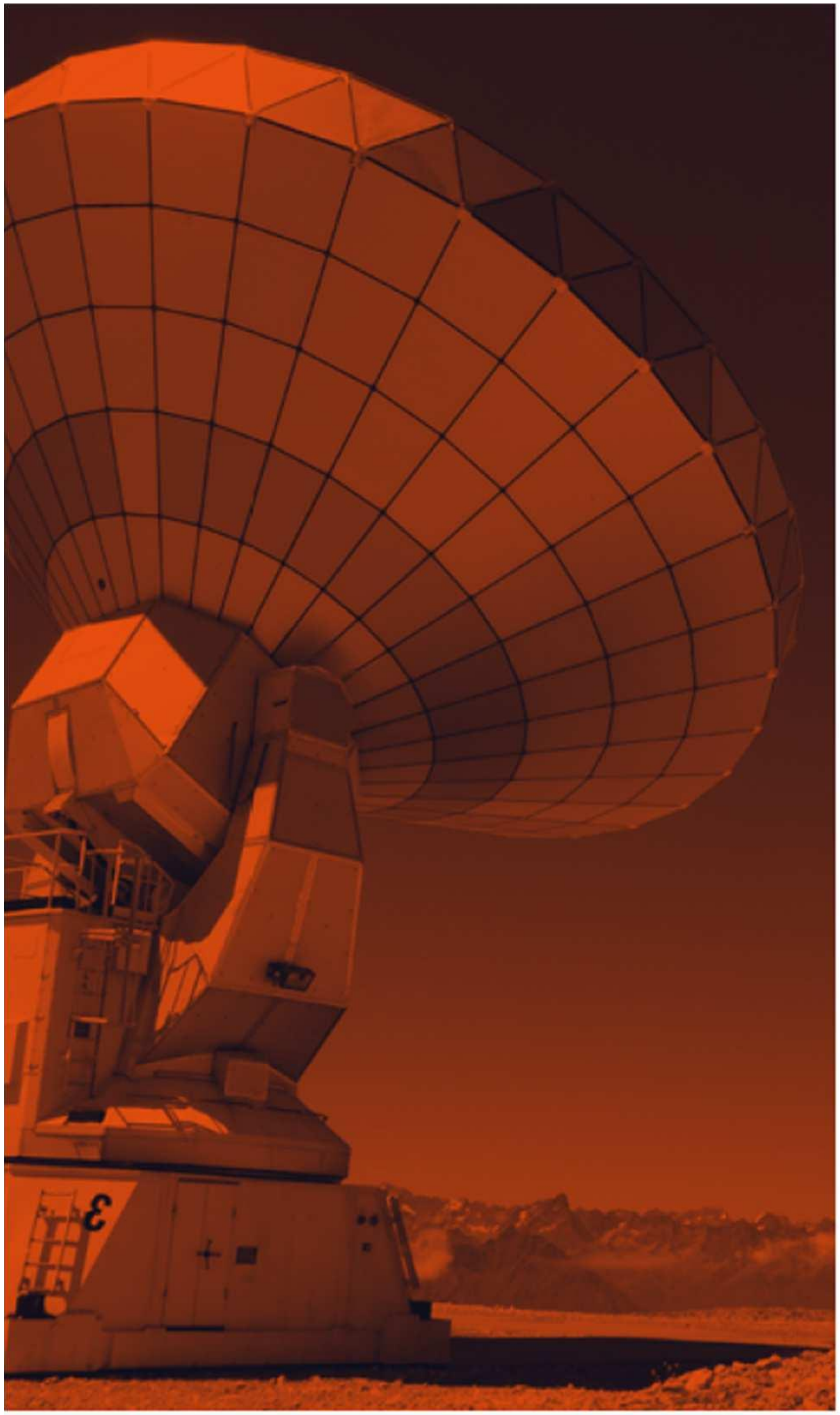
ATDI and IoT RF network planning



OUR BUSINESS IS RADIO

Founded in France (Paris) in 1991

World leader for radio engineering solutions with more than 2,000 customers in over 60 countries

Specialised in:

- ✓ **Radio network planning & optimization (civil & military)**
- ✓ **Spectrum management**
- ✓ **Digital cartography**

ATDI TEAM
OUR PEOPLE ARE KEY TO OUR SUCCES

ATDI's **group of experts** have solid experience in transaction based SW platforms. The software developers have higher degrees in technical sciences and come with experience from both mature and emerging markets from all over the world.

