



DIONIS: efficient monitoring system for vineyards



Macedonia: Facts & Numbers

- ▶ **Rich viticulture** and **distinguished history of winemaking**
- ▶ 27 500 hectares of vineyards that produce considerable quantities of highest quality grape
 - ▶ 65% belongs to wineries, 35% to individuals
 - ▶ 98 millions liters wine per year (150 million kilograms of grapes)
 - ▶ 88 wineries
- ▶ Main varieties grown
 - ▶ *Vranec* (red) and *Smederevka* (white)

▶ Trend of wine export



Year	2007	2008	2009
Exported Wine (million €)	17.4	17.7	19.6

- ▶ *Vranec*, *Zilavka*, *Kartoshija* and *Temjanika* are successfully penetrating the Western - European market



Trend of wine production: Towards quality

- ▶ **Production of wine** and the land used for **vineyards** has **decreased** over the last 20 years according to the EC (European Commission) reports
- ▶ A need for
 - ▶ **Efficiency** in vineyard capacity utilization
 - ▶ **Stability** in the grape growing process
 - ▶ **Quality over quantity!**
- ↪ Improving the wine **manufacturing** mechanisms
 - ▶ New equipment, automated systems...
- ↪ Improving the process of **growing** grapes
 - ▶ Optimization of the irrigation system ⇒ **Efficiency**
 - ▶ Prevention from grape diseases ⇒ **Stability**
 - ▶ Different conditions are required for different varieties ⇒ **Quality**



Precision Agriculture: Vineyards monitoring

- ▶ **Precision agriculture** ⇒ an emerging trend in the agricultural sector that includes *implementing new technologies* for
 - ▶ improvement of the crop production management and
 - ▶ agricultural decision making
- ▶ **Precision agriculture in vineyards** (particularly wireless sensor network technology) provides
 - ▶ **continuous monitoring** of the vineyards
 - ▶ enables in time **notice delivery** anytime and anywhere



- ↳ **improves** the yield and quality of grapes
- ↳ **decreases** the costs and **reduces** the use of pesticides

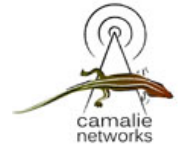
Existing implementations and experiences

- ▶ **Camalie Vineyards**: Napa Valley
 - ▶ Camalie Networks and Crossbow technology, USA
 - ▶ irrigation management, frost protection and powdery mildew management
- ▶ **VineSense**: Chianti region of Tuscany, Italy
 - ▶ Netsense, Italy
 - ▶ irrigation control; downy mildew, powdery mildew and botrytis protection; water stress and plant physiology; thermal characterization of the new plants
- ▶ **Climate Genie™**: Napa Valley
 - ▶ Grape Networks, California, USA
 - ▶ monitoring water, temperature, humidity and light
- ▶ **Agri-Sens**: Sula Vineyard, Nasik, India
 - ▶ SPANN Lab, IIT Bombay, India
 - ▶ monitoring temperature, humidity, soil moisture and plant temperature
- ▶ **Precise Water Monitoring**
 - ▶ Fruition Sciences, California, USA
 - ▶ irrigation optimization based on sap flow



Experiences: Camalie Vineyards

- ▶ Area of coverage: 1.58 ha
- ▶ Divided in 10 regions on the basis of the combination of vineyard, the soil type, exposition of sun and the climate
- ▶ Different quantities of water supply are used in distinct regions



	Years	Crop [t/ha]	Crop - total [ton]
(1)	2001-2004	0.63	1
(2)	2005	2.53	4
	2006	6.00	8.4
	2007	11.5	18.2
	2008	6.13	9.68
	2009	11.1	17.55

Years	Rain [cm]	Plants [number]	Water supply [thousand liters]
2002	/	342	70
2003	103	644	1091
2004	65.8	4200	819
2005	94.5	4200	677
2006	97.5	4200	726
2007	46.2	4200	573
2008	58.2	4200	684

- 1 - Sensor network is installed along with 3000 new plants
- 2 - Different conditions are considered for different grape types



Distributed and Intelligent system for monitoring vineyards with Sensor networks

- ▶ Facilitating better vineyard management with:

- ▶ **sensor system**

- ⇒ observing the vineyards specific conditions

- ▶ **visualization system**

- ⇒ monitoring the quality and vitality of the grapes in a vineyard

- ⇒ the need of water supply

- ⇒ the need of applying pesticides

- ▶ **alarm system**

- ⇒ providing alarm messages if some conditions require urgent reaction

- ↳ thus improving the **yield** and **quality of the crop**

Sensors

Transceivers

Data Center

User Interface

DIONIS: Sensor system

- ▶ **Sensor network** features 24/7 observation of the vineyard specific conditions that can affect the grapes growing process

Irrigation optimization

soil moisture, sap flow, rainfall, temperature, humidity

Drought and frost prediction

temperature and air humidity

Disease prevention

leaf wetness, temperature, humidity, rainfall, UV radiation,

Soil quality

chemical composition of the soil



Temperature, humidity



Soil moisture



Leaf water potential



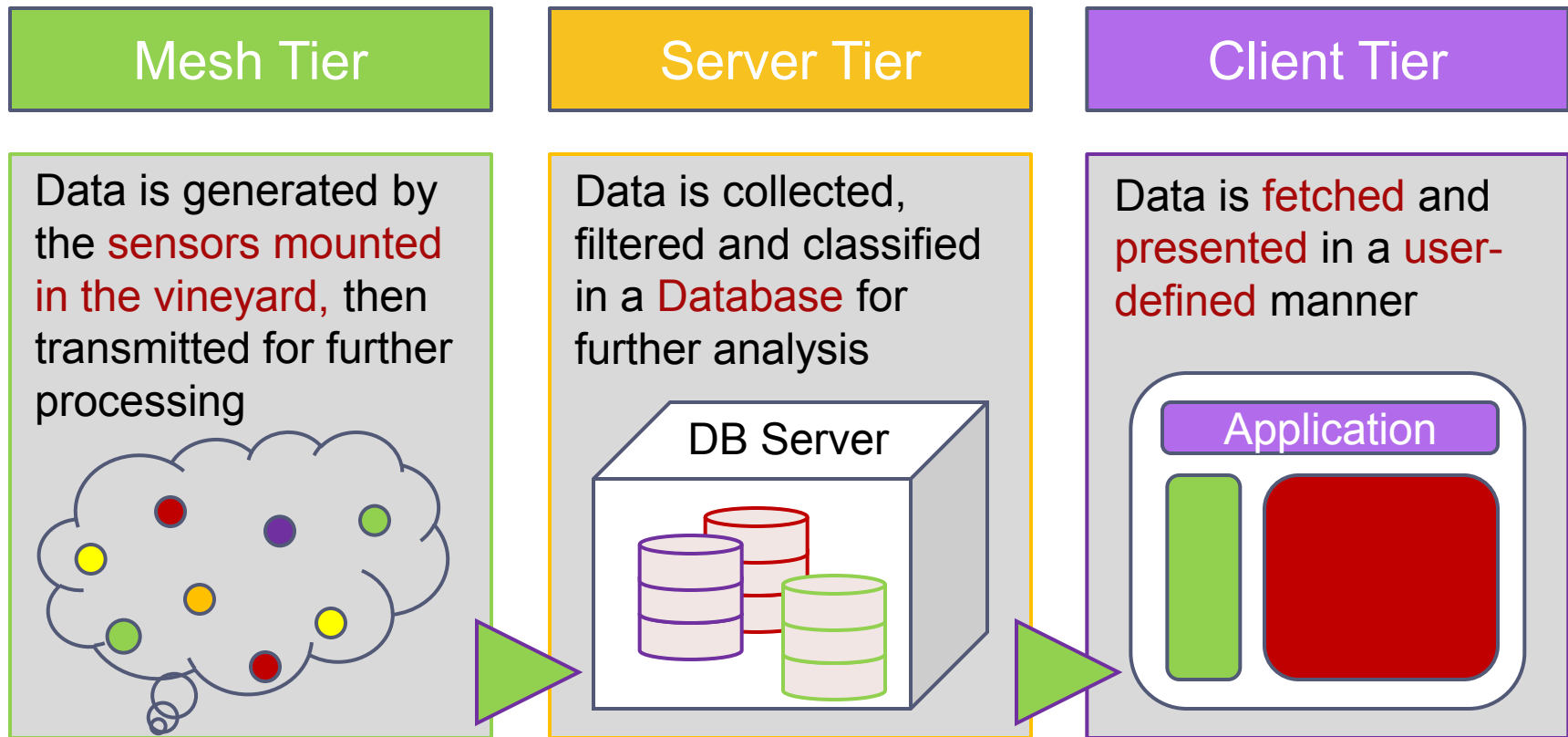
Solar radiation



Sap flow

DIONIS: Visualization system (1 / 2)

