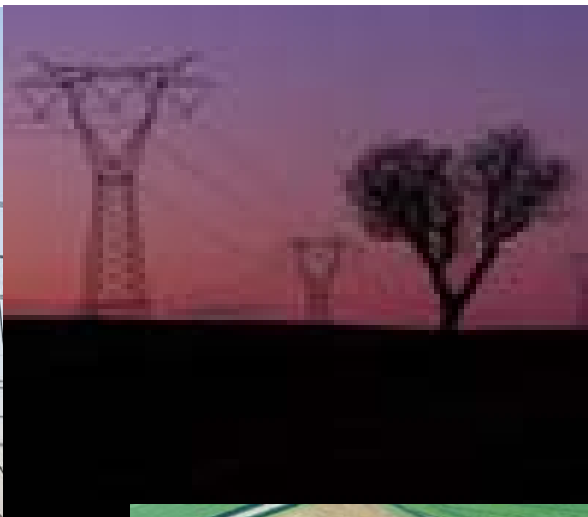


SPACEGRID

Enrico Vellucci



OVERVIEW



TERNA : SPACEGRID END-USER



The company is the primary owner of the Italian National High Voltage Electricity Transmission Grid (NTG), with 62 thousand km of lines throughout the national territory and nearly 400 substations. Maximum voltage 380 kV.

Terna is the first independent operator in Europe and the seventh in the world in terms of kilometers of lines managed

The company is responsible for the transmission and dispatching of energy throughout the entire territory, and therefore for the safe management of the balance between electricity supply and demand in Italy, 365 days a year and 24 hours a day.



Main objective was to reduce the impact of RES (Renewable Energy Sources) on dispatching electricity on NTG with satellite technologies



CARLO GAVAZZI SPACE SpA



Conclusions:

Main result of the study is that improvement of electric power productivity forecast of wind and solar farms is possible by using satellite technologies.

A further result is that there are other utilities tasks and operations where satellite technologies can be profitably applied.

Objective:

to demonstrate the benefits of space technologies integration in the *current* European electricity grid.



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Phase 1:

- Needs, technical feasibility and CBA (Cost Benefit Analysis)
- Study execution : 2010 (January – October)

Phase 2:

- Design, deployment and pre-operations
- Under preparation



TERNA needs and objectives:

- Reduce the impact of wind farm on dispatching
- Improve the quality of its services
- Improve competitiveness
- Reduce overall costs

Expected benefits for TERN:

- improved accuracy of wind power production forecasts.
- improved security of the grid through innovative and cost effective maintenance tools
- improved availability of communication links in emergency and contingency situations;
- rapid deployment of communication links in remote areas (e.g.: for new wind farms);



- ❑ HIGH VOLTAGE LINES MONITORING for MAINTENANCE
 - ❑ Vegetation monitoring
 - ❑ Building monitoring
 - ❑ Subsidence of pylons monitoring

- ❑ WIND FORECASTING IMPROVEMENT

- ❑ SATCOM VS GROUND BASED COMMUNICATIONS
 - ❑ Star network
 - ❑ Mesh network

STEP 1

The Spacegrid technical solutions and the associated costs have been presented and discussed in three different dedicated meetings involving both TERNA technical and management personnel :

Meeting 1 : Maintenance July 12 2010,
 Terna Roma North Substation in Roma

Meeting 2 : Wind Forecasting July 12 2010,
 Terna Control Center in Roma

Meeting 3: Satcom July 7 2010,
 Terna Control Center in Roma

STEP 2

Cost / Benefit Analysis has been carried out by TERNA management personnel during July and September 2010.

HV LINES MONITORING WITH EO MAINTENANCE SERVICES

VEGETATION MONITORING

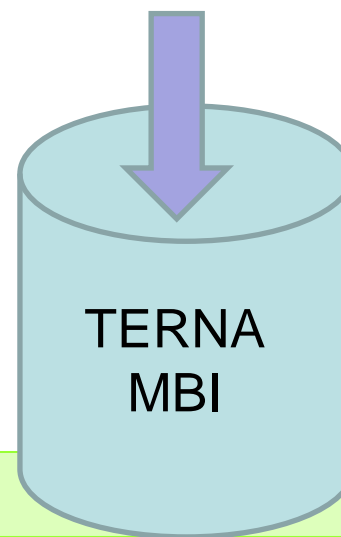


Vegetation Vector Layer (magenta) identified on the Panchromatic orthorectified image (1m resolution).



