in Action

Smart communications solution in emergency situations

Natural and man-made disasters are part of life that can happen at any time, with little or no warning, and in unfortunate cases with devastating consequences. The ability of public safety agencies to cope with such unexpected situations with efficiency and effectiveness depends heavily on their preparedness for emergency management with appropriate communications infrastructures in place.

As stated by the United Nations Foundation,

> »when disaster strikes, the immediate needs are obvious: food, water, shelter, and medical supplies. But none of these necessities will reach survivors without the largely invisible communication networks that must be set up quickly to enable relief workers to save lives.«
> (United Nations Foundation, »Disaster Relief Deployments«)

In day-to-day operations, Emergency Communications Systems (ECS) set up by public safety agencies for professional use operate normally. However, in emergency situations, such as massive floods, nuclear accidents or earthquakes, communications services are scarce and often unreliable resources. On such occasions, providing communications for first responders is a multi-dimensional challenge.

6inACTION system

A visionary solution with unique value proposition for...

6inSAFETY
for PUBLIC SAFETY AGENCIES

6inACTION equips first responders with technologically advanced survivable high-performance communications and intervention management services in day-to-day operations and in disaster relief missions.

6inBUSINESS
for TELCOs and SERVICE PROVIDERS

6inACTION helps telcos and service providers enter new vertical markets and develop new business models targeting critical communications and premium broadband services.

6inSCIENCE
for APPLIED RESEARCH AND INNOVATION

6inACTION sets up unique test and experimentation environments to support scientific and applied research in various communications and public safety fields, such as SDN, IPv6, ECS, IoT, BB-PPDR, security, etc.

6 in Action

6onDASHBOARD
INTERVENTION MANAGEMENT SOFTWARE

6onFIRE
ON-SITE SITUATION SURVEILLANCE SYSTEM

Smart communications solution in emergency situations

6onMOBILE

MOBILE TRIAGE AND TRACKING APPLICATION

6onCORE

SMART NETWORK ENABLER

6inSAFETY

Survivable high-performance communications and intervention management software for first responders

1 **Set up on-site intervention command center using 6onCORE**

- Compact mobile or portable network node
- Installed in first responder vehicles
- Provides tactical communication services for intervention management by selecting best available networks for the required services
- Connects to 6onFIRE sensor deployments on site

**2** **Deploy 6onFIRE sensor system on site of the intervention**

- Ad-hoc or permanent deployment
- Various commercial sensors – first responder vital signs,
- Temperature, humidity, avalanche level, flood level, butane sensor,...
- 6onFIRE gateway connects sensors to the command vehicle and headquarters
- Can be kept on site after the intervention is over for long-term site surveillance

3 **Use One-touch 6onMOBILE triage and tracking application to report conditions and events from the intervention site**

- Mobile application for Android and iOS
- Simple one-touch alerting from the intervention site
- Real-time triage reporting
- Real-time unit tracking (time-based and location-based)
- Alerts and reports transmitted to 6onDASHBOARD
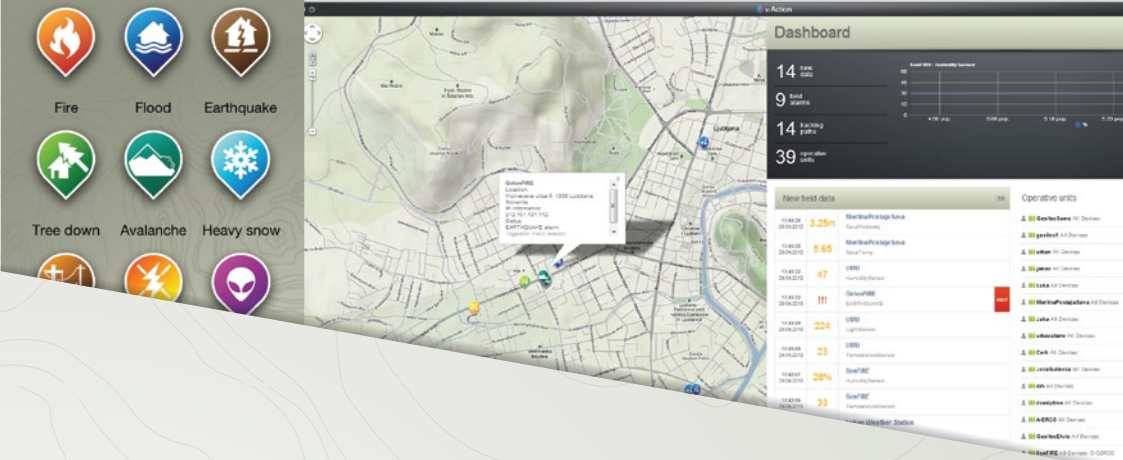
4 Manage the intervention with 6onDASHBOARD tactical intervention management software