We continuously recruit accomplished professionals within **each field of expertise in spectrum management**, which gives us an unparalleled capacity to deliver complex projects on time and on budget. ATDI enjoys a high degree of commitment and employee loyalty thanks to its organizational style.

HTZ Communications, the leading software for IoT network planning

HTZ Communications is a radio simulation software that incorporates every aspect of radio propagation and ensures public, private, licensed or unlicensed radiocommunication networks offer a high degree of reliability, and do not suffer from harmful interference – from few kHz to 350GHz.

Features for designing IoT networks at state of the art;

- 2D and 3D simulation with medium and high resolution cartography
- Prospective planning for automated site planning
- Automated cell optimization
- Mesh network clustering
- Traffic & mobility profile editor (end devices) Gateway/Hube/e-nodeB setting parameters (duty cycle, power, bandwidth, antenna…)
- Traffic modelling (aggregated traffic with related QoS and reliability targets)
- IoT DL/UL link budgets
- Coverage, Interference, capacity, reliability analysis
- Geolocation analysis

LoRa Alliance · NB-IoT (3GPP) · SIGFOX · LTE - M · Wifi · INGENU · Z-WAVE · SmartMesh WirelessHART

6LoWPAN · ISA 100 · nwave · Bluetooth · ZigBee Alliance · enocean · waviot · RPMA

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Key References in IoT

CISCO France, Australia and USA (LoRA, MeshGrid)

Western power, Australia (SmartGrid)

Horizon power, Australia (SmartGrid)

NNN Co, Australia (LoRa)

Actility France (LoRA)

Swisscom Broadcast (LoRa)

Axians, France and Switzerland (LoRa)

Regro, South Africa (LoRa)

IMDA Singapore regulator (LoRa)

QOS telecom France (SmartGrid)

Honeywell (MeshGrid)

DSI telecom, France (LoRa)

ST Electronics (Singapore, Smart City)

SenSys (NZ, LoRa for agriculture)

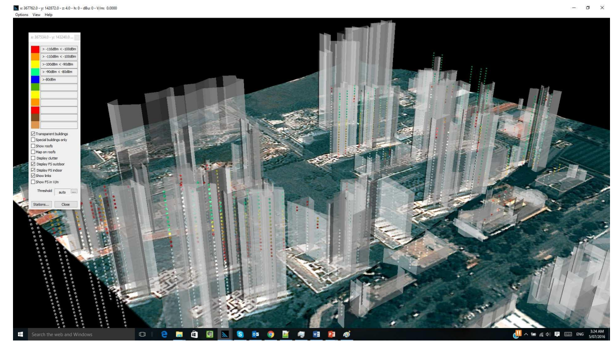
HUB ONE (LoRa)

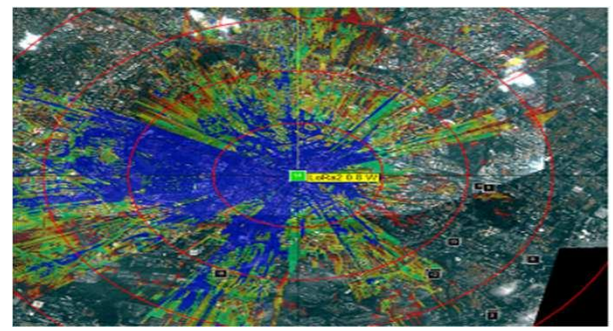
IoT network design challenges

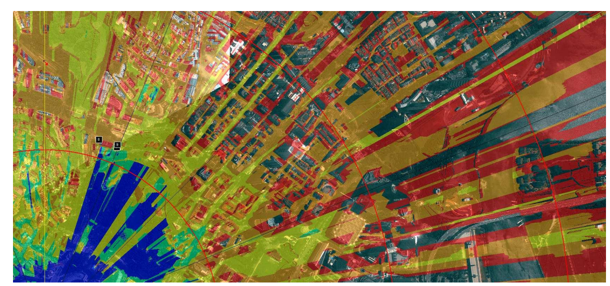
- **Dense urban environment & high-rise buildings**
- **Large number of devices and messages**
- **Overcoming the random transmission nature of IoT technologies**
- **Regulatory requirements such as maximum power and spectrum occupancy**
- **Evaluating the potential interference from adjacent bands/technologies**

Case study 1: designing a Lora Network in an unlicensed frequency band

Whatever LoRa or NB wireless system - there are RF limitations inherited from the use-case itself. M2M communication networks are P-MP in nature with sensors installed at different floors including basement. LoRa supports multiple spreading factors from 6 to 12. With 12 being the most robust but also the longest in terms of air-time occupancy and capacity restrictions.







