INTERREG IVC Program

DETECTION

Synthesis of good practices

Partner No. 5

National Forest Centre, Zvolen

Slovak Republic

Contents

Detection and monitoring of forest fires

1) Definition of the problem and objective of the solution

Approximately 30-50 ha of forest is destroyed by fire a year. It is a large area and it produces more carbon monoxide than the overall automobile traffic. Monitoring of the potential risk areas and an early detection of fire can significantly shorten the reaction time and also reduce the potential damage as well as the cost of fire fighting. Known rule applies here: 1 minutes - 1 cup of water, 2 minutes - 100 litres of water, 10 minutes - 1 000 litres of water. The objective is to detect the fire as faster as possible, its exact localization and early notification to the fire units. Further required evaluation criteria are especially efficiency (success of the detection, localization accuracy) and efficiency of the financial system.

2) Existing solutions

There is a number of detection and monitoring systems in the world. These are in particular, observers, in the form of patrols or monitoring towers, aerial and satellite monitoring and increasingly promoted detection and monitoring systems based on optical cameras, different types of detection sensors or their combination. It turns out that the last mentioned are the most advanced technical solutions of forest fire monitoring in the future according to the practical experience.

The following part presents a brief overview of automatic and semi-automatic detection and monitoring systems of fire protection in the world, experience with these systems in practical operation, their evaluation in terms of efficiency, accuracy, versatility and other key attributes.

2.1 General division and characteristics

Detection and monitoring systems are divided into two basic groups:

a) **land (terrestrial) systems** based on the tracking of ground monitoring stations,

b) **satellite-based systems**.

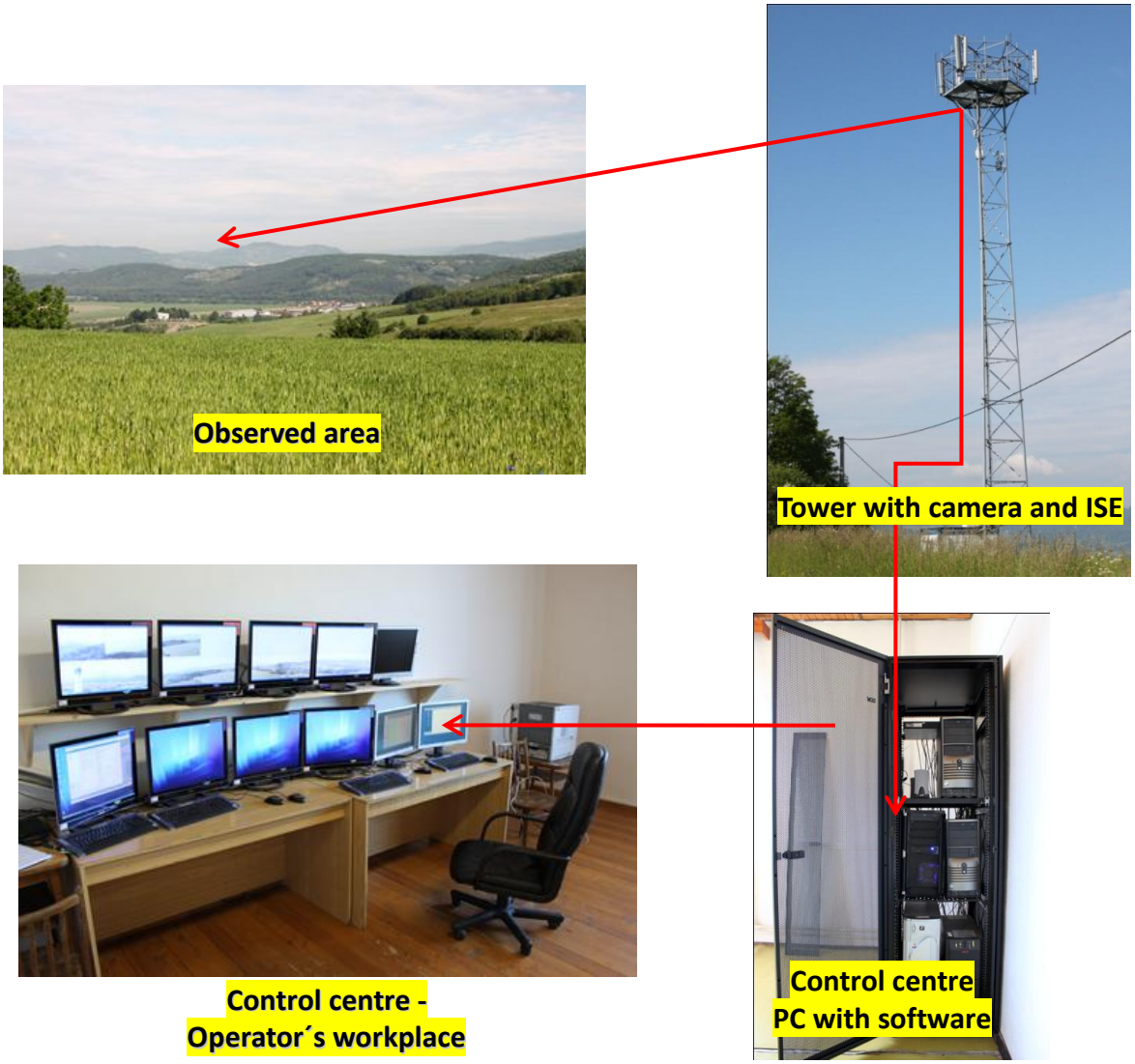
Satellite systems are suitable for monitoring the large forest areas, such as Canada and Siberia. Especially, they are aimed at monitoring the status and development of fire. To monitor the areas in European conditions terrestrial or land systems are preferable.