ASCII FILE (example)

- 1)Geographic Coordinates:
Lat:41.740534, Lon:12.848472 (center of the vegetation element approximately)
- 2)Position with respect to Pylons: 3
- 3)Vegetation growing class according to TERNA classification: (Fast Growing Class)
- 4)Date : 2010-05-24



BUILDING MONITORING



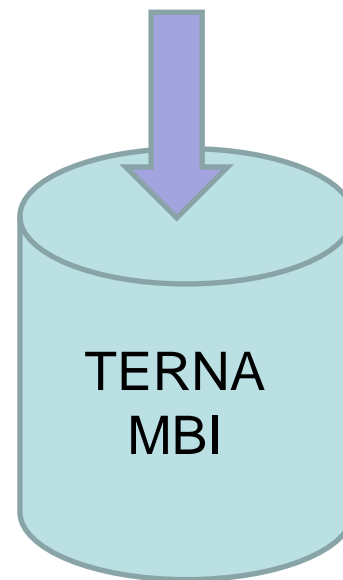
old

new

Building Changes Vector Layer (yellow) identified on the Panchromatic orthorectified image (1m resolution).

ASCII FILE (example)

- 1) Geographic Coordinates:
Lat:41.740534, Lon:12.848472 (center of the new building element approximately)
- 2) Building area
- 3) Date of change: 2010-05-24



PYLON DEFORMATIONS MONITORING

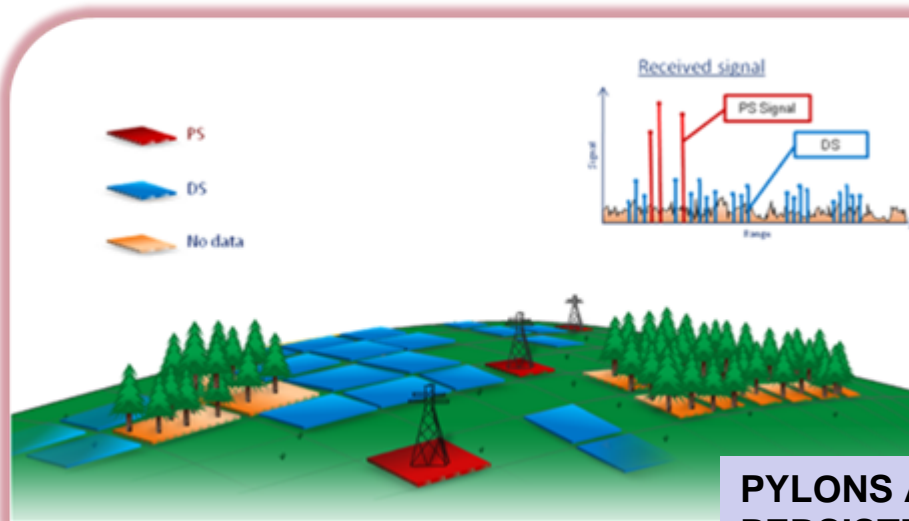


SAR images (~30)

Processing

ASCII FILE (example)

- 1) Geographic Coordinates of Pylon
Lat:41.740534, Lon:12.848472
- 2) Deformation velocity : x mm /month
- 3) Date: 2009-09-30



**PYLONS ARE GOOD
PERSISTENT SCATTERERS !**

TERNA
MBI

Results of CBA for Maintenance Services



- ❑ *Result of Vegetation Monitoring Service CBA is negative (at this time), mainly because of the low value of benefit.*
- ❑ *Result of Building Monitoring Service CBA is negative (at this time), mainly because of the very important cost of Very High Resolution EO images.*
- ❑ Result of Pylons Deformations Monitoring Service CBA is positive, both because of the high value of the benefit (grid security) and of the adequate price. TERN A confirms its will to proceed with the phase 2 of SPACEGRID project.

