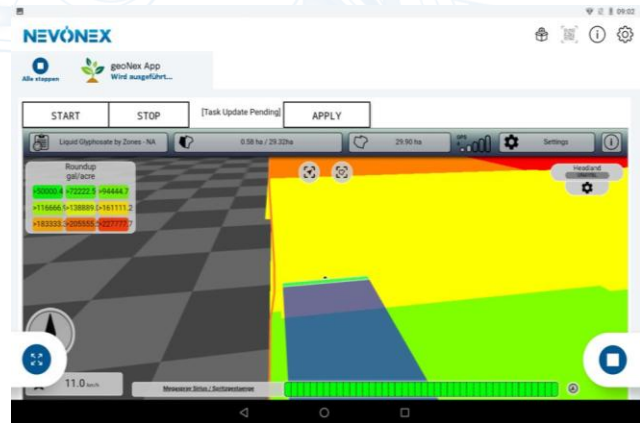
Example: retrofit Task Controller

Without NEVONEX

- TC activation expensive licence with recurring cost when leasing machines are exchanged
- Application maps transferred manually with flash-drives (risk of loss, wrong versions etc.)
- Different UI for each tractor display

With NEVONEX

- NEVONEX Box contains Task Controller (one-time Hardware & Licensing cost)
- Retrofit possible on any ISOBUS ($\geq V2$) machine
- Down- & Upload of application maps to many clouds via Digital Services of the Digital Service Providers