Challenge

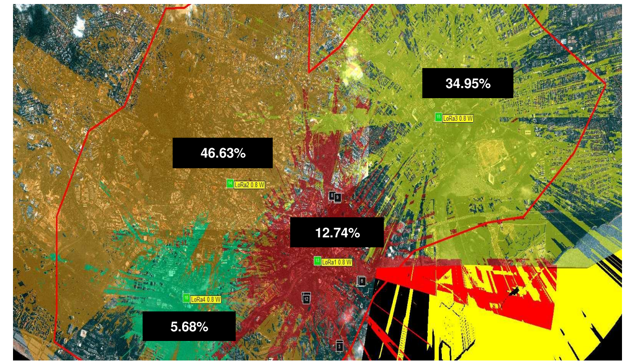
During LoRa radio network planning, and in order to perform accurate network dimensioning, it is necessary to take into account the following :

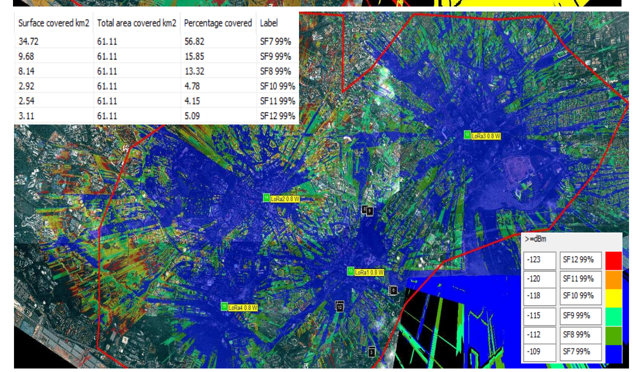
- **3D digital maps** and apply **path-specific full deterministic propagation models**.
- **accurate signal level prediction to work out the SF distribution** amongst target End-Points.
- **device should be covered by at least 3 gateways to make a time difference of arrival (TDOA) calculation** on the received LoRa signal and calculate the position for a GPS-free LoRaWAN geo-location.

Case study 1: designing a Lora Network in an unlicensed frequency band

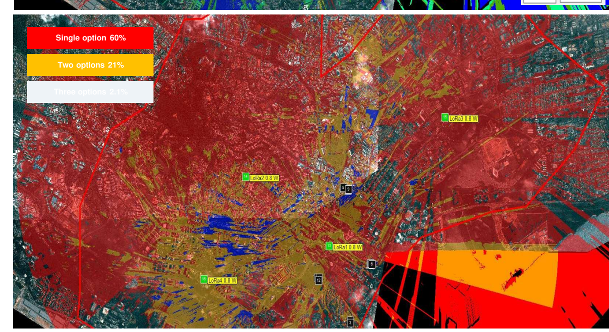
Solution

- HTZ Communications comes with a **set of full 3D and deterministic propagation models** proven in case-studies and validated by field measurements for urban/suburban/rural environment. **These models are described as path-specific**. Unlike classical models such as Extended Hata which is typically used for macro-coverage predictions and street level mobile receivers.
- HTZ Communications provides **SF distribution map** based on *SINR calculation* for **link adaptation analysis** and **target air-time thresholds**.
- *Network analysis* functions provide instruments to analyze **zones with more than 3 gateway diversity for providing geolocation services** in LoRaWAN network.