Different types of detection sensors can be used in terrestrial systems:

- Video-camera, sensitive to visible spectrum of smoke recognizable during the day and a fire recognizable at night,
- Infrared (IR), Thermal Imaging Cameras based on the detection of heat flow of the fire,
- IR spectrometers to identify the spectral characteristics of smoke
- Light Detection and Ranging systems - LIDAR (detection of light and range) that measure laser rays reflected from the smoke particles

Use of the type of camera or sensor depends on the specific conditions of the operation but also on the financial resources available. Comparable infrared and laser systems are more sensitive and produce fewer false alarms than CCD (charge-coupled device) cameras. Their price is inadequately higher. For example, an approximate price of a typical high-quality outdoor moving CCD camera is about 3,000 EURO and price of IR Thermal Imaging Camera is 25,000 EURO. Another attribute of CCD cameras placed on the market today is their double sensitivity. These are colour camera sensitive to visible spectrum during the day and monochrome cameras sensitive to IR spectrum at night. These features extend the possibility of their use.

We can conclude from the above-mentioned facts, that the ground systems based on CCD infrared cameras presents the best and the most effective solution for automatic monitoring and detection of forest fires at a present time. Currently, almost all countries with an increased risk of forest fires has been developing or designing at least one of such a system. All of these automatic fire detection systems are principally based on the recognition of smoke during the day and fire at night.



Basic scheme of automatic detection systems

The major problem of all the systems is high number of false alarms arising due to worse weather conditions (cloudy, rainfall, dust), reflection of light and human activity, etc. That's the reason why they are supervised by a human operator and only he issues the final decision. Then the alarm is generated and suspicious locations are marked on the screen automatically. The operator determines whether to confirm or cancel the alarm. Therefore, the role of the operator is not to check the monitors constantly, as for example a classical observer does, but especially to verify the fire alarms. If the operator is not sure he can switch the system to manual operation, and to carry out further controls by moving camera and zooming. Using such an automated monitoring system in combination with an operator

significantly increases its efficiency. The operator can also control multiple cameras and the system minimizes the exhaustion of the operator.

2.2 Overview of automatic detection and monitoring systems aimed at forest protection against fire

FireHawk

Producer/Owner: **ALASIA Marketing**

Employment: South Africa

FireHawk is a risk management system controlled by an operator. The system provides him with the necessary information, such as the locality of fire and the best access roads. Cameras can cover the radius of 6-8 km from the installation site. Although the range of cameras is more than 6-8 km, the weather condition does not always allow to detect fires outside this observed area. Currently, Firehawk is installed in two areas in South Africa. It is used by big companies (Mondi, Sappi, NCT, SQF and Masonite), private farmers, but also government agencies.

AlarmEYE

Producer /Owner licenses: **InnoSysIndustriesInc**, Thailand

Employment: Thailand

AlarmEye Forest ® is an intelligent video detecting system, specially developed for fire detection in the forest. It processes information from multiple sensors - IR, monochrome, color, multi-frequency. Standard effective distance is determined according to the range of the selected camera. „Self-learning" algorithms has been integrated into this software, which considerably increases the reliability of the detection. It is relatively resistant to false alarms.