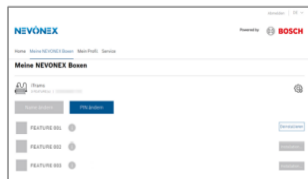


Components

NEVONEX retrofit kit

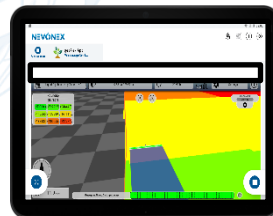


UI

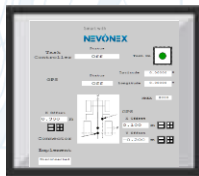


MyNEVONEX
Device
Management

NEVONEX Cockpit
App UI for Operator



ISOBUS VT
configuration mask



Digital Services



Easy download, update & upgrade machines



Automated documentation



Process optimization



Save time/cost/resources

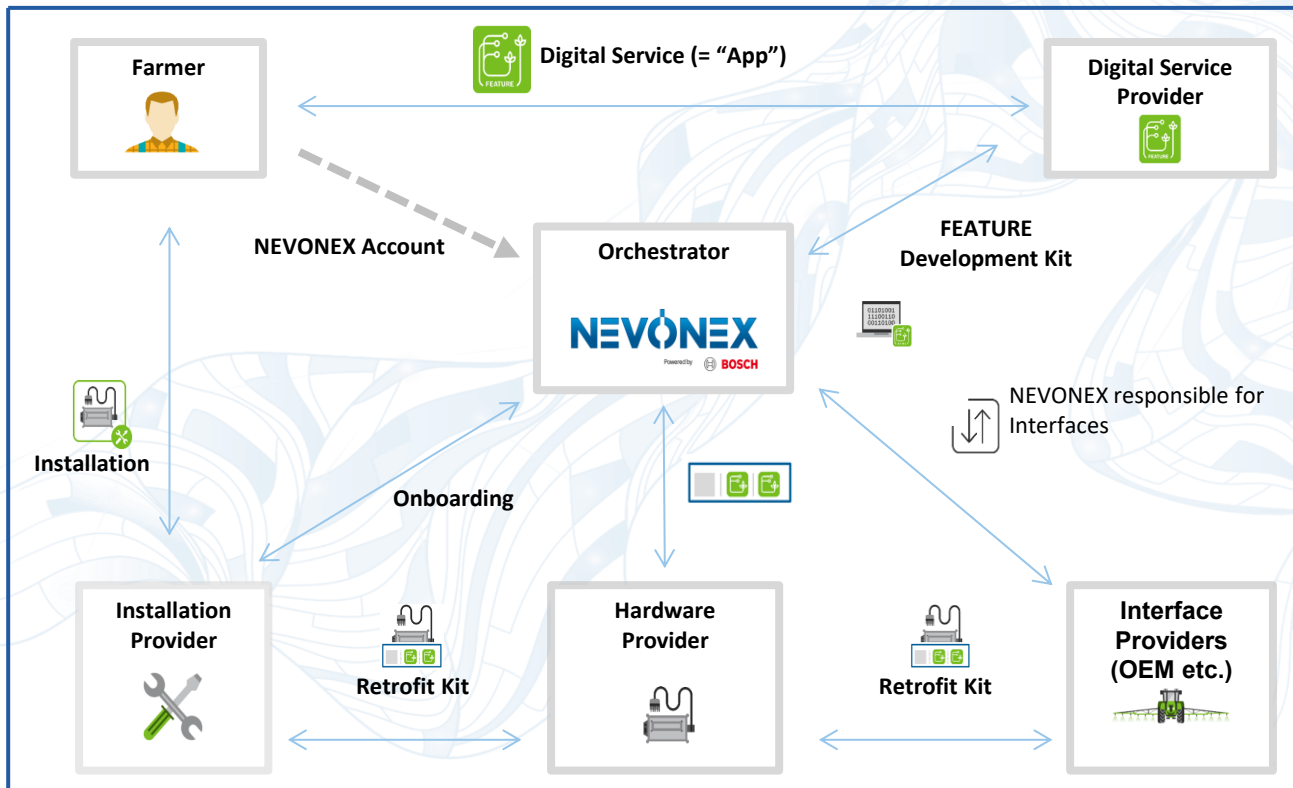


Enhance quality of live & convenience for Operators & farmers



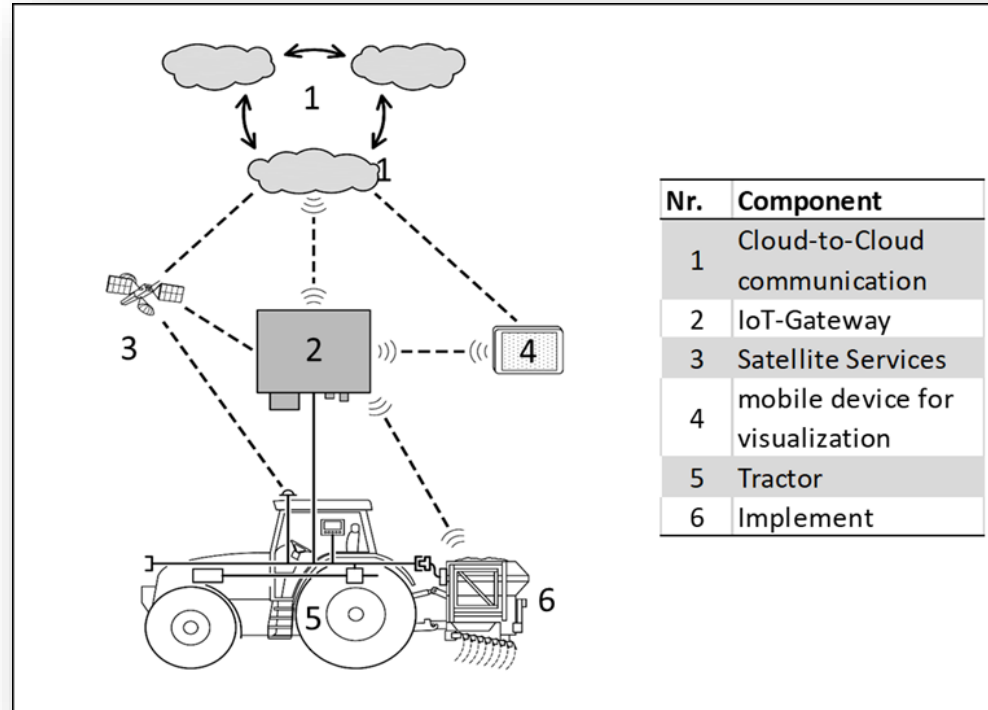
Co-funded by
the European Union





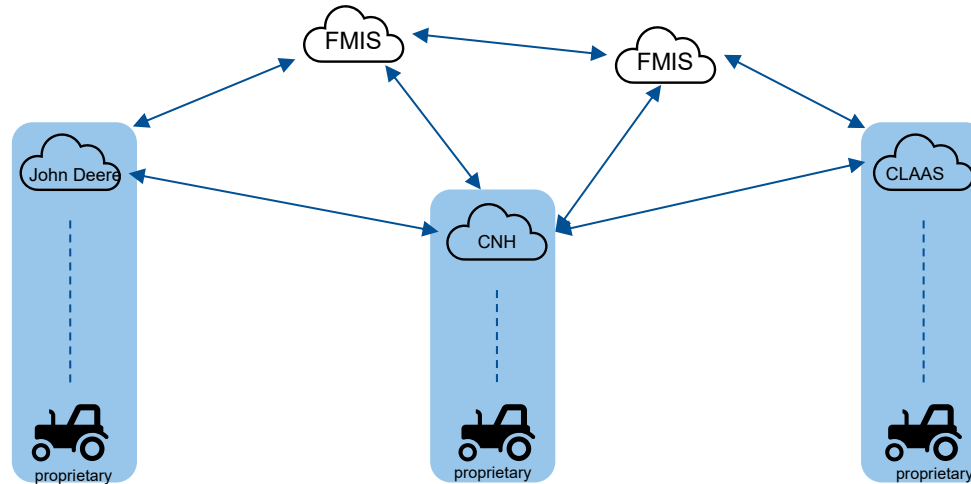
What's the difference between NEVONEX and ... ?