- ▶ **Web Application** provides remote vineyard monitoring
 - ▶ the overall **data flow** of the Web Application:

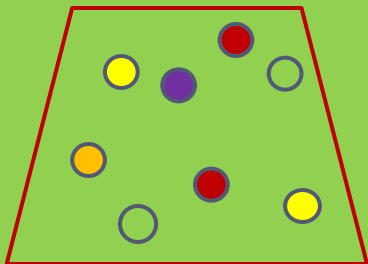


DIONIS: Visualization system (2/2)

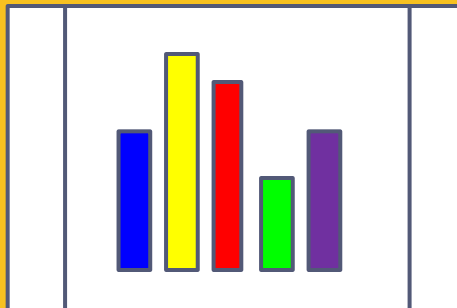
▶ Main features of the application interface

- ▶ Graphical representation of the processed data, as well of the vineyard itself
- ▶ Configurable Graphs – daily, weekly, monthly graphs that can be configured
- ▶ Alarm messages – accordingly to the configured parameters

Topographic View
(overhauls)
of the vineyard and
the mounted
sensors



Configurable Graphs
for data analyzes, data
comparison & planning



Alarm messages -
can be configured
and sent to various
devices

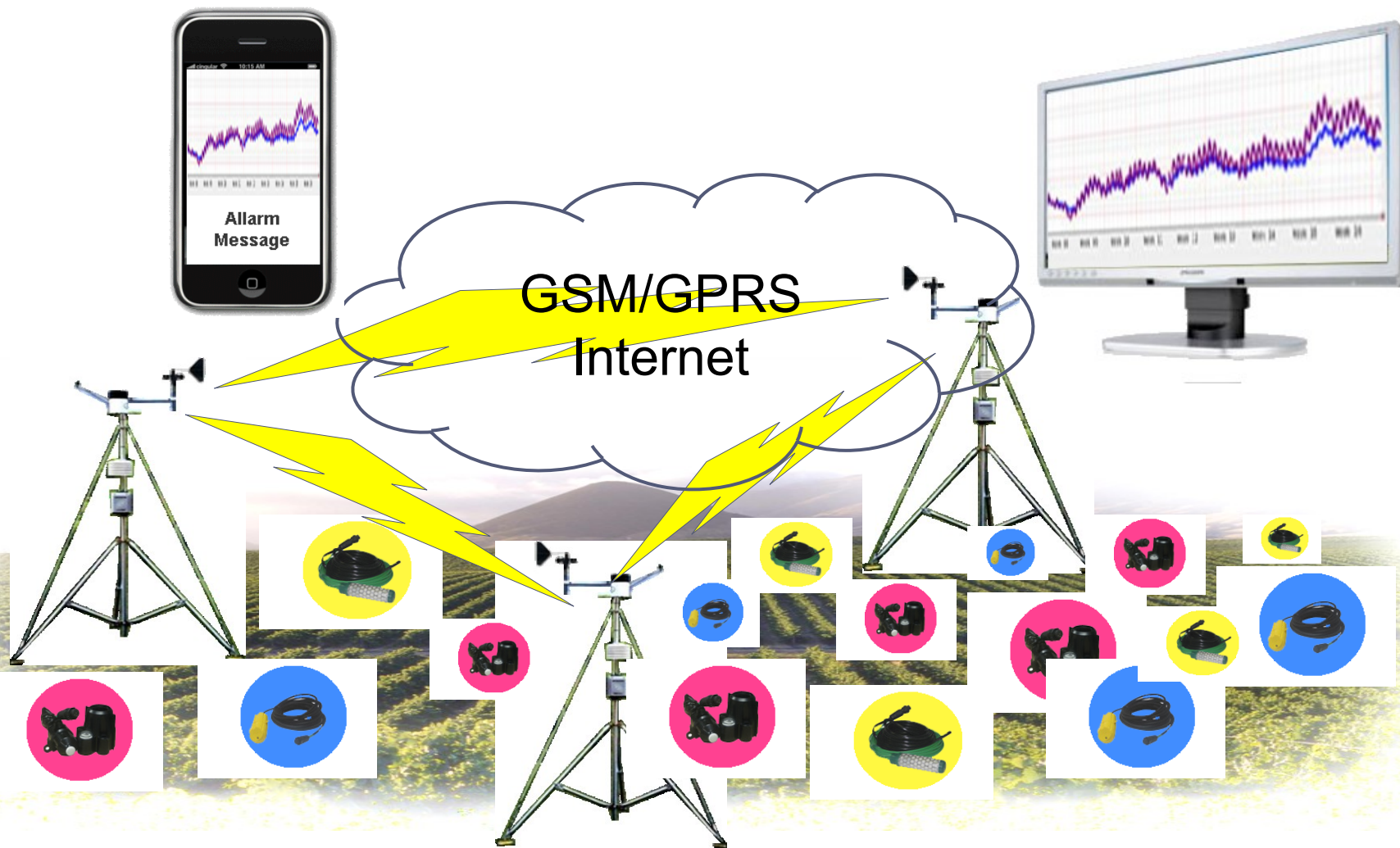
App listing

SMS Message

e-Mail

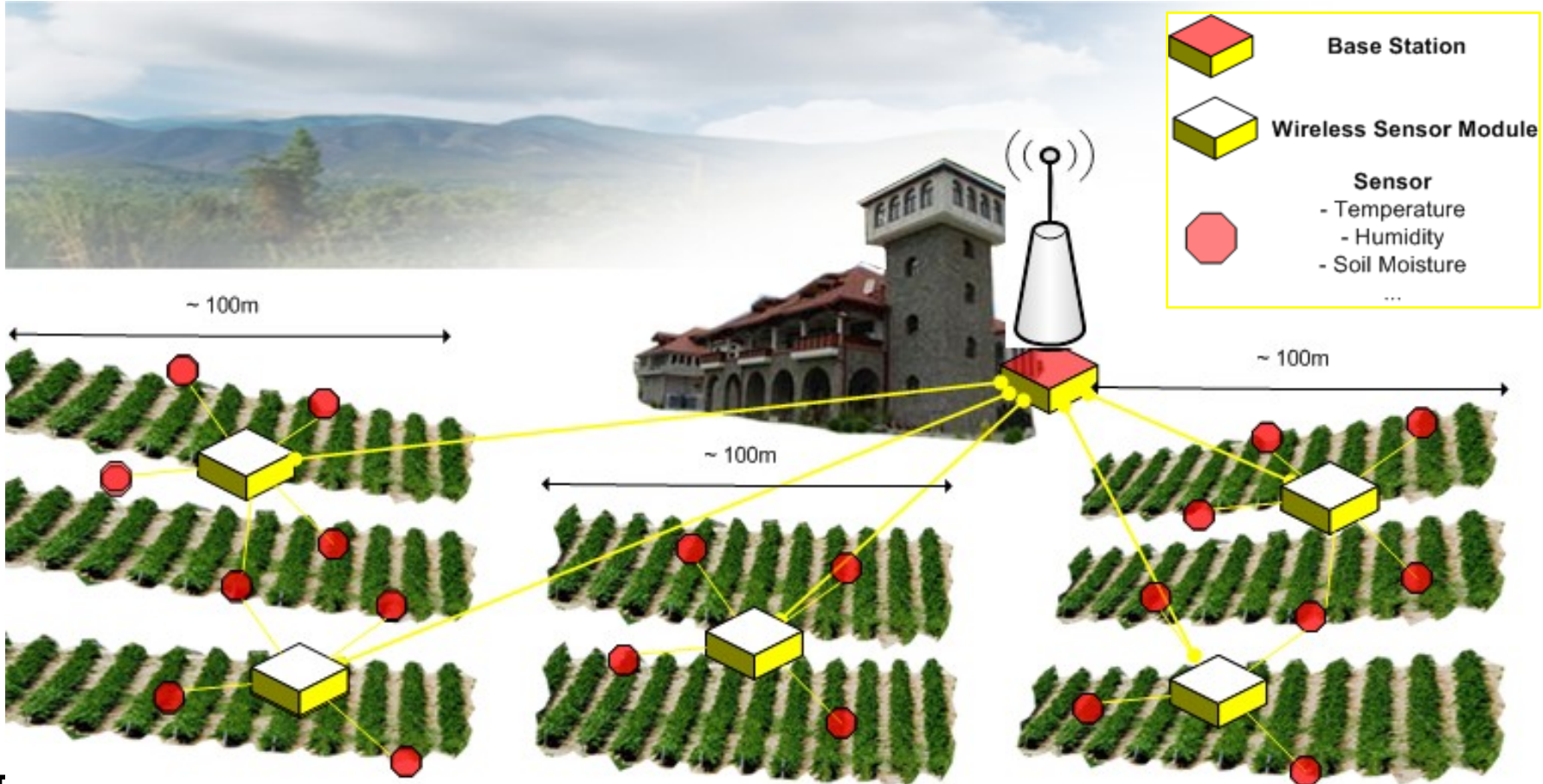
Other ways

DIONIS: Process of implementation



DIONIS Beneficiary:

Private winery - Popova Kula

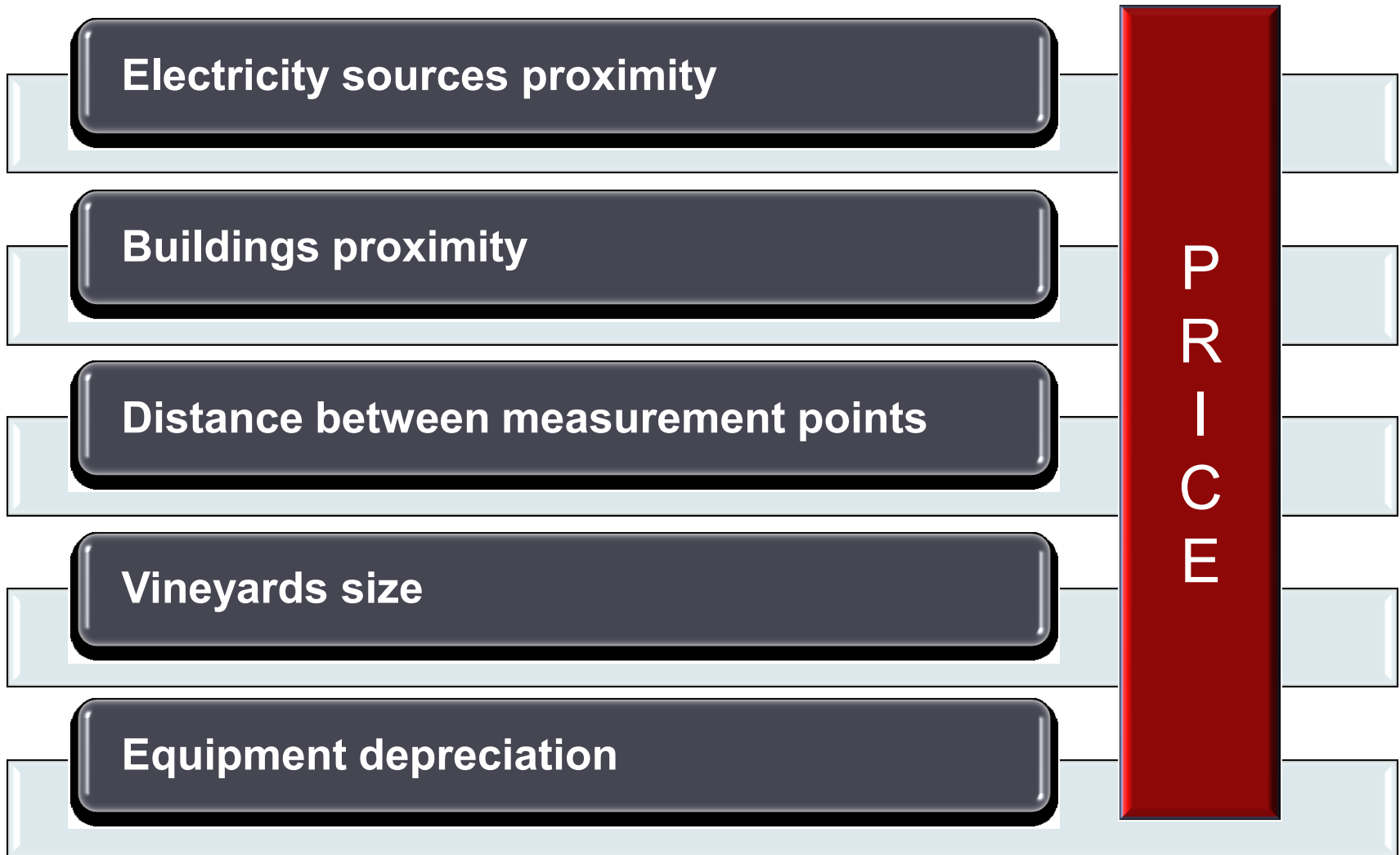


Popova Kula winery: www.popovakula.com.mk

CNN news: Creating Napa Valley in Macedonia

<http://edition.cnn.com/2010/WORLD/europe/05/10/macedonian.wines.napa.valley/index.html?iref=allsearch>

Implementation constraints?



Conclusion (1 / 2)

- ▶ **Vineyards monitoring** is an invaluable factor in **increasing the production** and **quality** of grapes cultivation
- ▶ Sensor networks are the **solution of the future**
 - ▶ Application in many diverse areas: greenhouses, floriculture, fruit growing etc.
 - ▶ Implementation in the most successful wineries in France, California, South Africa etc.
- ▶ The implementation of the sensor networks in vineyards means:
 - ▶ **24h monitoring** of the vineyard micro-climate conditions
 - ▶ **Remote access** to the vineyard monitoring system
 - ▶ **Alarm notifications**



Conclusion (2/2)

- ▶ **DIONIS** project
 - ⇒ application of sensor networks in vineyards monitoring
 - ▶ the ICT knowledge as a support in agriculture
 - ▶ cooperation between academia and SME
- ▶ **DIONIS** implementation
 - ▶ **Popova Kula** winery (first phase of DIONIS implementation)
 - ▶ Extending the project for
 - ▶ monitoring and automation of the wine cellars, wineries and wine production processes