EYEfi SPARC

Producer/owner: **EYEfi,** Australia

Employment: Australia

EYEfi SPARC consists of a camera (color-operated during the day and monochrome at night), weather station, light detecting sensor, Thermal Imaging Cameras, communication

device and hardware to run the system. EYEfi can be installed on monitoring towers and also on vehicles of rescue service or trailers. In 2010, EYEfi SPARC did not offer an automatic detection of smoke, but it plan to introduce it. Systems communicate via the API, i.e. transmission through questions and answers.

UraFire

Producer/Owner: Uratek, France

Employment: France

UraFire system is based on the identification of smoke in real-time by clustering motions on a fractal curve with a time input. CCD cameras are used here.

ForestFireFinder

Producer/Owner: NGNs-IngeniousSolutions, Portugal

Employment: Portugal

ForestFireFinder is based on the chemical analysis of the atmosphere by an optical spectrometric system. The system analyzes the way how the sunlight is absorbed in the atmosphere. The absorption depends on the chemical composition of the atmosphere and it has specific characteristics in the presence of smoke. Spectrum (graphic) presents the analyzed chemical composition. This means that the system is able to detect organic smoke (burned trees) and to distinguish it from industrial smoke (factories, tires, *etc.*) up to 15 miles, and decide autonomously whether it is a reason to release fire alarm. In case of alert, FFF provides additional information such as the exact location of the fire, images detection and atmospheric data that are sent to the control centre. Consequently, it passes the records to the nearest fire fighting service.

ForestVu

Producer/Owner: **AngloDesignHoldings PLC, United Kingdom**

Employment: **Portugal, Greece, Australia**

ForestVu is an advanced digital video detection of smoke (Video Smoke Detection VSD). ForestVu protects forests, parks and other outdoor places as it continuously monitors and records the incoming video streams from four cameras. Live and recorded video images

with full colour display can be distributed to several users via TCP / IP network in order to quickly visually verify the events.

Two systems are considered to be relevant for a real employment in conditions in the most of European countries - FireWatch and Forestwatch. Both systems have a long-term development and are still improved, tested and commercially used in many countries around the world.

FireWatch

Producer/Owner: **German Aerospace Institute (DLR), Germany**

Employment: **Germany, Estonia, Cyprus, Mexico.** Pilot operation: Czech Republic, Portugal, Spain, Italy, Greece, USA, Lithuania

FireWatch is able to control constantly large forested areas and in case of any occurrence of smoke to monitor immediately the dynamics of its development. The system works 7 days a week, 365 days a year. Device on monitoring tower consists of a camera and a computer control unit. The camera monitors continuously the area of interest regardless of terrain and weather conditions. Each camera covers a segment of 15 km, with an option up to 360 degrees. The camera is placed on the monitoring tower (telecommunication tower, building, pole) and is movable in all directions. Camera with and extreme resolution is connected to a control unit by fibre optical cable.

The computer controls position of the camera and processes the images from the camera in order to detect smoke and fire. This information is sent immediately to the control centre. The Control Centre provides a user interface for the staff and the final processing of data that are stored. Telecommunication or radio link can be used as a communication medium with the control centre. The system is monochrome or it works in shades of gray colour.

Visual data are then processed and evaluated by the central control station. In case of fire identification, the operator sends alarms to relevant subjects (firemen, foresters, mayor of the municipality...). An early detection of a little smoke provides early identification of fire before the fire reaches the critical point. FireWatch system calculates and shows the exact location of fire (GPS coordinates) during the warning alerts.

FireWatch System Control Centre is equipped with a technology and staff depending on the number of cameras. In principle, one person can easily operate 3-5 cameras. The advantages are relative simplicity and low demands on staff training.

ForestWatch

Producer/Owner: **EnviroVisionSolutions PTY Ltd., South Africa**

Employment: **South Africa, Switzerland, USA, Canada, Chile, Slovakia**. Pilot operation: Greece, Slovakia

Forestwatch ® system is an automated monitoring fire protection system produced by company EnviroVision Solutions PTY Ltd. in South Africa, the distributor for Europe is EagleEye Protection from Greece, represented by ICZ Slovakia Ltd. in the Central Europe region.

Forestwatch ® system consists of several following components:

• Camera

• Industrial computer (ISE – Image Sampling Engine)

• Communications sub-system

• Forestwatch ® software

Two main parts of the system are monitoring towers and control centre. Forestwatch ® software is installed in the control centre on the servers and computers and observation camera, communication sub-system and industrial computer (ISE) are placed on the tower.

