Space Positioning Navigation and Timing for the energy sector

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Space Positioning Navigation and Timing

- Positioning Navigation and Timing is entering more and more in our daily lives of citizens and in many sectors of our economy, becoming essential for critical operations

- This significant increase of the role of PNT was made possible by the deployment of GNSS constellations which are now fully operational: high accuracy, worldwide, user friendly

Space Positioning Navigation and Timing

- **applications domains**

  - ✓ Autonomous vehicles:
    Rail, Road, Maritime, Aviation

  - ✓ Location based services : health, emergency, safety of operations, tourism

  - ✓ Working machines and IoT

  - ✓ Energy

  - ✓ Finance

  - ✓ Space (Moon, Cubesats,…)

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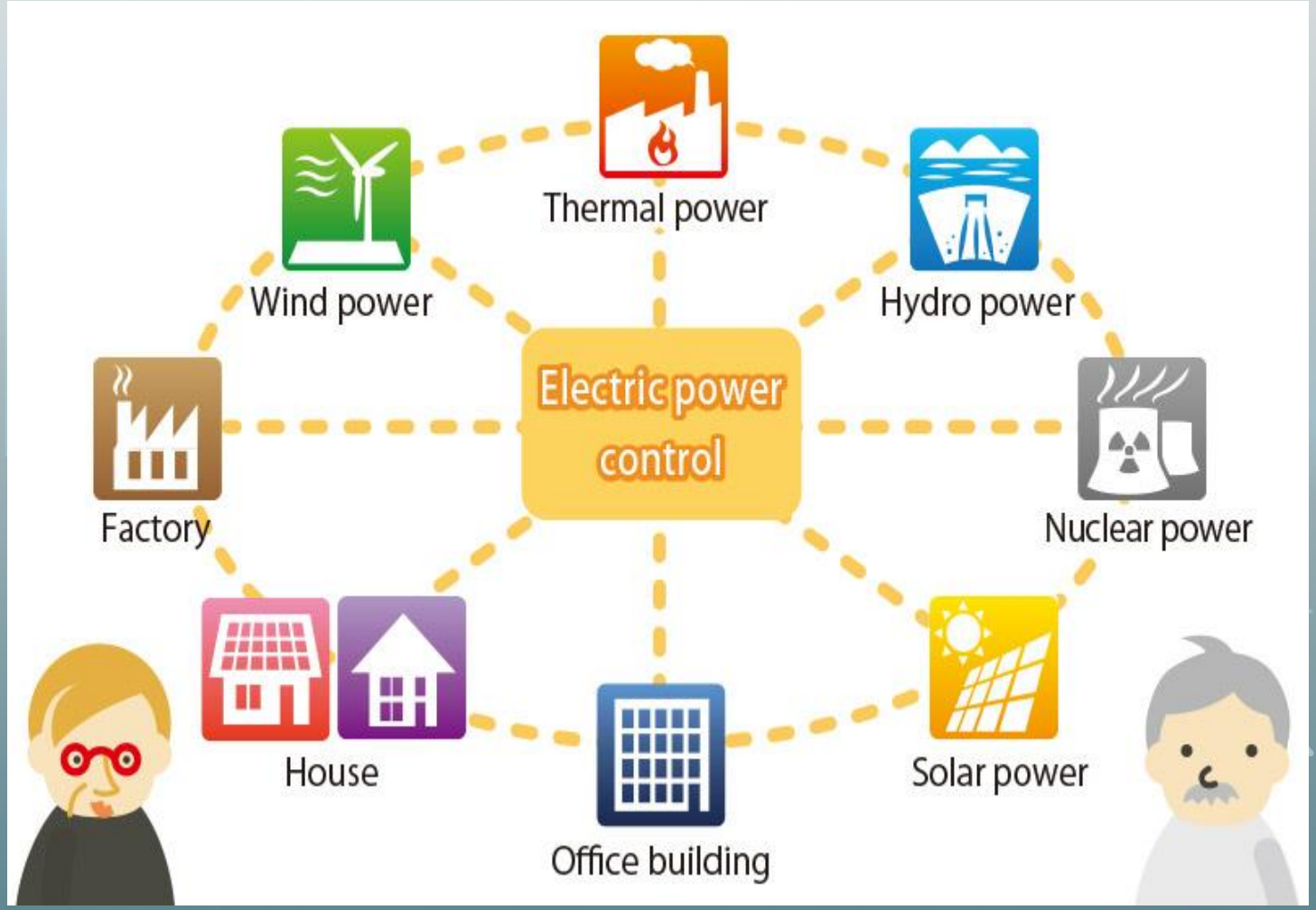
- GNSS the main source of PNT information is presenting however weaknesses and fragilities: easy to jam and spoof, sensitive to atmospheric effects, multipaths