What's the difference between NEVONEX and ...?



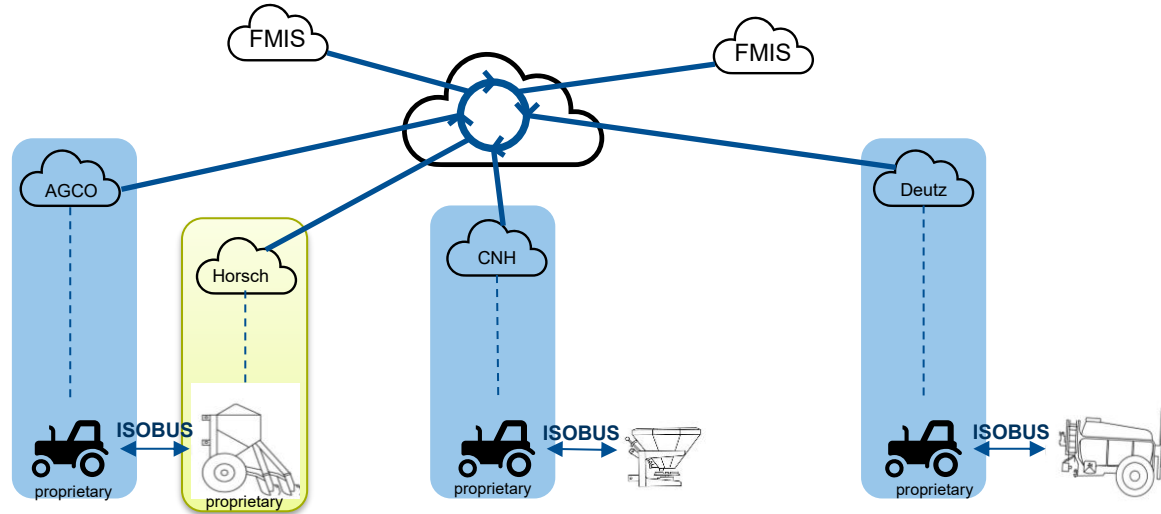
What's the Difference between NEVONEX and...?

Data Connect



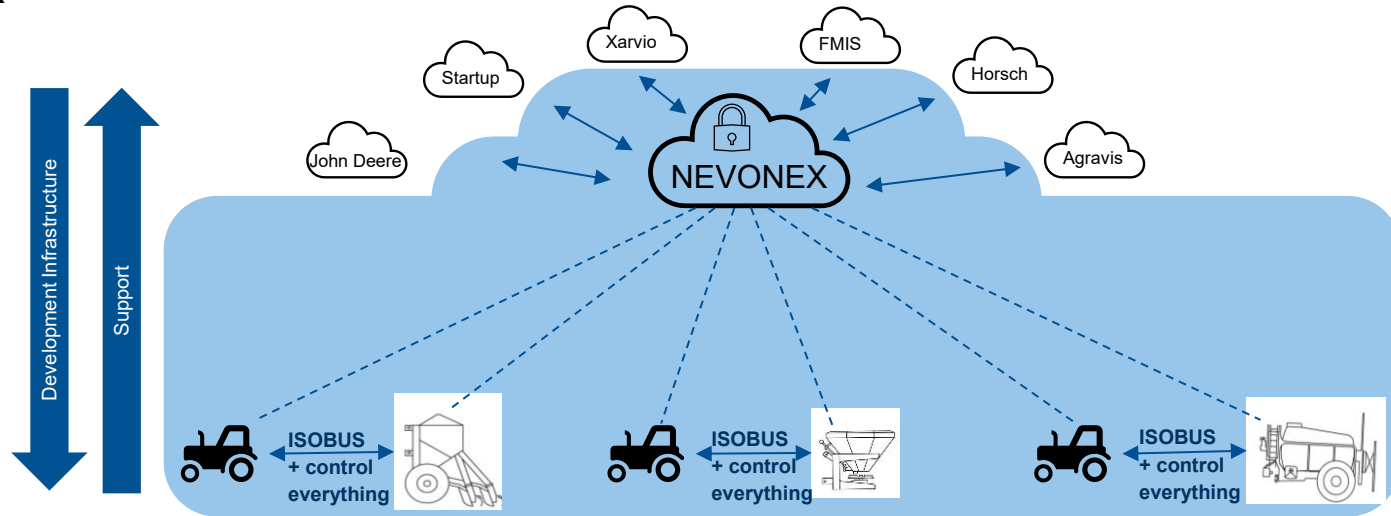
What's the Difference between NEVONEX and...?