The system operates continuously and controls the monitoring area 24 hours a day / 7 days a week (system allows to monitor the area also at night - cameras have sensitivity up to 0.005 lux). Camera includes pan and tilt mechanism. Pan mechanism allows camera rotation in 360 degrees, tilt mechanism allows to tilt the camera at +33 ° to -83 ° from the horizontal position. The camera has integrated optical subsystem with an automatic focus and 24x optical zoom.

Data from cameras on monitoring towers are adjusted by an industrial computer installed also on the monitoring tower, it controls camera and manages communication through the communication sub-system. In addition, it performs dynamic image stabilization, controls camera movement and zooming. Processed data (noise removal, compression) are

transmitted for processing and evaluation through a communication sub-system into the control centre.

Forestwatch ® is sophisticated software for collecting data from monitoring towers, their analysis and evaluation. The software is installed in computers and servers in the control centre, where the operators use it. Software of the control centre receives data sent by communication sub-system, processes and evaluates it. According to the evaluation of received data, the personal of the control centre receive visually and sound warning of the possibility of fire. The operator has the option to take control of any of the cameras and to monitor the indicated incident.

The system distinguishes between three possible warnings:

1. Category is new fire when the system alerts the operator that there is an indicated fire in the area,
2. Category is old fire when the system notifies that there are still signs of fire in the indicated area,
3. Category is unrecognized state when the system is uncertain and requires operator interaction.

The system works with so-called digital terrain model, which shows the identified incidents. When the incident shows, operator has available digital terrain model, map and data from the camera. The incident is recorded on the map and also in digital terrain model, GPS coordinates are available. When using a digital terrain model it is not necessary to use triangulation to locate the incident. System has a standardized format ESRI and allows to use different kinds of map layers according to the needs.

An important part is the methodology. Methodology describes the working method with the system and subsequent solutions to occurred incidents; it is based on the established methods of fire reporting and communication with the fire fighting department. The advantage of the system is service able to deliver GPS coordinates of the fire to fire fighting units, which makes fire localization and fire fighting significantly easier and faster.

Benefits of the system include:

- continuous, automated monitoring of defined area,
- continuous assessment of the state in the area,
- warning the operator on change in the situation in the area and indication of changes in monitored variables,
- displaying information about the cause of warnings,
- defining the indicated problem area by GPS coordinates and its display on a digital map,
- ability to define areas with permanent sources of smoke (factory, houses, isolated houses...),
- possibility to control the system - cameras manually,
- operator can monitor more areas - the system is automated and only warning of the system must be addressed,
- reduced costs on monitoring of risk areas.

In addition to the direct benefits of fire protection the system provides instruments and capabilities for an effective management and monitoring of forest stands in relation to:

- illegal logging,
- illegal access of vehicles,
- illegal hunting or poaching,
- movement and migration of animals and thus promotion of forest protection and forestry as a whole.

The system is relatively demanding on the quality and training of operators. In contrast, high-quality operation with the system achieves outstanding results in terms of an early and exact fire detection.

3) Knowledge's and experience of the EUFOFINET project partners

Greece

The SITHON system use both terrestrial and airborne technologies to achieve an effective detection, monitoring and management of forest fires. System consists of a wireless network of *in situ* optical cameras, and an airborne fire detection system based on a fully digital thermal imaging sensor.

The network of optical sensors consists of monitoring towers, transmitters and wireless transmission units, linked to an integrated GIS environment in order to facilitate the fire fighting management and support the decision making process during forest fires. The GIS database incorporates qualitative and quantitative information layers necessary for the estimation of fire risk. This includes information about the vegetation types, fuel load quantities, the road network for accessing active fires, the area's morphology, high risk locations (settlements, camps, folds, archaeological sites, *etc.*), sensitive infrastructures (fuel stations, flammable materials, industrial areas, *etc*.), availability of natural or artificial water reservoirs and more. The SITHON platform includes a Control and Monitoring Centre or Control Operating Centre (COC), which receives information in the form of optical and thermal images from the wireless sensor detection systems. The optical images are displayed on wide screen monitors and analyzed to derive the dynamic picture of fire evolution.

In the chosen experimental area of the Sithonia Peninsula (N. Greece), the appropriate locations for the installation of the optical cameras were selected taking into account technical needs and the geomorphology of the terrain.

The monitoring devices comprise an optical camera that captures high resolution images with a powerful zoom in real-time. The camera is digitally controlled by a pan tilt step motor unit that allows horizontal and vertical rotation. The pan tilt step motor has the ability to memorize pre-located points and also provides automatic or manual scan of the camera.