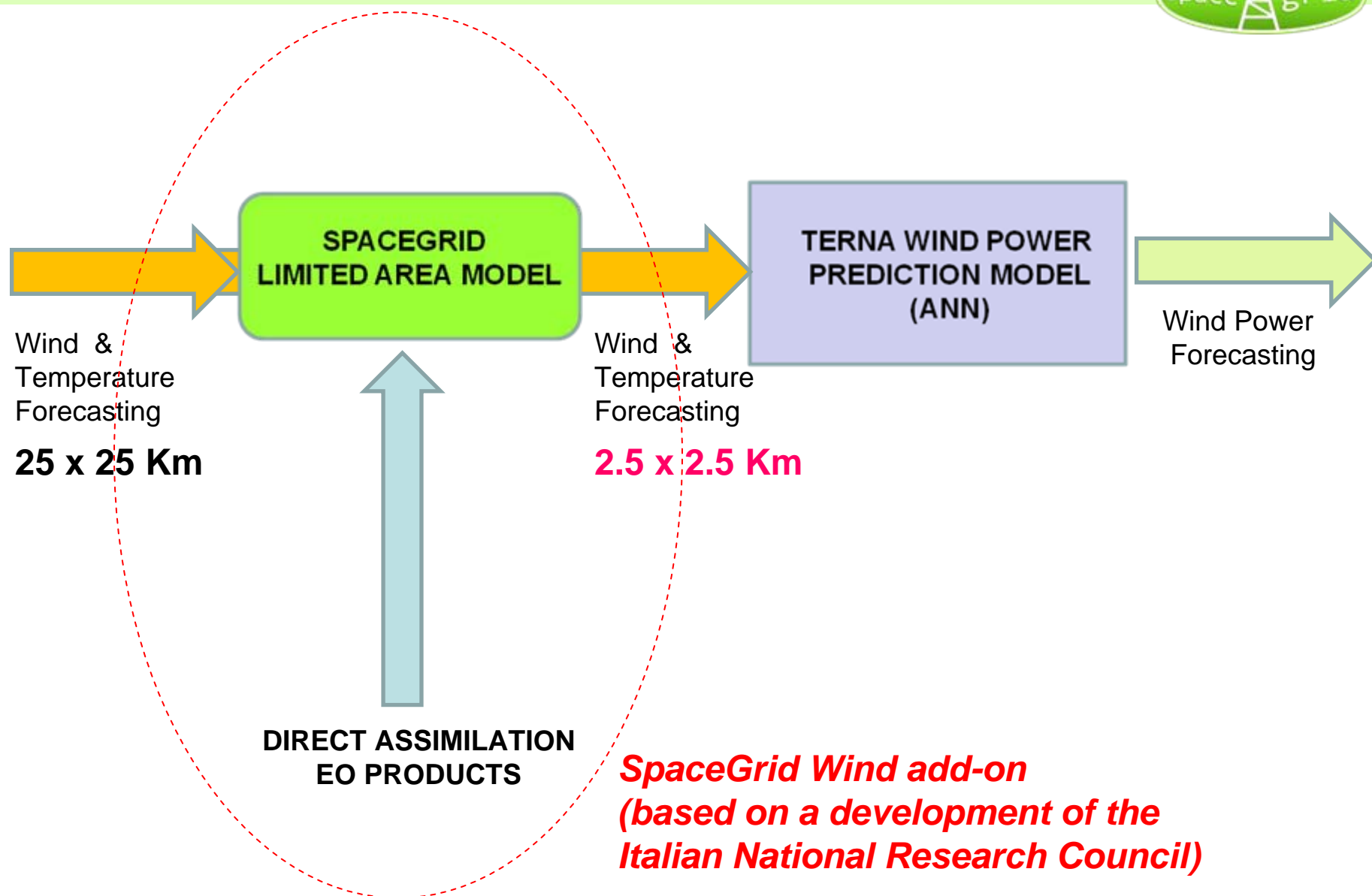
WIND FORECASTING IMPROVEMENT WITH WIND SUPPORT SERVICE

- ❑ Improve accuracy of the “one-day ahead” (hourly granularity) wind power prediction of the TERNA WPPS system.