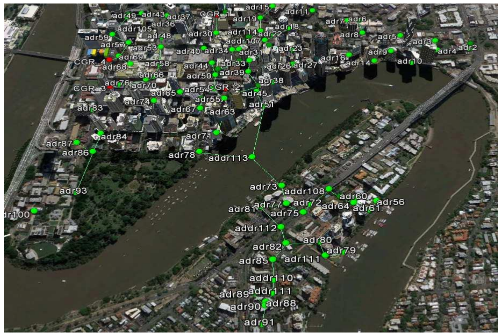


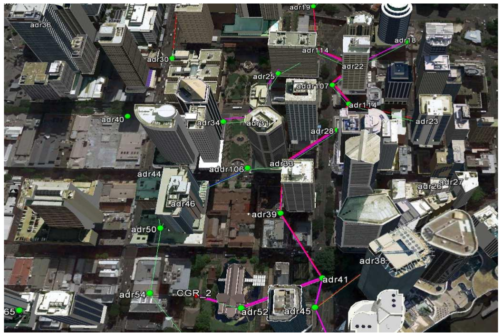
Surface covered km2	Total area covered km2	Percentage covered	Label
34.72	61.11	56.82	SF7 99%
9.68	61.11	15.85	SF9 99%
8.14	61.11	13.32	SF8 99%
2.92	61.11	4.78	SF10 99%
2.54	61.11	4.15	SF11 99%
3.11	61.11	5.09	SF12 99%



Case study 2: designing an IoT mesh network to raise network availability

The majority of Industrial Internet of Things networks are based on the mesh architecture, which provides connectivity between different IoT sensors and actuators in scalability and flexibility manner. These devices operating in the field typically incorporate multiple logical roles (sensors, gateways, hubs) with different capacity and latency requirements.





Challenges

It is essential to consider following factors in design/planning of IoT radio network to achieve accurate dimensioning of mesh nodes:

- **Coverage requirements for different types of nodes**
- **Quality and latency of links between different nodes and end-devices**
- **Capacity of nodes at different locations**
- **Availability of bi-directional connectivity**.

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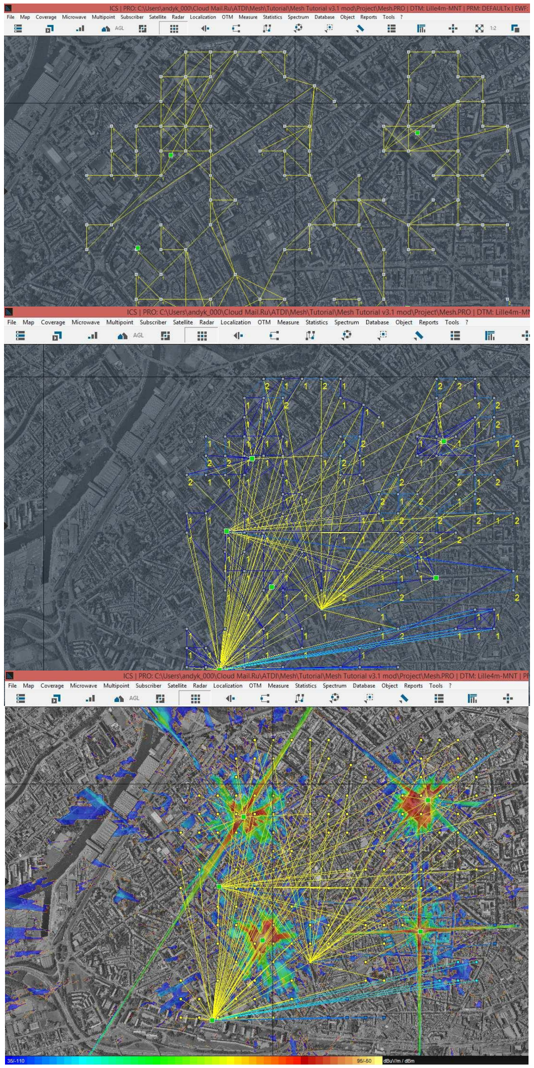
Case study 2: designing an IoT mesh network to raise network availability

Solution

- ✓ The *Cluster assignment* function of HTZ Communications EV based on:
  - ***distance between two linked devices***,
  - **maximum *number* of devices per node and per cluster,**
  - **bi-directional connectivity** and **received power**