The Control Operating Centre is the reception room where the final analysis of the information from the *in-situ* cameras is done.

The operator(s) can manually control the cameras and zoom in-out in order to get information about a fire. The second or third operator elaborates the GIS data base and

provides continuous information (available also in projection) needed to facilitate the firefighting and support the decisions of the Officer or Coordinator in charge.

Spain

To monitor and detect forest fire, thermal cameras are used in Spain in the province of Soria, Castilla y Leon. In 2006 a new system of fire detection with 8 cameras started to develop in the province Soria. During the period 2007 – 2009, the system was adjusted and has been expanded to a total of 19 cameras with a coverage of over 380 000 ha.

This new system allows to monitor the possibility of forest fire for 24 hours a day, within optimal response time. The system consists of the following parts:

- Thermal IR camera
- High-performance CCTV sensor
- Geo-reference system
- Meteorological station
- Communication devices
- Control and computer centre

Specialized software provides early fire detection and its consequent monitoring. The cameras placed on the monitoring towers rotate in 360 degrees with 8 minute time limit of detection and they can detect any source of the heat within 8-10 km. When the system detects fire, the operator is alerted both visually and by sound with an exact localization of fire.

Poland

Poland's wildfire detection system is comprised of:

- a network of fire lookout towers,
- ground patrols,
- air patrols

The selection of the most appropriate location for a fire tower is based on maximizing the viewable area; the size of the viewable area is measured by the observation/visibility radius. Normally, this measurement is between 10 and 15 km.

The Polish national fixed fire tower network consisted of 639 sites, these included:

- 476 metal,
- 132 brick,
- 17 wooden and
- 14 other.

As a rule the lookout towers are elevated a few meters above the tops of tree crowns, and they are if possible placed on tops of local highest spots (hills). The absolute height of lookout towers ranges from more than 20 meters to more than 30 m.

The fire tower and aircraft detection apparatus are supplemented by ground patrols in the Polish system. This part of the fire detection system is most effective in those areas of greatest wildfire risk, in areas where they have considerable tourist traffic, along busy transportation routes and in those areas where no other wildfire detection is available. The use of ground patrols are implemented at the lowest (third category) of wildfire risk.

Of the three separate elements comprising the wildfire detection system, the fixed fire towers were the most effective with 38% of the total wildfires detected. 14% were detected by ground patrols and the least, 2% were detected by aircraft. The greatest number of wildfires was reported by the general public; who in large measure thanks to a well-developed communications system (primarily cellular phones) reported almost 45% of all wildfires.

Slovakia

Monitoring of forest fires in Slovakia is regulated by the Act No. 326/2005 of the Coll. on forests and by other related legislation. It is carried out by a combination of three methods as in Poland:

- Ground patrols
- Air patrols
- Automatic detection system

Forest owner or forest manager is obliged to provide **ground patrols**. It is carried out mainly in the afternoon, non-working days and public holidays. Monitoring is intensified especially in the spring months, when we record most fires caused mainly by burning grass. Although this activity is prohibited in Slovakia, it poses still a big problem especially in rural areas.

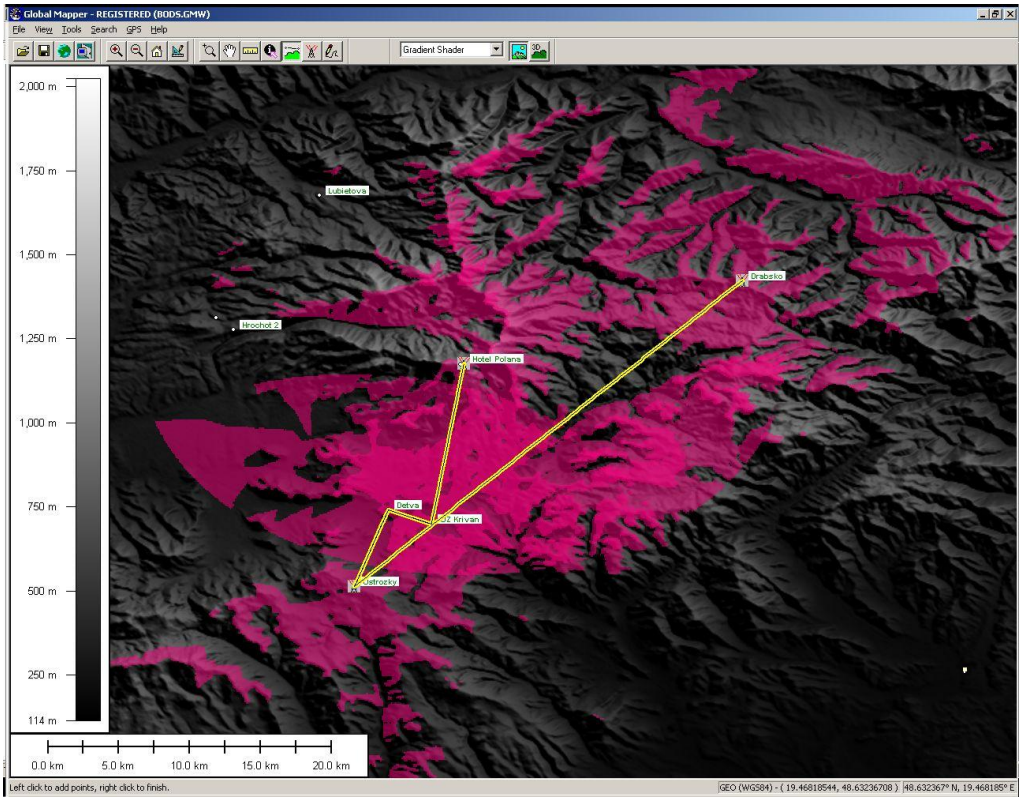
NFC Zvolen provides **air patrols**. Operator of air patrols is selected every year according to the results of a public procurement. The annual budget for this activity is approximately 100 000 to 130 000 € and it takes on average 400 to 550 flying hours.