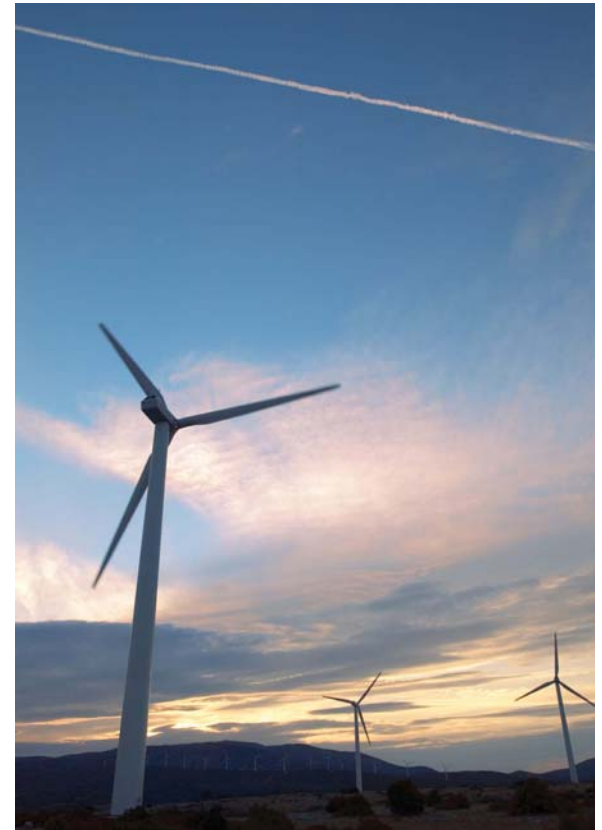
- ❑ Areas of interest :
44 “Reference” wind farms