 - ▶ implementing diverse sensor network solutions ...



About us...

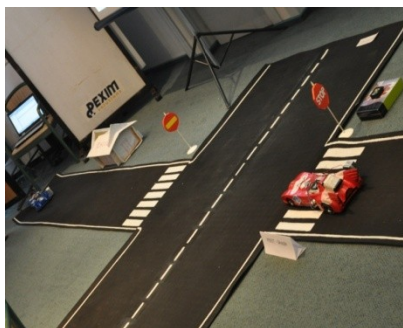
WinGroup & ECS

- ▶ **WiN Group** (Wireless Networks Group) is a research activity oriented group, specializing in wireless and mobile networking
 - ▶ Founded in September 2007 as part of the FEEIT - Skopje
 - ▶ The group participates in many national and international (EU FP7) projects: ProSense, ARAGORN, RIWCoS, QUASAR, FARAMIR, etc.
 - ▶ <http://wingroup.feit.ukim.edu.mk>
- ▶ The relevant experience in the field of Wireless Sensor Network is gained in EU FP7 project ProSense
 - ▶ In the scope of the project, sensor network equipment is purchased and diverse applications are developed
 - ▶ <http://prosense.feit.ukim.edu.mk>
- ▶ **ECS** (EuroComputer Systems)
 - ▶ Established in 1991
 - ▶ One of the most successful IT companies in the Republic of Macedonia participating in a number of system integration projects
 - ▶ <http://ecs.com.mk>

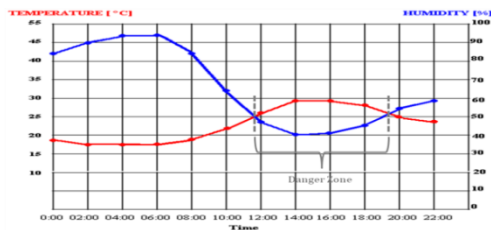
About us...

WiNGroup & ECS

Testbed platforms



Equipment & GUI



<http://prosense.feit.ukim.edu.mk>

mk

WSN-SME: ProSense workshop, Ljubljana, May 19-21, 2010

FEEIT-ECS Collaboration agreement



Thank you for your attention



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