- Central web-based intervention management portal
- Tailor-made for intervention site monitoring and surveillance
- Customizable views and access control for strategic, command, tactical and operational levels
- Real-time tracking and monitoring of units, users, devices and sensors in a web-based GUI
- Centralized service dashboard for voice and video communications, surveillance and tracking, and sensor data
- Time-based and location-based first responder tracking
- Big data analytics and tracks
- Intervention reports

Value proposition for public safety agencies

- A compact mobile **6onCORE** solution for survivable communications on site of the intervention
- Customized intervention management software **6onDASHBOARD**
- **6onFIRE** sensor-based situation surveillance
- **6onMOBILE** professional triage and tracking application

First real-world emergency response 6inACTION trial with Fire Fighter Services in Ljubljana, Slovenia

Survivable communications with 6inACTION

- 6inACTION enables first responders on the field to connect to the headquarters through existing professional, commercial and ad-hock backhaul systems
- It introduces new communication services – satellite, 3G/4G, WiFi in addition to DMR and telco UMTS/HSPA

Multimedia-rich communications and IoT services

- First responders are equipped with IoT-based sensor services for intervention management and long-term situation surveillance
- 6onDASHBOARD intervention management software provides common operational picture
- Support is available for multimedia-rich services over virtualized backhaul tunnel, including video feeds and sensor and M2M services
- Tailor-made 6onMOBILE triage application is used for on-site alerting, triage reporting and first responder tracking

Department for Protection, Rescue and Civil Defence of the Municipality of Ljubljana supports first real-world 6inACTION trial

- Real-world first responder requirements
- Positioning of 6inACTION into official intervention management procedures
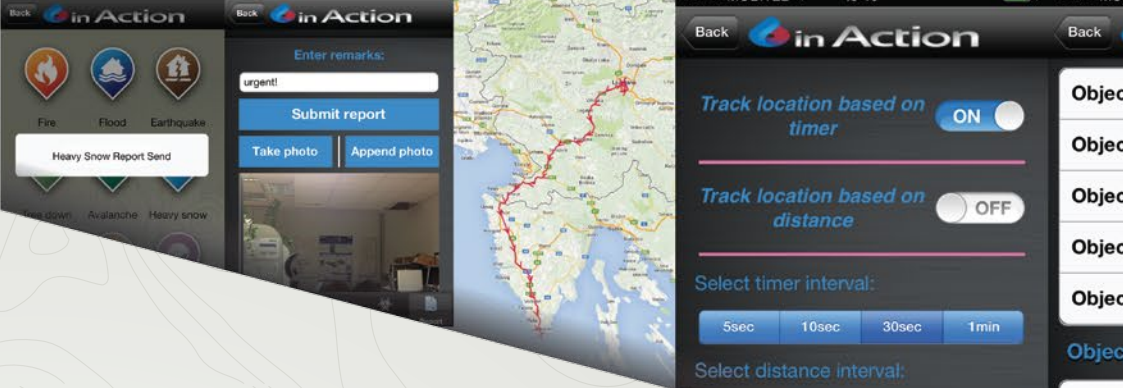
Implementation challenges