Automatic detection system: Pilot project of stationary fire monitoring was carried on a Regional Directorate Kriváň with a coverage of 60 000 ha of forest, mostly in the use of Forests SR, s.e. In 2008 several works was carried out related to the preparation, implementation, pilot operation and evaluation of the system efficiency. The system is operational and suitable for a wide range of use in Slovak forests. Forestwatch system was used to implement the pilot. Chapter 2 presents technical details of the system.

The project has been supported by the Ministry of Agriculture - Forestry Section under the trilateral agreement between NFC Zvolen (sponsor and coordinator), Slovak State Forests (user) and ICZ Slovakia, Ltd. (technology supplier). Moreover, foreign companies EnvirivisionSolution (JAR) and EagleEye Protection (Greece) cooperated within the pilot project.

The pilot project was carried out in the area of Regional Directorate Kriváň. It is located in the area of an increased risk of fires, most of the forests are state-owned and a significant part of the area is represented by the National Nature Reserve Poľana. In terms of morphology the terrain is relatively broken. In particular, this attribute was important to verify in our conditions, as this system is operated mostly in lowland areas in the world.

The system monitors more than 65 000 hectares of forest with three cameras. Cameras are located on poles of mobile operators. It was necessary to build one monitoring tower on Ostrôžky, so-called "data transmitter" due to the configuration of the terrain. The control center is established in the area of Regional Directorate Kriváň. The system is connected to the central control station (Slovak Fire and Rescue Service). Cooperation with fire fighting unit will prompt the response to the fire. Link is re-secured - telephone, mail and the web.



Location of the cameras, data transfer and a direct visibility of cameras

The operation began on 1 July 2008. Evaluation parameters determining the success or the suitability were objectives and quantifiers that were set as a priority during the preparation and launch of the project and that provide a complex and realistic picture of the possibilities, as well as risks of the technology.

The following was taken into account:

- system performance in terms of fire protection needs,
- suitability of the system in terms of territory or site of employment,
- methodology of work and service activities,
- usability of the system, not only in terms of fire protection, but also for other purposes (such as illegal logging, migration of animals, *etc*.).

We have used a model of mixed personnel when providing the operation of the control centre. During the working day, it was carried out by internal staff of Regional Directorate and on weekends and public holidays by trained staff of forest offices. Based on the acquired knowledge we passed to operational model with external specially trained personnel. This change significantly improved the effectiveness and efficiency of the system.