- The common challenges to foster PNT space based applications:
  - ✓ To increase resilience (integrity, availability, continuity)
  - ✓ To protect against jamming, spoofing and cyber attacks
  - ✓ Identify and locate interference
  - ✓ Mitigate atmospheric effects
  - ✓ To increase performance (accuracy)
  - ✓ Reduce receiver power consumption, mass and costs
  - ✓ Reduce multipath effects

PNT for green growth and sustainable development

- Energy – and in particular sustainable energy – is one of the most challenging topics of our time.
- GNSS based solutions can play a significant role in addressing a number of the energy-related challenges:
  - ✓ Protection of critical infrastructure
  - ✓ Optimization and safety of maintenance operations
  - ✓ Smart grids and power control and distribution
  - ✓ Generation of green energy



Space Positioning Navigation and Timing

- Timing for an efficient power supply and distribution

Timing for efficient energy distribution

- Complex scenario:
  - ✓ Diversification of sources; renewable energy highly variable.
  - ✓ 'non-traditional' loads such as Electrical Vehicles and heat pumps are also increasing.
  - ✓ Multiple stakeholders.
  - ✓ The market is evolving to meet end-consumers demand.
  - ✓ Granularity, Interconnectivity, interoperability, network of cells
- The need for more sophisticated control systems became apparent. "Smart Grid" the next generation power transmission network: Great domain for technological innovation
- A new generation of 'smart grid' applications is slowly evolving to meet the demand for better real-time information about network operation. The most radical changes in grid operation are taking place in the Low Voltage and Medium Voltage networks which are the final link in the consumer. Waveform analysis from multiple locations requires that all samples be placed on an accurate, common time reference.
- Smart grids have fundamental requirements for time and synchronisation to achieve efficient power transmission and distribution