- Full and intact operability of existent professional network
- Choice of ruggedized COTS equipment

Business challenges

- Private-public partnership for 6inACTION deployment
- Commercial backhaul network providers with commitment for BB-PPDR infrastructure support

6inAction validated and demonstrated at the official international rescue dog exercise (Ljubljana, May 2014)

6inACTION command center set-up

- Collocated with central command post, including mobile built-in 6inACTION infrastructure in the tactical command vehicle
- Set-up of 6inACTION command office
- Portable ruggedized 6onCORE, work terminals, plasma screens, standard IT utility equipment (printer, fax, scanner), satellite dish
- Backhaul support system provided by Telekom Slovenije (LTE/HSPA/EDGE)
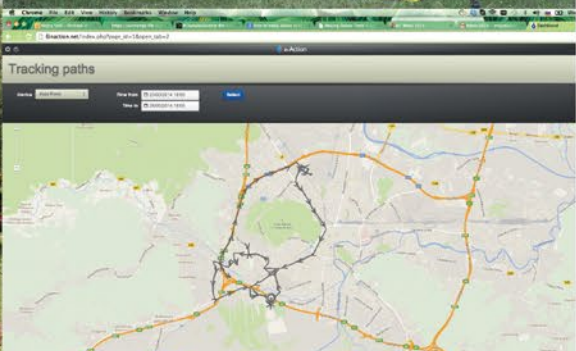
Real-world validation of 6inACTION was enabled by the Municipality of Ljubljana, Department for Rescue, Defence and Civil protection

The major stakeholder testing and validation event took place at the International Rescue Dog Exercise, organized by the OZRCO in Ljubljana in May 2014. This is a well-recognized yearly international event dedicated to field exercise and competition of dog rescue teams from EU member states. At the event, a central SECC location is established, as well as numerous distributed worksites in the region that offer either ruined buildings as training areas or natural environment, both simulating a catastrophic event during which persons are missing and must be found. The competing teams are assigned different rescue tasks and evaluated for their performance. The exercise is run from the tactical HQ base, set up on the field together with the 6inACTION command base.

6inACTION rescue worksites

- Smartphone and tablets with 6onMOBILE application for tracking of rescue teams on worksites
- Extended features on 6onMONBILE for referees to support rescue team competition evaluation from 6onMOBILE, with automated reports integration on 6onDASHBOARD
- Fixed worksite equipment including 6onCORE portable nodes and video streaming cameras for worksite monitoring
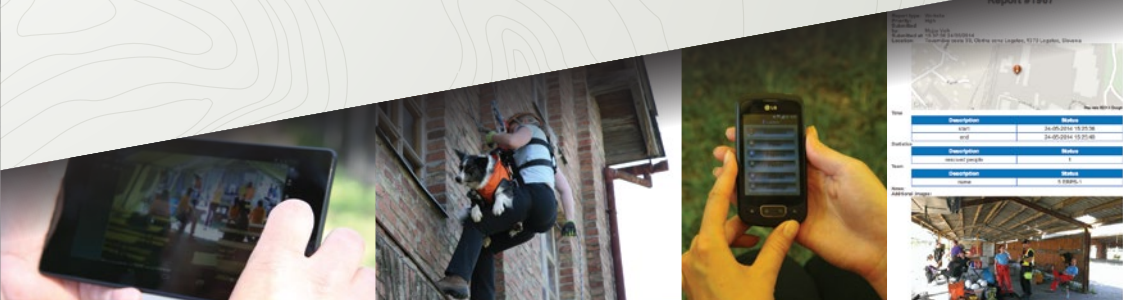
Validated services

- Monitoring of on-site infrastructure in the SECCU command center and across distributed worksites in the Ljubljana region
- Tracking of worksite teams
- Triage reporting from the field
- Streamed video monitoring of remote worksites using 6onDASHBOARD, outdoor video cameras and smartphones

