

 **AMSAT Italia**

Florio Dalla Vedova  
Iw2nmb

*SkyWave-Ionosfera :*

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**Space Weather and Radio-Amateurs Communications**

SKW-0016

## Contents

- *SkyWave – Ionosfera ?* ▶
- *Space Weather ?* ▶
- *Ionosfera practically* ▶
- *Users & Services Requirements* ▶

*SkyWave - Ionosfera*

## OUR Project

- *SkyWave – Ionosfera* is a project
  - made by and for Radio-Amateurs
  - ideated in AMSAT-Italia in October 2000
  - serves and potentiates our interests
  - obviously with “Ham Spirit”

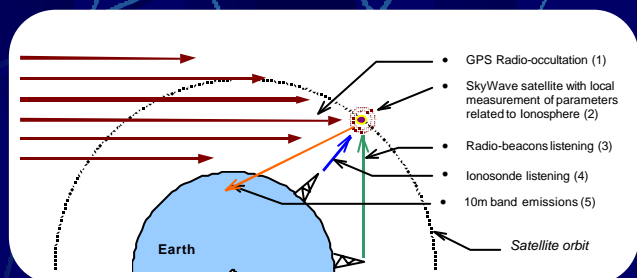
## Practical Ionosphere

- Principal objective of *SkyWave – Ionosfera* is to improve the practicability and reliability of radio-communications via ionosphere
- The project is willing to develop a complete, dedicated system based on :
  - a satellite (space segment) and
  - a ground network organised around a website (ground segment)

## The Space Segment

- The Space segment is defined in the *SkyWave* sub-project.
- The *SkyWave* satellite will ensure :
  - the in-situ collection of scientific data related to the ionosphere
  - the radio-amateurs communications thanks to dedicated transponder(s).

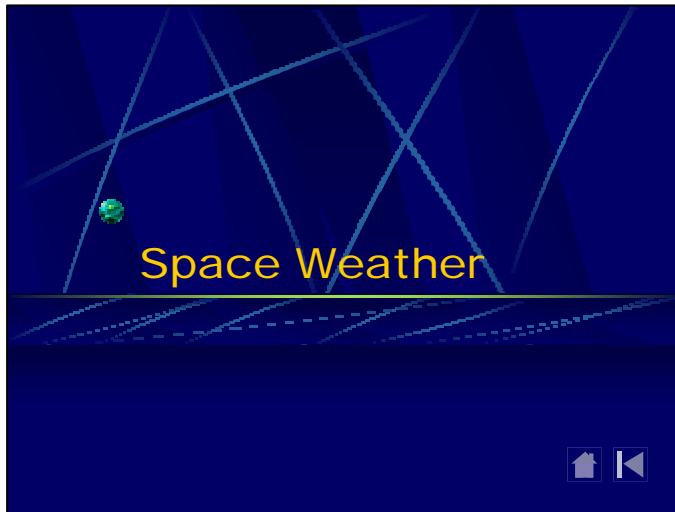
## The *SkyWave* mission



Presented at URSI GA 2002 – Maastricht, NL

## The Ground Segment

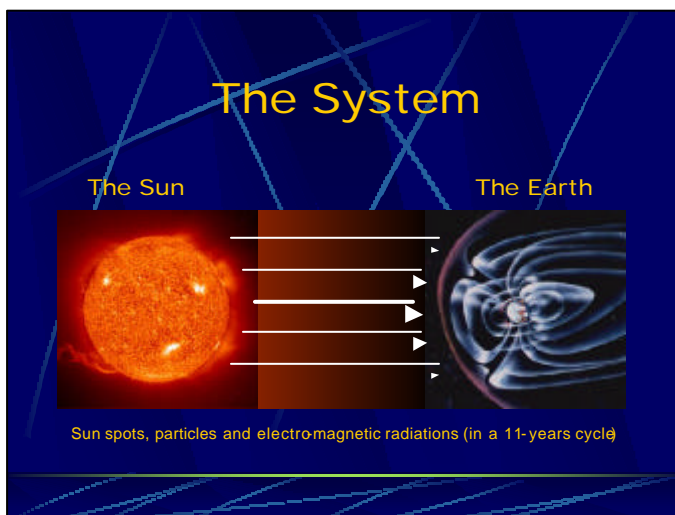
- The Ground segment is defined in the *Ionosfera* sub-project.
- *Ionosfera* is currently supported by the European Space Agency (ESA) as a *Pilot Project for Space Weather Applications*.
- *Ionosfera* develops a network of Radio-Amateurs and a website able to :
  - collect operational/scientific data on the ionosphere
  - offer (free-of-charge) services for the prediction and analysis of radio-propagation via ionosphere



## Space Weather ?

“Conditions on the sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can :

- influence the performance and reliability of space-borne and ground-based technological systems,
- endanger human life or health”



## Effects (☹)

- Satellites affected by radiations, plasma, atmosphere and particles
- Astronauts in orbit (ISS) and in EVA
- Radiations effects on electronics, on crew and passengers of commercial air-flights
- Black-outs, interruptions in the electricity provision due to induced currents in the transportation network
- Interruptions in communications via ionosphere
- Degradation of the radio-localisation signals (Galileo, GPS)
- Climate degradation (?)