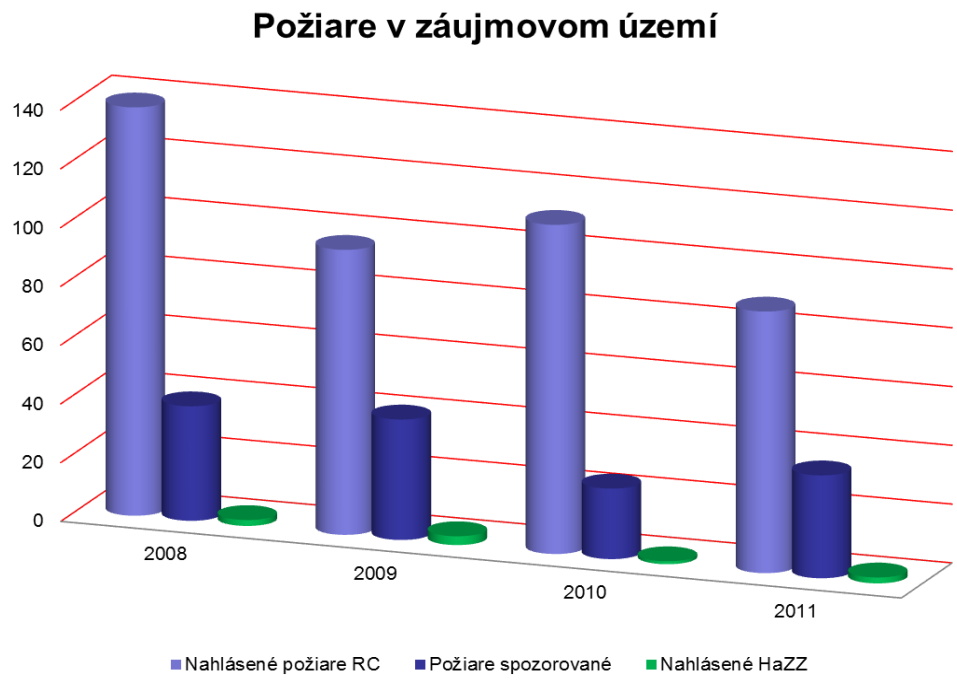
Evaluation of project implementation and pilot operation:

Development and implementation of the pilot project of stationary monitoring system has no significant problems and the system was put into operation according to schedule. The greatest demands were on the coordination of activities as foreign partners from Greece and South Africa were also involved in the project. The core but hardly affected factor of successful operation was a problem caused by severe storms and consequent power failure transfer.

Fire monitoring was evaluated in terms of the methodology in two main groups:

• fires reported to the control center (CC)

• unreported fires - detected fires (burning of grasslands, fields, meadows...)



Graph of fire incidents in a monitoring period

Požiare v záujmovom území – Fires within the area of interest

Nahlásené požiare RC – Fires reported to CC

Požiare spozorované – Detected fires

Nahlásené HaZZ – Fires reported to Slovak Fire and Rescue Service

Also those fires were reported known to CC operators and under monitoring. These types of fires were quite often reported by the employees of forest offices and they mainly correspond to control burning of harvest residues in the forest stand. Unreported fires were those registered in CC and consequently, the service has carried out all appropriate measures to eliminate them or they were monitored. Chapter 2 presents benefits of the system.

After five years we can conclude that the system is functional and suitable for a wide range employment not only on lowland areas but also in mountain forests.

4) Proposals of technical and organizational solutions

DMS seems to be a progressive method of early fire detection. At the present time they are used commercially and their efficiency, reliability and accuracy will increase with an advanced technology. We present the following framework proposals and recommendations in the field of forest fire detection based on the analysis of existing solutions and knowledge of the EUFOFINET project partners:

Combination of several methods of monitoring

Each method of forest fire monitoring has its own characteristics and limitations. According to the practical experience (e.g. Poland, Slovakia, Greece...), combination of several methods of monitoring is the most suitable (ground patrols, air patrols, DMS ...), these methods should be complementary and not to overlap (if so, only partially). A suitable combination of these methods will provide a significant increase of the efficiency and will eliminate the risk of false alarms. DMS will find application especially in hardly accessible, remote and mountainous areas. However, they have been approved on large lowland areas where they can cover a relatively large area with a small number of sensors, which will positively impact the efficiency of operation.

Education of and cooperation with the population

Besides education (prevention), it is very important to cooperate with population in reporting fires. For example, Polish experience shows that the majority of fires is reported by tourists or local people. It's very fast, efficient and cost-saving way. Communication and promotion should increase their awareness of the willingness to cooperate in the reporting of

fires. It is also necessary to provide technical conditions (free mobile number, call without a SIM card, the system of identification points/signs for a proper location of fire, *etc.*).

Increasing the efficiency and versatility of DMS

The rate of DMS efficiency and utilization depends on the quality and accuracy of detection. It is increased by a combination of different types of sensors (optical, thermal, IR...). Each sensor detects itself the status of the site and the control computer provides operator with a comprehensive analysis based on evaluation of all the input data. It expands the possibilities of use for other purposes than the primary fire detection (e.g. illegal timber felling, wildlife migration, *etc.*). DMS becomes a universal tool for monitoring and control of the selected area. Such versatility is very suitable, for example in national parks or tourist areas.