Agrirouter



What's the Difference between NEVONEX and...?

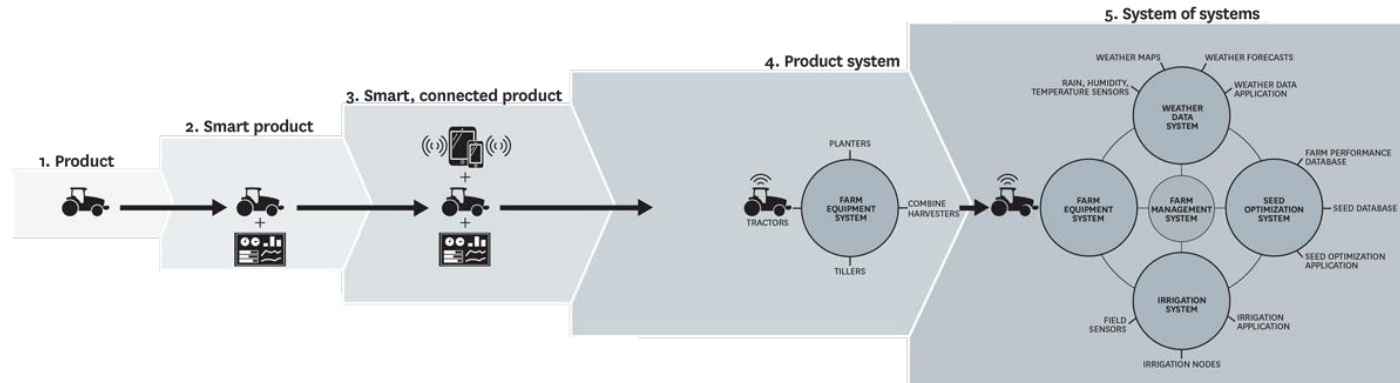
NEVONEX



Outlook



...2014 Porter/Heppelmann perspective

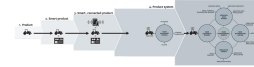


<https://tbr.org/2014/11/how-smart-connected-products-are-transforming-competition>