SPACEGRID SOLUTION

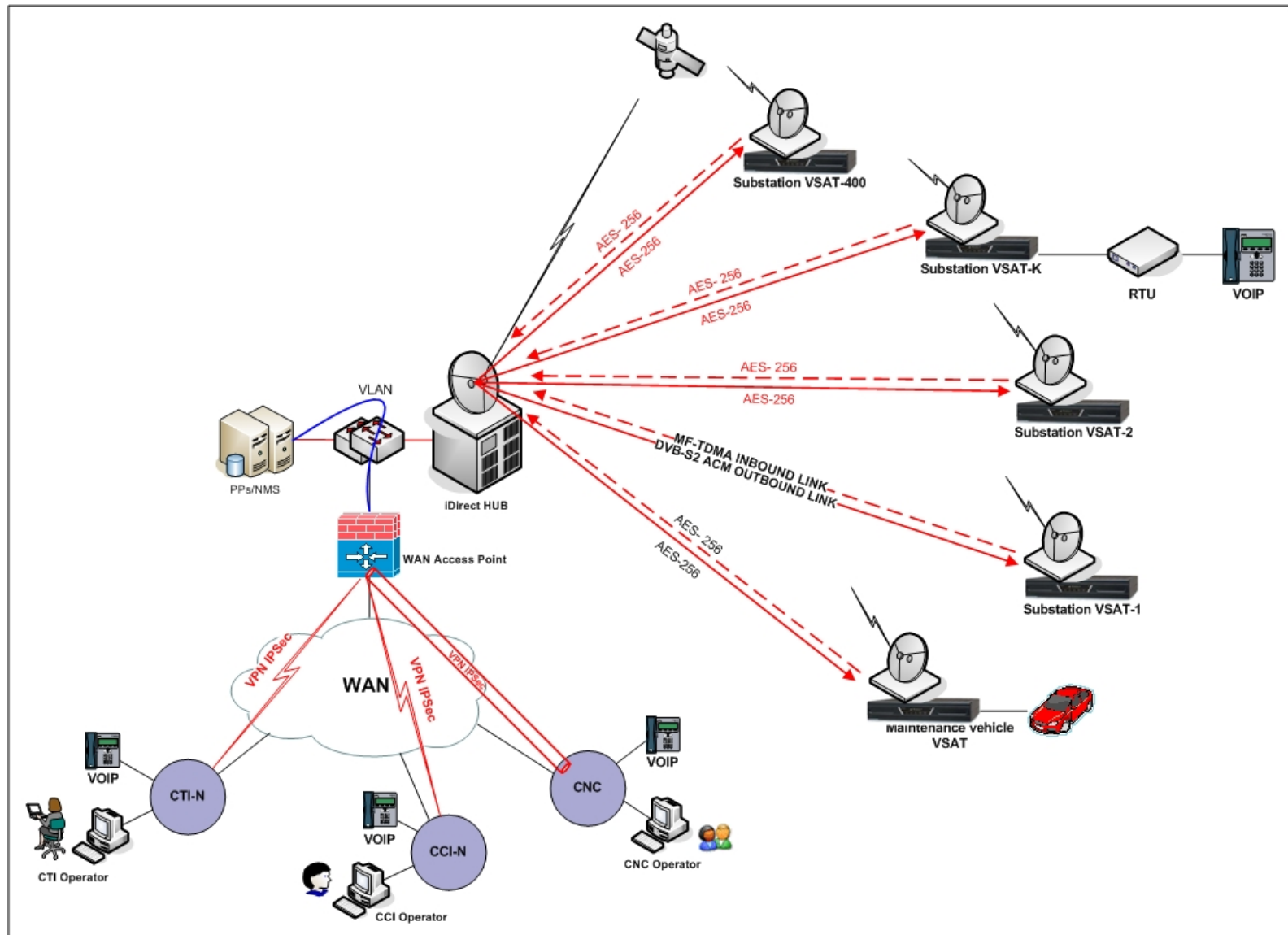


The Cost / Benefit analysis related to the proposed SPACEGRID Wind Support System is positive and therefore TERN A confirms its will to proceed with the phase 2 of SPACEGRID project