Quality map layers

One of the DMS advantages is a relatively precise location of fires. According to the type of system, triangulation of multiple sensors, digital terrain model or their combination is used. DMS operators receive output in a form of GPS coordinates of the incident site and may therefore report the exact locality to the units. DMS usually uses different map layers. It is very useful to create a specialized map layers for actions in the forested areas. Besides normal road, these map layers include information on forest and field roads, the parameters (width, slope, turn radius...), water resources and other important information facilitating the action of fire fighters.

Fire indices

Fire indices are directly related to the monitoring of forest fires. It concerns a numerical determination of the fire risk level in the area. There are different ways of setting the fire indices. In principle, it is always a combination of weather parameters (humidity, temperature, wind speed and direction...), fuel models (the amount of "fuel", tree species, *etc*.) and other parameters. Reliable fire indices determine an effective preventive management of the site (transfer of techniques, more intensive monitoring, prohibited entrance to the forest, no handling with open fire, *etc.*)

5) Legislative and economic recommendations

Legislative support of DMS - to adopt national legislation on the employment and use of such technologies in countries with a lack of legislation.

Funding - create conditions for funding of DMS establishment and operation at a national level of different states, or at a European level. It should be recognized, that establishing of DMS is relatively expensive. On the other hand, damages after forest fires and damage to habitats are usually very extensive. However, people and their property are threatened at the first place.

Possible sources and methods of funding:

• facilitate funding of DMS establishment and operation from sources of EU projects in the programming period.

• create conditions for collecting of funds for DMS establishment and operation for individual forest owners and users (e.g. based on the monitored size of area).

• combining own and project sources (e.g. establishing DMS from EU projects, DMS operation from own sources while maintaining the provision of sustainability)

• give privilege to forest owners and users, who has introduced DMS, for example by reducing of local taxes, insurance and so on.

6) Summary

Forest fires damage or completely destroy large areas of forest stand every year and they are one of the most drastic ways of its devastation. Forest fires damage all components of biocenosis, so it is very difficult to gain the original state.

High temperatures, long term drought, low humidity, strong wind and the human factor are ideal conditions for the emergence and spread of forest fires. It should be noted, however, that climate conditions are directly affected by human activities - production of waste and emissions. Current climate conditions, particularly, global warming contributes to an increased number of forest fires.

In general we can conclude that forest fires are mainly caused by natural environment and man himself. Human factor causes 80 to 98% of forest fires in European countries. The most common cause are negligence, lack of observance of fire precautions or underestimation

of fire danger when handling with open fire - burning of grass, brushwood, stetting fire, smoking, children playing with matches.

Forest fires do often occur in areas not accessible to the fire fighting equipment, with lack or inadequate water sources, requiring enormous human capacity and special fire fighting technology and sometimes also aviation technology.

Direct damage is associated with limited value of trees, processed and unprocessed timber, loss of the current increment or decreased quality of wood raw material. Indirect damages arise with the onset of other secondary harmful agents, as well as with an increased cost on eliminating the consequences of fire. In addition, forest fires pose a real threat to human life and cause ecological and economic damage to settlements and adjacent urban areas.

The aim of this section of project EUFOFINET was to analyze used, technically and commercially available fire detection and monitoring systems in the world with a focus on Europe. It shows an overview of solutions and experience with monitoring and detection in partner countries of the project.

Australian study: Testing detection systems - Evaluation of three fire monitoring systems
http://www.em.gov.au/Fundinginitiatives/NationalEmergencyManagementProjects/National_Emergency_Management_Projects_09-10/Pages/RemoteFireDetectionSystemTrials.aspx
stated that even though camera systems are capable of detecting fires during the day and at night, trained observers are able to detect and locate fires faster and more reliable than the camera systems.

We can conclude:

- It is not possible to rely on cameras as a sole and primary detection method to identify fires. Their important role rests in the use in connection with human observers, especially at night or in remote areas.
- Data from the monitoring systems are important for better information during the fire, navigation of rescue vehicles, for modelling the spread of fire, early warning of the population and so on.

Automatic and semi-automatic monitoring and detection systems are irreplaceable in the prevention and fighting of forest fires. They are the only solution for early detection of forest fires in many areas, especially remote and mountainous locations. They are versatile. It can be expected that the development of new technologies will significantly increase their sensitivity, accuracy and reduce cost. These are the main prerequisites of its increased employment.