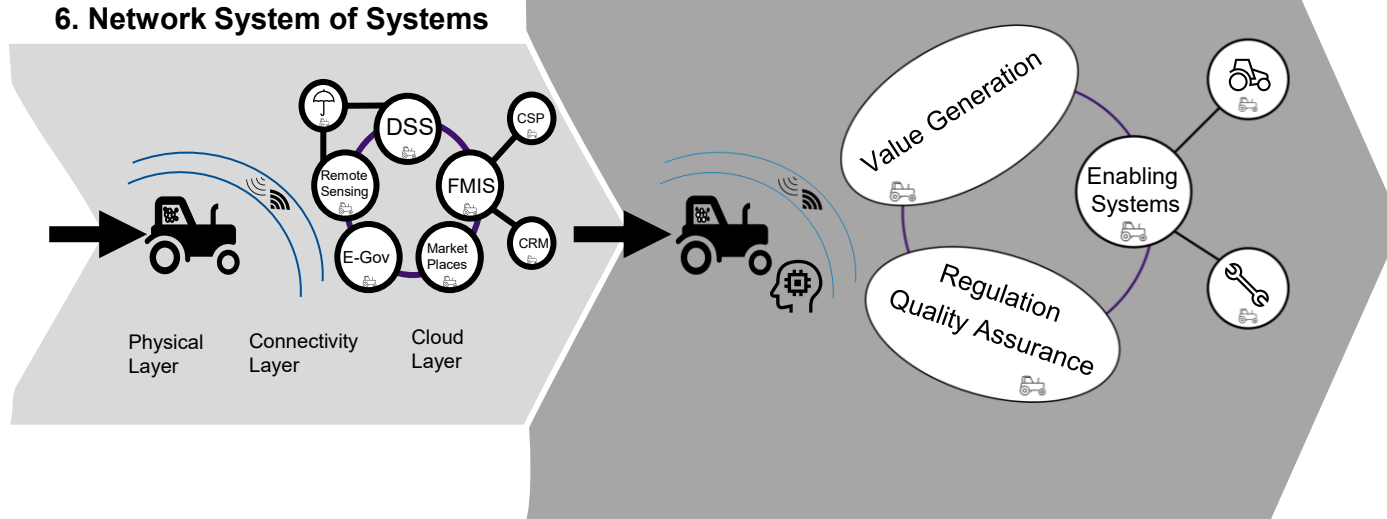
...today's perspective



Co-funded by
the European Union



6. Fused System of Systems

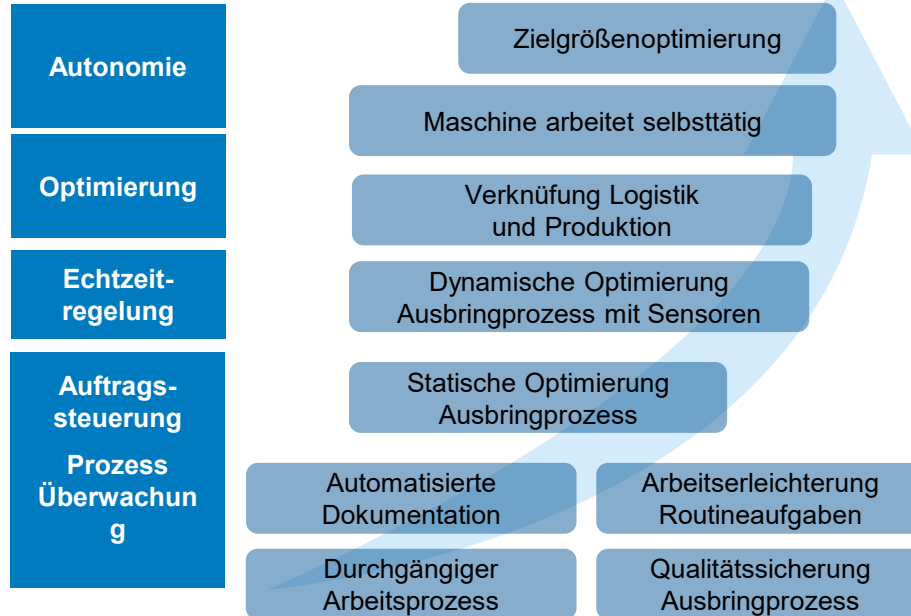


CSP Collaborative Sourcing & Planning CRM Customer Relationship Management FMIS Farm Management Information System DSS Decision Support System