## Effects (☺)



- Some nature beauties ...
- **The ionospheric radio-propagation !!**

## Ionosfera (practically)



## Intro



- For the European Space Agency (ESA), both Space (and "Terrestrial") Weather are important themes of study.
- In particular, ESA started a serie of activities dedicated to the "Space Weather" (see [www.esa.int/spaceweather](http://www.esa.int/spaceweather)) and invited interested groups to participate.
- Considering own interest and capabilities, AMSAT-Italia and the Radio-Amateur Community took the opportunity and launched ...

the **Ionosfera Project**

## Objectives (1)

- With (*SkyWave-*) *Ionosfera*, Radio-Amateurs want to contribute to the world-wide research effort on practical ionosphere.
- Our final goal : allow future secure and fully predictable radio-communications through ionosphere refraction.

## Objectives (2)

- Ionosphere indeed is a Space Weather “product” still not fully understood.
- “Classical” Science has done a lot and continues to investigate this medium ...

## Objectives (3)

- Yet, we believe that, thanks to their important number (about 1 million), world-wide distribution, and intense ionosphere-related activities, Radio-Amateurs can support this research effort.
- This would surely provide with another point of observation toward Ionosphere.

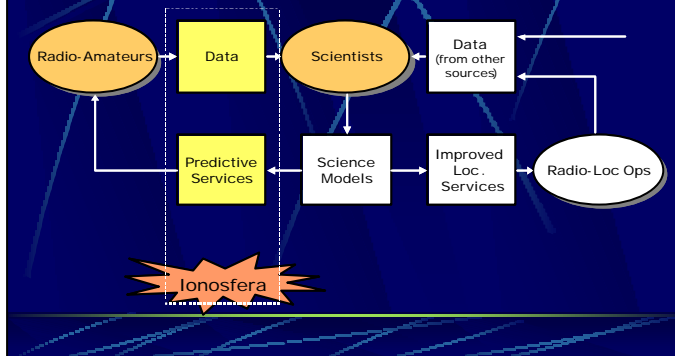
## Users and Needs (1)

1. Radio-Amateurs (Users & Actors)
2. Space Weather Scientists
3. Radio-sat Constellations Operators
4. Populations (in case of emergency)

## Users and Needs (2)

1. try to achieve long-range radio-links
2. observe, analyse, study, and model
3. suffer from its effects on space signals
4. would benefit from a secure and wireless long-range communication mean.

## Users and Needs (3)



## Proposed Services (1)

Ionosfera will provide two kinds of services :

- A. Ionosphere related **Data** (as Data Provider)
- B. Iono-communication **Tools** (as Service Provider)

*Both accessible via website to (free-of-charge) registered Users*

## Proposed Services (2)

Operational and/or Scientific Data :

- Operational data on achieved (or not) communications through Ionosphere
- Radio-scientific data like derived TEC, or “sounds” connected to Space Weather (at various frequencies)

## Proposed Services (3)

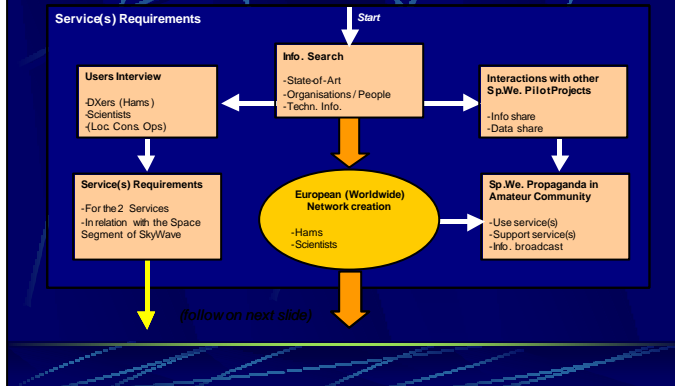
Prediction & Understanding Tools :

- (Predictive) Tools for transmission
- (Understanding) Tools for reception

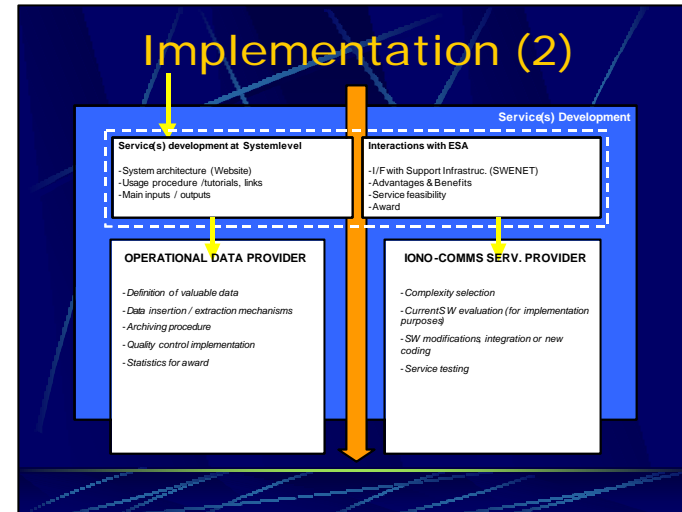
(relative complexity is TBD)