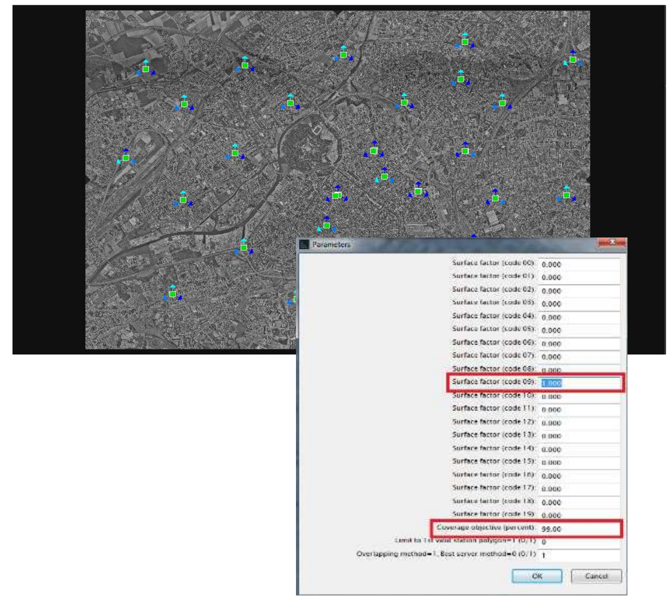
  for performing automatic clustering connections between the different IoT devices.
- ✓ ***Parenting*** between Subscribers/Clusters and Gateways**,** considering the **maximum number of devices allowed by node or gateway capacity and received power**.
- ✓ The *Hopping report* function includes the **number of hops for each subscriber to reach a Gateway** for latency minimization.
- ✓ Finally, the ***Prospective** planning* function includes:
  - **candidate locations for new nodes**,
  - **coverage area of existing gateways**,
  - **location of sensors,**
  - **coverage thresholds for links, cluster configuration**

  for the automatic addition of repeater nodes to ensure connectivity for all devices, which cannot be directly connected to a gateway.



Case study 3: designing an Smart City Narrow Band IoT network

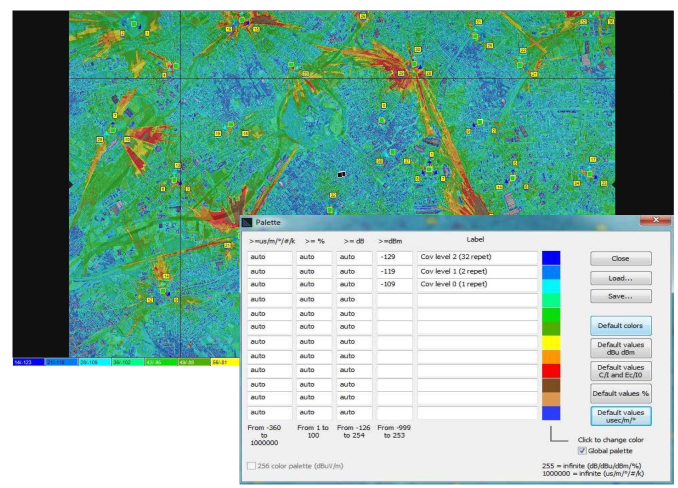
NB-IoT network should provide coverage for different use cases with different requirements. What needs to be appraised: deep indoor, outdoor, traffic model and battery life.



Challenge

During NB-IoT radio network planning, and in order to perform accurate network dimensioning, it is necessary to consider the following :

- **existing 2G, 3G, 4G sites candidates**
- **different types of subscribers**
- **coverage extension levels capacity restrictions**
- **Number of repetitions**