NEVONEX
Powered by **BOSCH**



Complexity of deployable use-cases rises



Internationale
Skalierung von
Innovation



Diskriminierungs-
freier Daten-/
Prozesszugang
in bunten Flotten



Verteilte, intelligente
Systeme mit
Edge Computing



Internationale,
offene Plattformen



E-Government,
E-Produkt
Infrastruktur

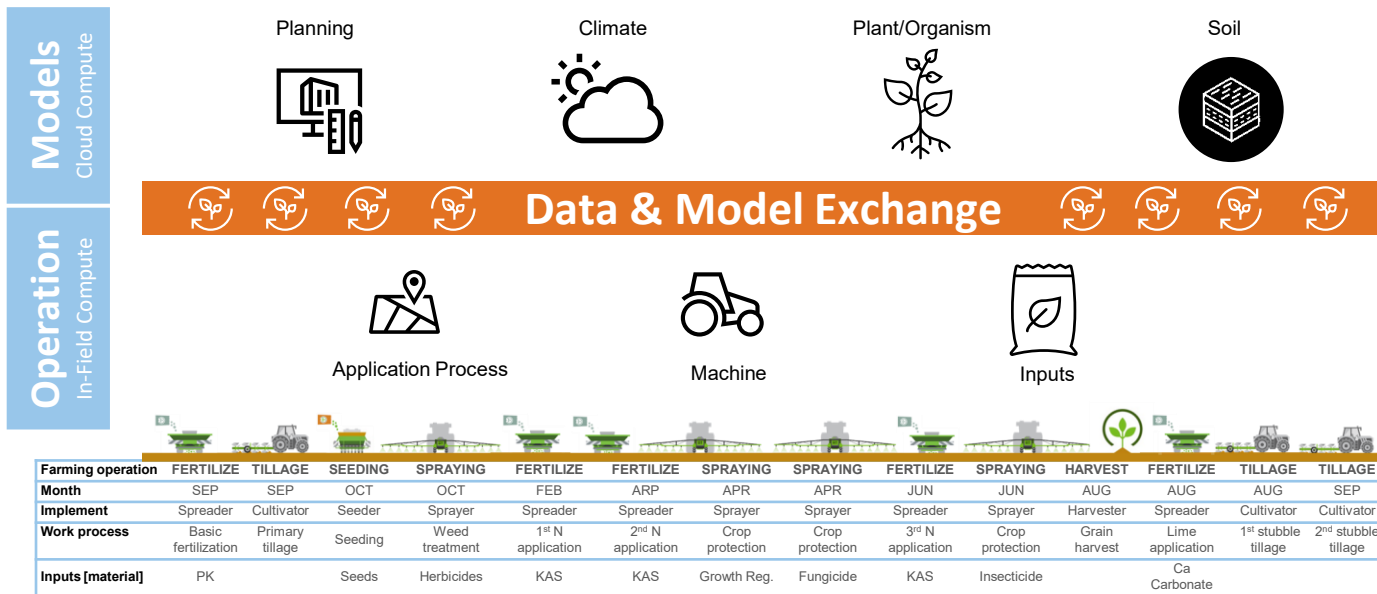


IoT Infrastructure paves the way for AI on the Edge

Networking on data and model level



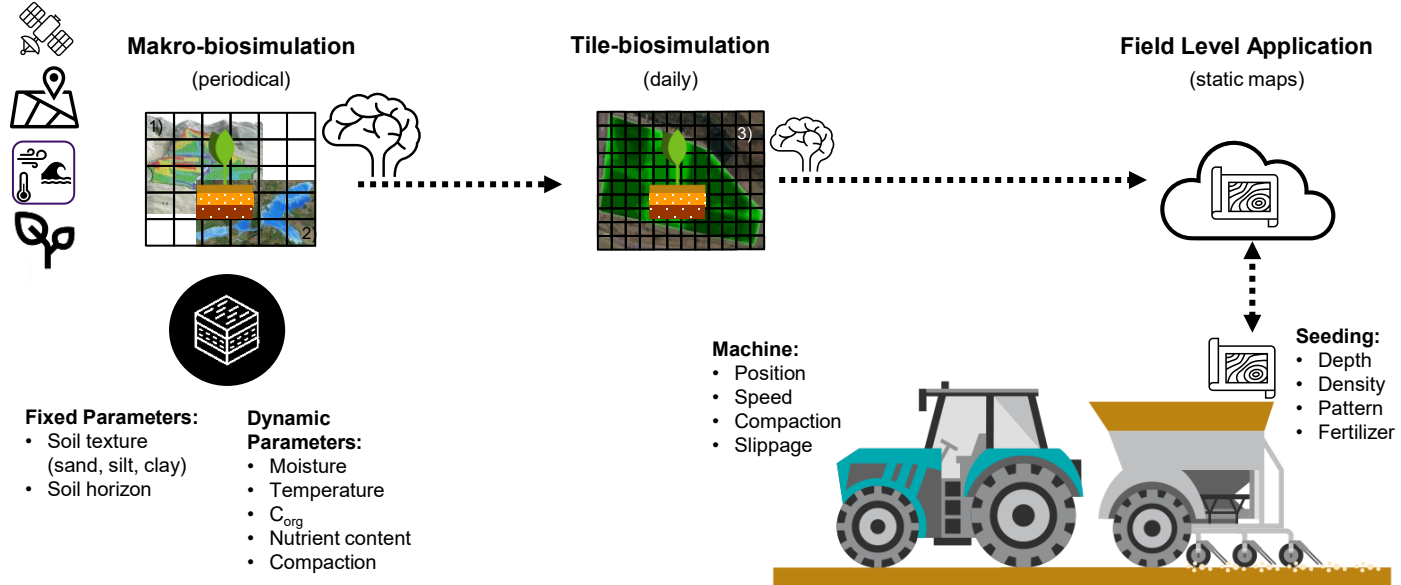
Co-funded by
the European Union



Example: Winter Wheat

Today's seeding process not reaching full potential...

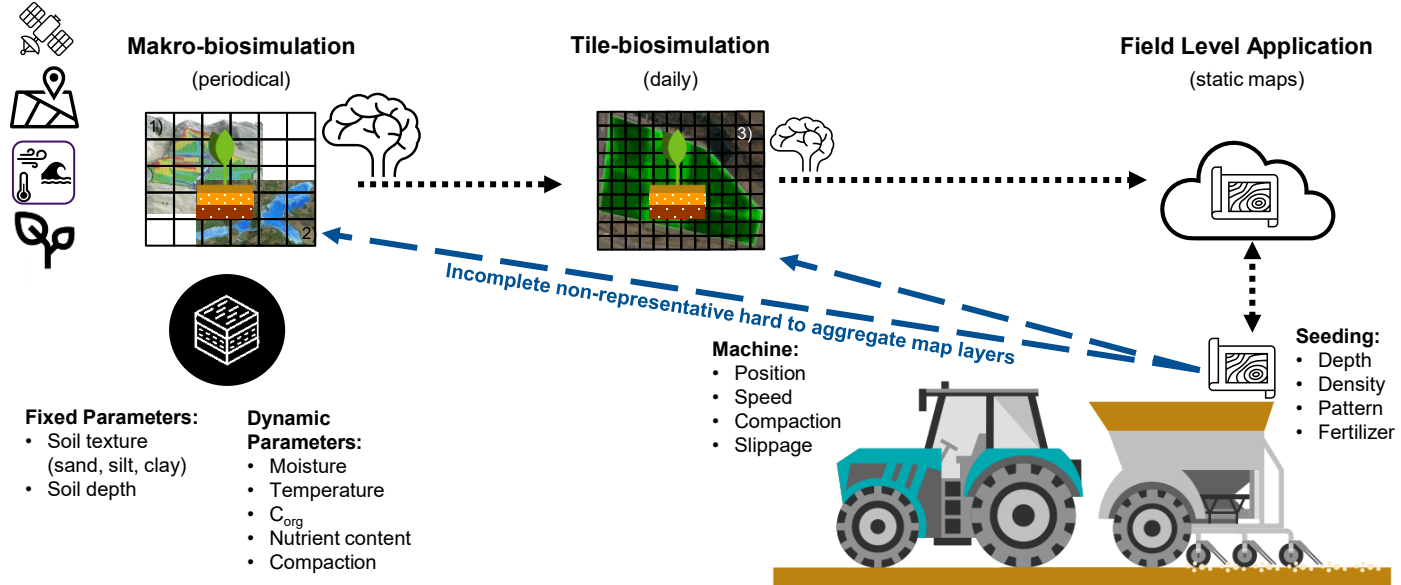
...as loop between supercomputing and airseeder is broken