Validation outcomes

- 6inACTION command center instantly deployable and operational on the field
- Successful operation of virtual private 6inACTION network supported nation-wide by Telekom Slovenije, with GTP tunneling with dual stack IPv6/IPv4 support and IPSec protocol with dual-stack IPv6/IPv4 support
- Live real-time reporting from the field with 6onMOBILE and 6onDASHBOARD, providing decision support information about actual conditions at the intervention sites as well as reporting of specific relevant events
- Validated location tracking of frontline teams for intervention support, field coordination and first responder safety
- Confirmed time efficiency and usability of digitized and real-time reporting on the field with 6onMOBILE and 6onDASHBOARD
- Real-world validation of video surveillance, recognized as one of the vital BB PPDR services for real-time monitoring and site observations, reducing field interventions and supporting time-efficient and cost-efficient operations
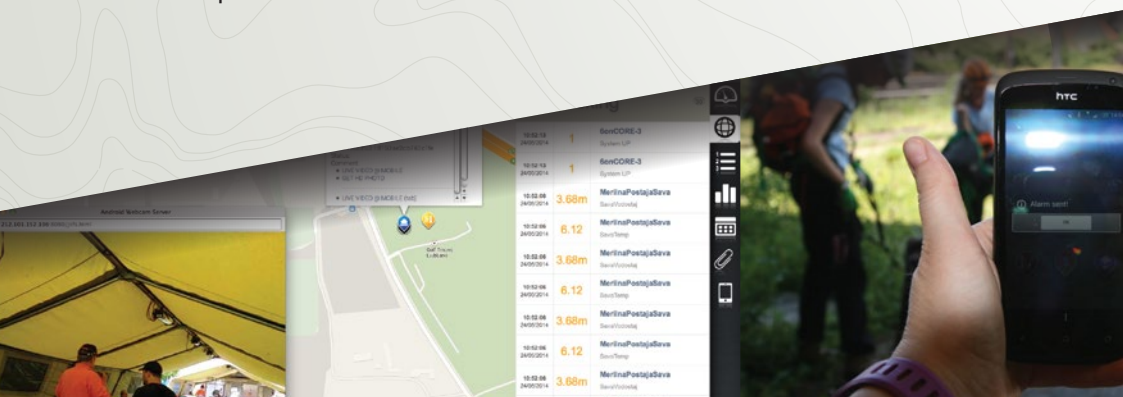
First use of 6inACTION in PPDR mission

In the event of the catastrophic flooding in the Balkan area in May 2014, the first responder team of the Municipality of Ljubljana was despatched on a one-week public protection and disaster recovery mission to the Republic of Bosnia and Herzegovina. The built-in 6onCORE node was used to connect the team with headquarters in Ljubljana, Slovenia, and facilitated data connectivity and infrastructure monitoring through the integrated backhaul support system connectivity in roaming mode provided by Telekom Slovenije.

The implemented system was operating and facilitated the required services. The major limitation identified was high costs of data connectivity services in roaming mode, clearly indicating the need to harmonize pricing schemes for mobile data services across Europe and non-EU roaming.

6inBUSINESS

New vertical markets and new business models targeting critical communications and premium broadband services

1 Offer 6inACTION solution with Commercial 3G/4G

- 6inACTION solution integrates mobile broadband networks with MPLS VPN and satellite services
- Enabled premium end-to-end QoS and SLA enforcement and provisioning
- Combined added value with preemption service on core and access 3G/4G networks
- Additional carrier-grade services, such as distributed data centers for disaster recovery services (XaaS) and as geo redundancy service
- IT/OSS/BSS integration providing flexibility and dynamic provisioning of public safety teams
- 24/7 user and system support