Timing for energy distribution

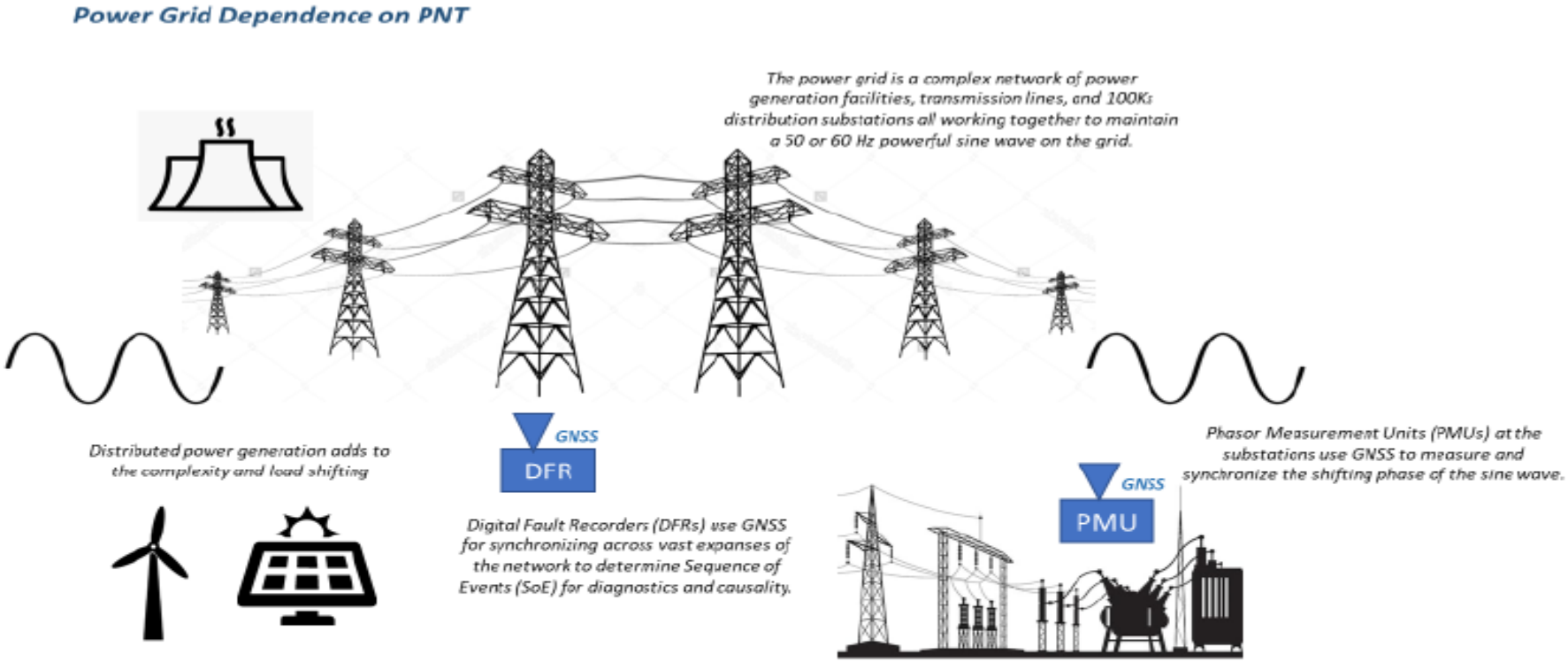


Figure 4: Power Grid Dependency on Precise Time

2. Smart Grid – a data network is being superimposed on the grid so that every device on the grid has network connectivity. For these devices to be managed and to interact with each other, they need PNT information to know where these millions of devices are and for them all to have a common time reference.

Timing for efficient energy distribution

- GNSS is currently the major contender for this function: time synchronization with microsecond or nanosecond precision. Possibility to acquire Coordinated Universal Time (UTC). Each power control device operates using this universal time to achieve time synchronization and stable power control throughout the power grid.
- however GNSS is suffering from two major disadvantages:

1. Accessibility. In many of the locations in which waveform sensors need to be placed, GNSS reception is simply not possible.
2. Increasing reliance on GNSS could introduce significant vulnerability into the network because of the ease with which GNSS signals can be locally jammed or because of any system failure .

PNT solution : Increased resilience obtained by hybrid timing sensors: multiple GNSS and integration with other sources of timing