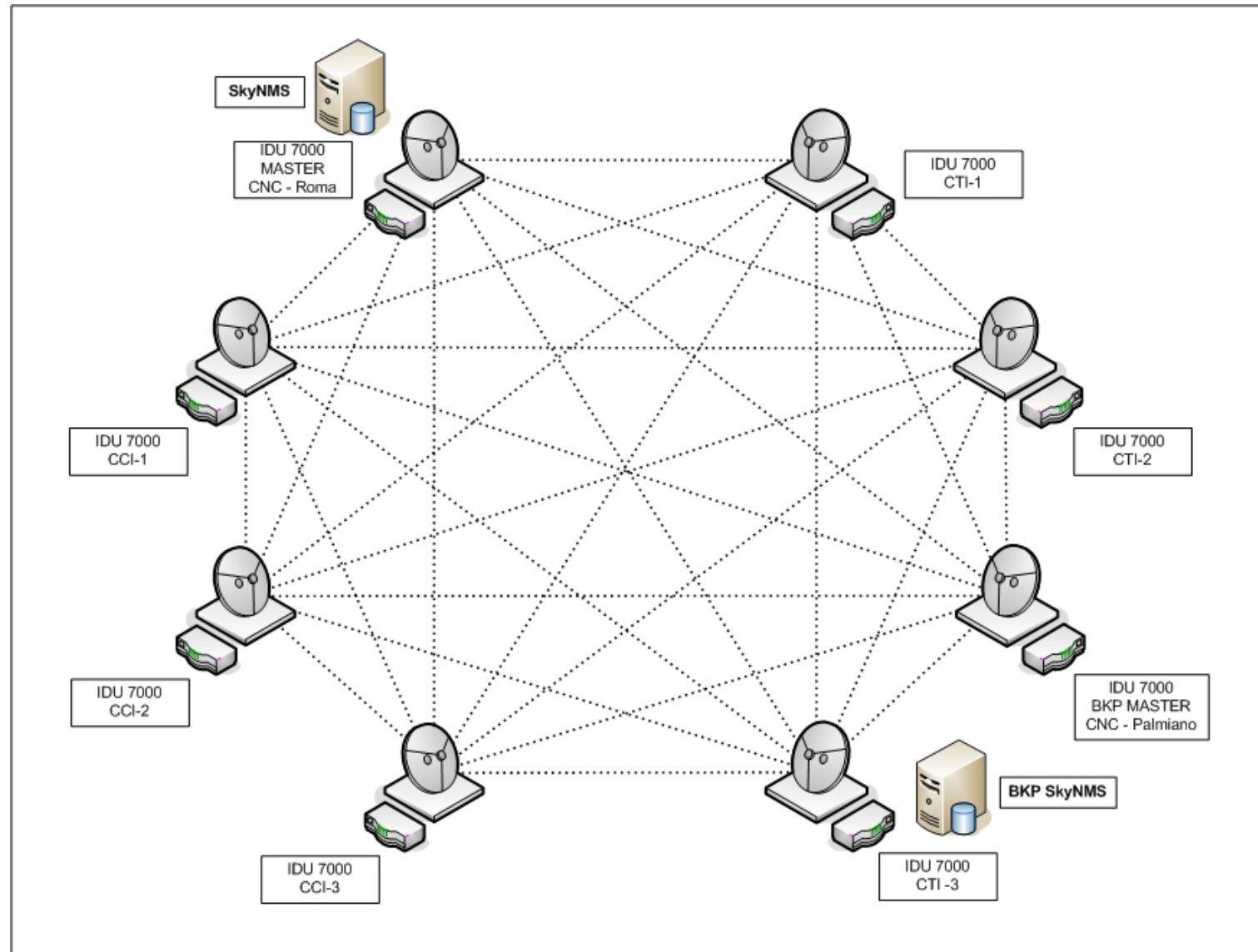


SATELLITE VS GROUND BASED COMMUNICATIONS

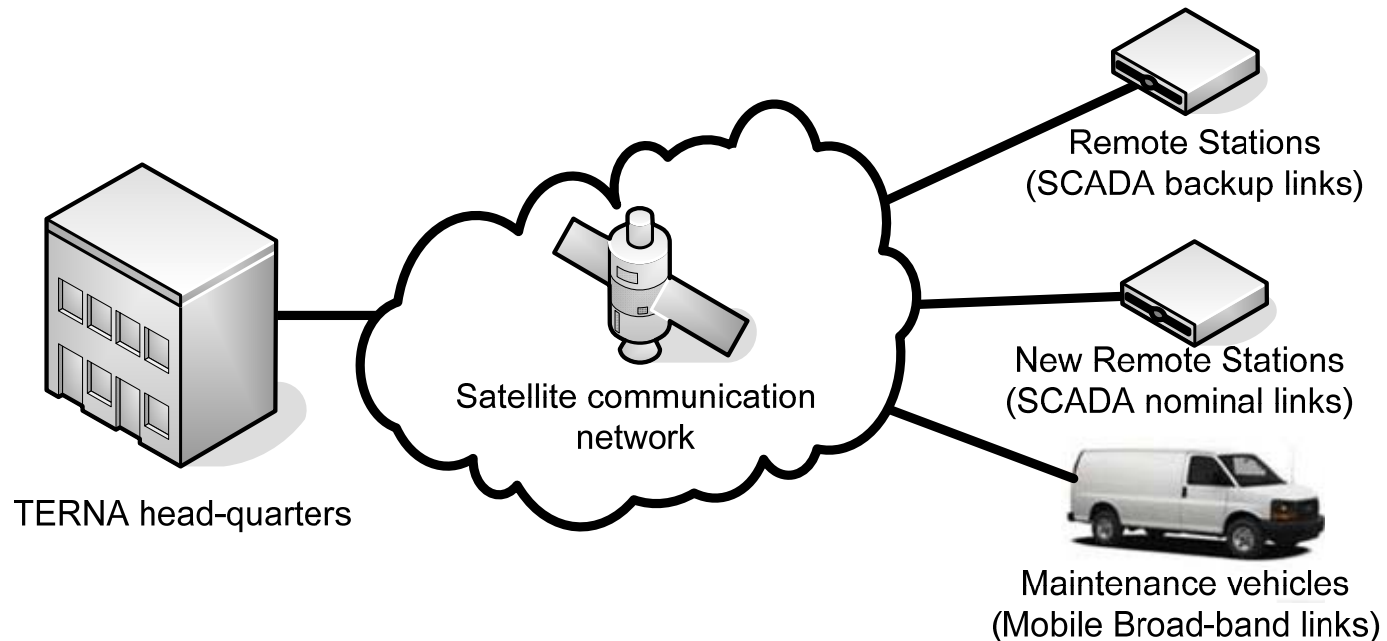
SATCOM STAR NETWORK



SATCOM MESH NETWORK



The result of the cost-benefit analysis confirms the TERNA interest in the phase 2 of the demonstration project related to the **star network**



CONCLUSION



Technical, economical, integration feasibility established for the following services:

**Pylon Deformation
Monitoring service**
BENEFITS FOR TERNA :
Improve Network Security
(Security of Supply)

**Wind Forecasting
Support Service**
BENEFITS FOR TERNA:
Reduce grid management costs
Improve Network Security & QoS
Reduce Congestions

SATCOM service - Star Network
BENEFITS FOR TERNA:
Rapid Deployment of data links: Facilitate integration of RES
Back up : Improve Network Security & QoS
Nomadic terminals: Facilitate maintenance operations

These services will be deployed, tested and demonstrated during phase 2 (expected start : Q2 2011)