TBD : To Be Defined

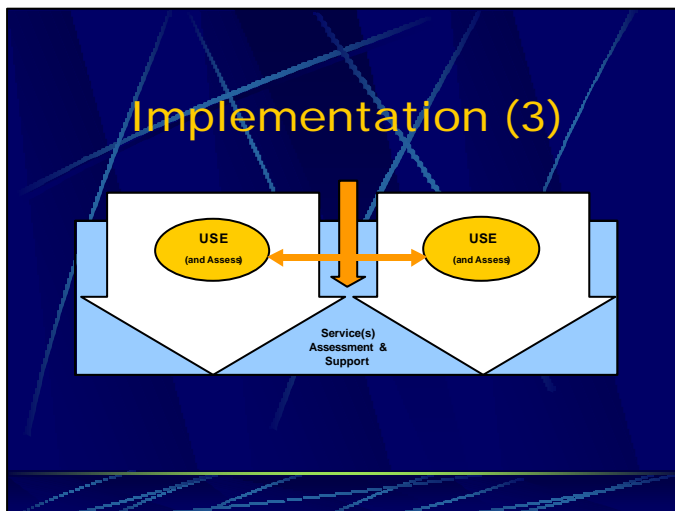
## Implementation (1)



## Implementation (2)



## Implementation (3)



## Schedule

1. Service requirements : for September 2003
2. Service development : for April 2004
3. Use of the service : from May 2004

## Contact

For further information please contact :

- Florio DALLA VEDOVA, Iw2nmb (email : [iw2nmb@amsat.org](mailto:iw2nmb@amsat.org)) or,
- Paolo PITACCO, Iw3qbn (email : [iw3qbn@amsat.org](mailto:iw3qbn@amsat.org))

## Users and Services Requirements



## Proposed Services

Ionosfera will provide two kinds of services :

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## System Requirements

- Free access to (free) registered Users
- Service(s) is/are upgradeable and new services can be added
- Space Weather indices are used everywhere and should be provided by the ESA Infrastructure (also forecasts of)
- Standard formats/graphics within the ESA Infrastructure ?
- Low maintenance website



## Data Provider (1)

- At present time, only operational data can be provided.
- Other types of data are hoped to be provided in the future, when larger, world-wide awareness of the Ionosfera project and its website will be achieved.

## Data Provider (2)

- Data will be collected/inserted by Radio-Amateurs and provided to interested Scientists and Radio-Amateurs.
- Data is essentially based on radio-amateur QSL content, for RX and TX.
- Data will be "index-stamped" for correlation studies.

## Data Provider (3)

- User/Station Data (*like callsign, locator/height, technical figures*) will be asked at registration.
- Operational Data (*like date/hour, frequency, mode, antenna orientation, RX or TX callsign & locator, signal level, ...*) will be inserted in real-time.
- Applicable Space Weather indexes (*like SSN, Solar Flux, Geo-magnetic*) will be stamped to the information provided.

## The "360" Degrees Award

- Promotion tool for data collection
- Both for receivers (RX) as for transmitters (TX)
- Goal: collect as many long distances radio links around your station
- Points are delivered based on amount and distribution of information



## Service Provider (1)

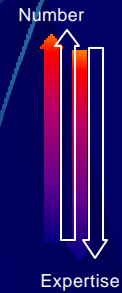
● Requirements have been derived from :

- Literature
- Users survey
- State-of-art prediction programmes

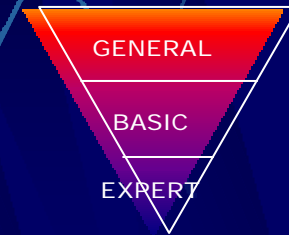
It comes out that ...

## Service Provider (2)

USER BASE



SERVICE STRUCTURE



## Service Provider (3)

● GENERAL layer :

- Gives general indication on bands opening based on real-time Space Weather indexes and variation speeds.
- Presents in real time the various Space Weather indexes (and their variation speeds) – *asked from ESA Infrastructure*
- Allow the retrieval of past, and derivation of future indexes – *asked from ESA Infrastructure*

## Service Provider (4)

● BASIC layer :

- Allow basic conversions/calculations (locator/geographic/geomagnetic coordinates ; great circle parameters ; bearings ; ...)
- Allow estimation of MUF (with MiniMUF, permission for use has to be asked) between two stations
- Allow calculations on ionosphere electronic density profiles (translation of IRI in C/C++ is done within the project)
- [MAYBE, a simple ray/signal tracer between two stations, for analysis]

## Service Provider (4)

- EXPERT layer :

- Links to other sites with prediction programmes.
- Links to specialised documentation