Space Positioning Navigation and Timing

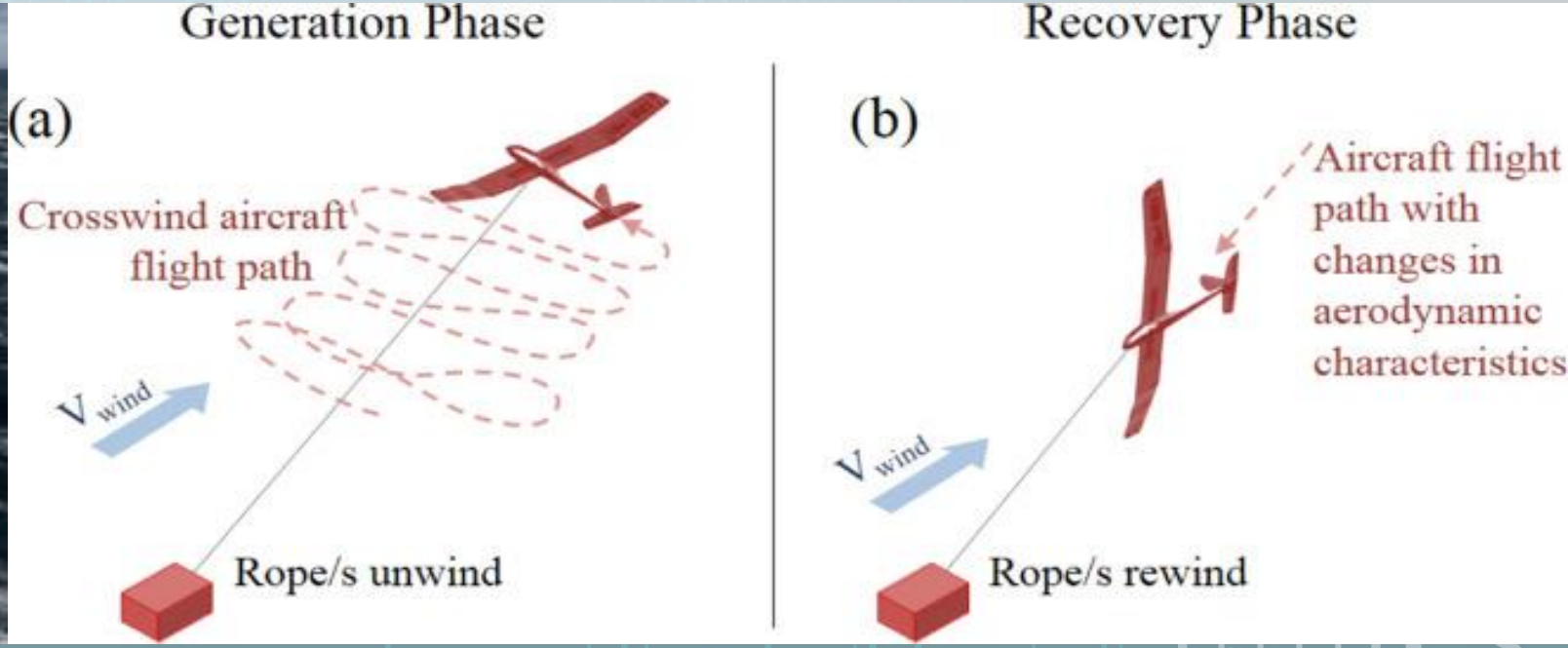
- Navigation for green energy generation

Navigation for the generation of green energy

- Airborne Wind Energy: Winds at higher altitudes become steadier, more persistent, and of higher velocity. The most promising AWE systems are not actually turbines — they're kites, modified parachutes, drones, dirigibles, tethered aircraft.

- Typical applications
  - Offshore repowering the over aged offshore windparks, which can no longer sustain the loads that conventional wind turbines exert on their foundations
  - Remote on shore, in places where conventional windturbines are considered too disturbing (visual, environmental impact)
  - Deep offshore using floating platforms. Water depths (30-300m) cannot be viably accessed by conventional wind turbines.

Navigation for the generation of green energy



Navigation for the generation of green energy

- Airborne Wind Energy systems present a new and rapidly developing technology that enters uncharted territory in drone autonomy and navigation
- Stringent requirements for the navigation module of the drone for autonomous landing.
  - A high number of automatic landings per year
  - High accuracy, horizontal and vertical for landing on the small platform
  - Safety requirements similar to aviation standard (integrity, availability) to enable safety critical autonomous applications

The PNT Solution: The resulting autopilot module is a redundant architecture including GNSS and other navigation and positioning systems. The objective is not to necessarily increase accuracy but integrity and availability

Conclusions

- GNSS has a fundamental role to support green growth and clean energy development.
- Optimal solutions are obtained by integrating GNSS with other PNT sources to increase the resilience of the information specifically for availability and integrity
- NAVISP is the ESA programmatic framework to explore innovative solutions and develop competitive products

THANK YOU!

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