1) <https://www.usgs.gov/media/images/nrp-software-gsflowing-2> 2) <https://www.dhigroup.com/global/news/2021/03/dhi-helps-the-danish-epa-use-ai-and-iiot-to-predict-flooding-on-denmark%E2%80%99s-second-largest-river> 3) <https://www.xarvio.com/content/dam/xarvio/images/fm/global-en-552x552-fm-seeding-benefits.png>

Today's seeding process not reaching full potential...

...as loop between supercomputing and airseeder is broken



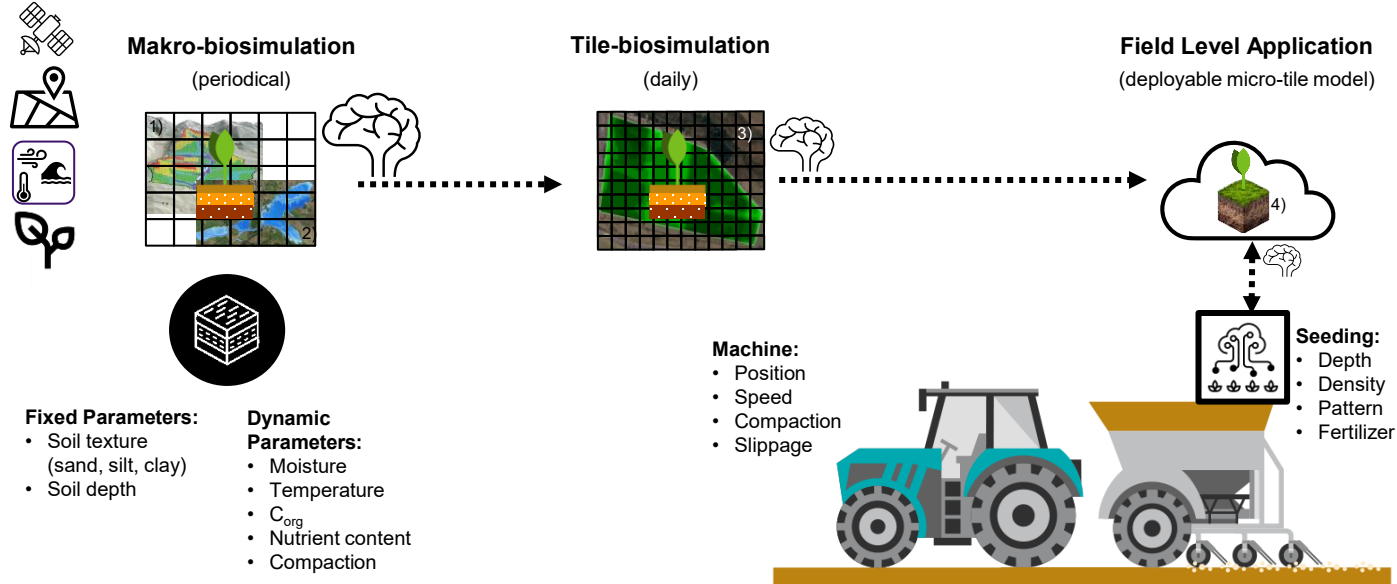
1) <https://www.usgs.gov/media/images/nrp-software-gsflowing-2> 2) <https://www.dhigroup.com/global/news/2021/03/dhi-helps-the-danish-epa-use-ai-and-iiot-to-predict-flooding-on-denmark%E2%80%99s-second-largest-river> 3) <https://www.xarvio.com/content/dam/xarvio/images/fm/global-en-552x552-fm-seeding-benefits.png>

Future seeding process can reach full potential...