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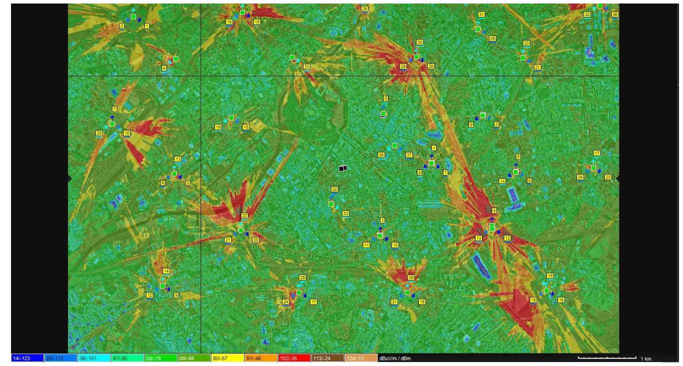
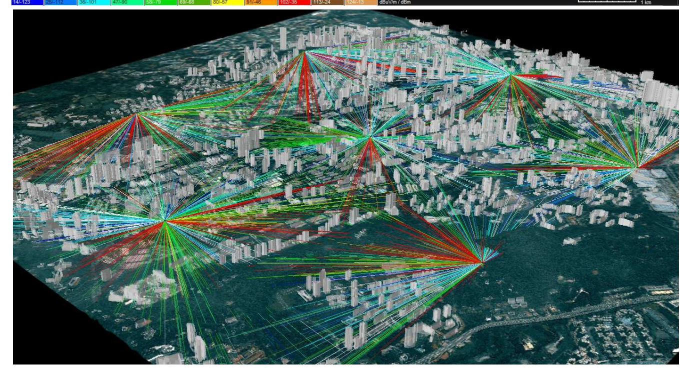
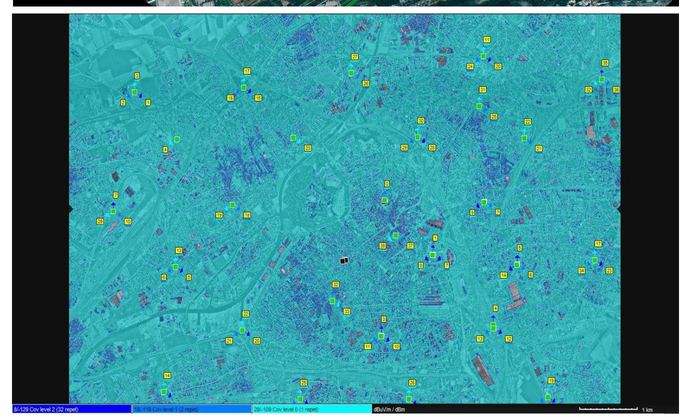
Case study 3: designing an Smart City Narrow Band IoT network







Solution

- *Automatic site searching* function will automatically perform the NB-IoT network design taking into consideration the **RSRP threshold requirement**.
- *Prospective planning* function allows to find the best locations for new sites in case of greenfield and densification scenarios. This function is based on **coverage target assumption**.
- *Subscriber* functions using **additional losses in subscriber parameters**.
- *Parenting* function is based on a **population of IoT devices** (profiles in term of traffic can be defined by user). This function is based on **DL/UL coverage criteria and traffic assumption**.
- Function *"Reports / Legend color report"* calculates distribution of different **coverage extension levels (CL 0-2) with different number of repetitions**, which takes into account **DL RSRP thresholds** based on RSRP coverage calculated. **Connection and active subscribers capacity** can be analyzed based on that distribution.

Conclusion

The software incorporates features and functions to manage the latest technologies: ***LTE-M, NB IoT, low power WAN, IEEE***

An ***unmatched degree of precision*** and ***superior prediction reliability***

> +50 propagation models, GIS AND percentage of correlation between prediction and measurements in excess of 90%

Best in class calculation speeds pixel by pixel resulting from ***massive processing*** and ***virtual machine licensing scheme***

The most ***advanced simulation features*** – focused on automation

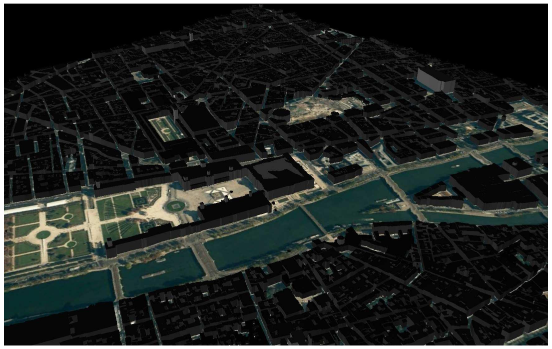
> HTZ Communications is capable of handling prospective planning, automatic frequency allocation, coverage optimization, carrier aggregation, throughput simulation, 3D coverage simulation

Multiple technologies can be simulated in the same project

> Coexistence of technologies or objects such as the impact of windfarms on airport radars or human exposure to electromagnetic fields can be analyzed

Excellent customer experience and ***coverage results can be shared***

> Easy import or export to most formats including Google Maps and MapInfo, meaning the entire organization benefits from the outputs



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THANK YOU FOR YOUR ATTENTION

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30 YEARS OF EXPERIENCE