...when AioT loop is established



Co-funded by
the European Union



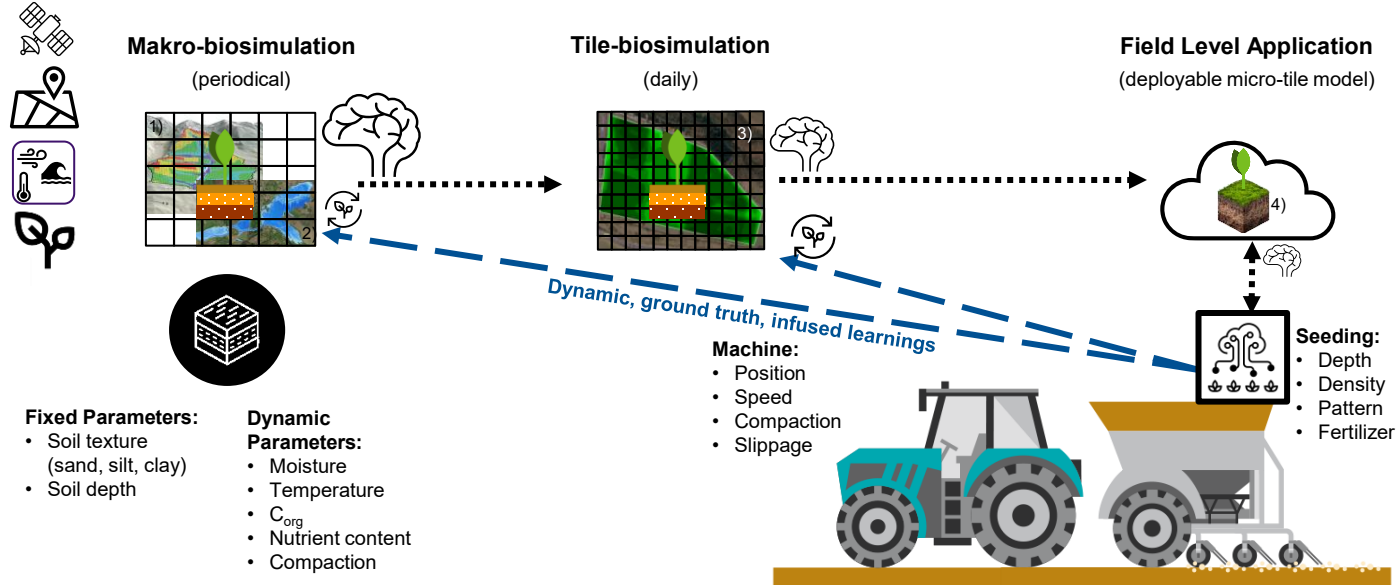
1) https://www.usgs.gov/media/images/hip-software-qsfowgq_2 2) <https://www.dhigroup.com/global/news/2021/03/dhi-helps-the-danish-epa-use-ai-and-sat-to-predict-flooding-on-denmark%E2%80%99s-second-largest-river> 3) https://www.xarvio.com/content/dam/xarvio/images/fm/global-en-562x552-fm-seeding-benefits.png_4 4) <https://www.google.com/url?sa=i&url=https://www.textures4photoshop.com/%2Ftex%2Fground-dirt-and-sand%2F3d-isometric-soil-and-grass-cube-cross-section-stock-image-free.aspx&pg=AOVWaw3Bag7sRWUjJZfB3R489TP&ust=1653137555685000&source=images&co=ve&ved=0CAwQRqFwoTCODrBPvCFQAAAAA&AAAAABAK>

Future seeding process can reach full potential...

...when AioT loop is established



Co-funded by
the European Union



1) https://www.usgs.gov/media/images/hip-software-qsfowgq_2 2) <https://www.dhigroup.com/global/news/2021/03/dhi-helps-the-danish-epa-use-ai-and-sat-to-predict-flooding-on-denmark%E2%80%99s-second-largest-river> 3) https://www.xarvio.com/content/dam/xarvio/images/fm/global-en-562x552-fm-seeding-benefits.png_4 <https://www.google.com/url?sa=i&url=https://www.textures4photoshop.com/%2Ftex%2Fground-dirt-and-sand%2F3d-isometric-soil-and-grass-cube-cross-section-stock-image-free.aspx&pg=AOvVaw3Bagf%2FwujjZfB3R489TTP&ust=1653137555685000&source=images&co=ve&ved=0CAwQIRxQfwTCODiBIPvCFQAAAAA&AAAAABAK>