2 Offer 6inACTION with Private 4G

- 6inACTION deployments with private 4G using compact LTE/EPC in combination with commercial mobile and fixed infrastructure
- BB-PPDR infrastructure provisioning for first responders with regulatory requirements
- Critical communications and situation surveillance provisioning for critical infrastructure owners, such as law enforcement, banking and finance, health providers etc.
- Value-added services, such as advanced BB-PPDR mobile system planning and 24/7 support

Value proposition for telcos and service providers

- Telco as public safety and critical infrastructure provider
- **Target markets: public safety agencies, critical infrastructure owners, airports, banking and finance, law enforcement etc.**
- **Owned, Leased or Hybrid models**
- Entering new vertical markets driven by critical infrastructure industries
- From "best effort" commercial mobile broadband to premium value tactical infrastructure with end-to-end QoS/SLA
- Leverage commercial mobile broadband value and increase ROI and ARPU
- **6inACTION** solution with state of the art IPv6 technologies presents safe and future proof investment

Private 4G

Commercial 3G/4G

Commercial fixed (FTTx)

TETRA, DMR, satellite

6onMOBILE
MOBILE TRIAGE AND TRACKING APPLICATION

6onCORE
SMART NETWORK ENABLER

...TE SITUATION ...RVEILLANCE SYSTEM

Premium carrier-grade 6inACTION package

- 6onCORE for survivable tactical communications
- 6onFIRE and 6onMOBILE for situation surveillance and awareness
- Customizable 6onDASHBOARD for intervention management
- Commercial and private LTE/EPC for survivable 4G network
- Premium broadband for advanced backhaul, including end-to-end QoS/SLA and preemption support

First real-world carrier-grade PPDR infrastructure provisioning trial with Telekom Slovenije
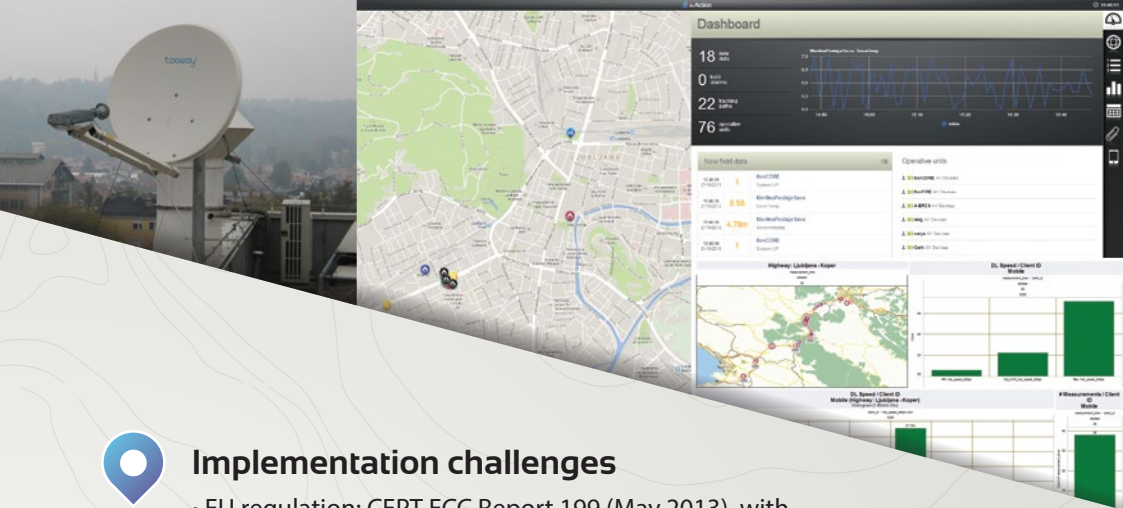
Key enablers for critical infrastructure provisioning @ Telekom Slovenije

- 4G + Private 4G + MPLS VPN + Data Center (XaaS)
- National fixed and mobile coverage
- Mobile system planning and provisioning expertise
- End-to-end SLA/QoS and service preemption support
- Geo redundancy and disaster recovery services
- Operation outsourcing for B2B
- 24/7 user and system support
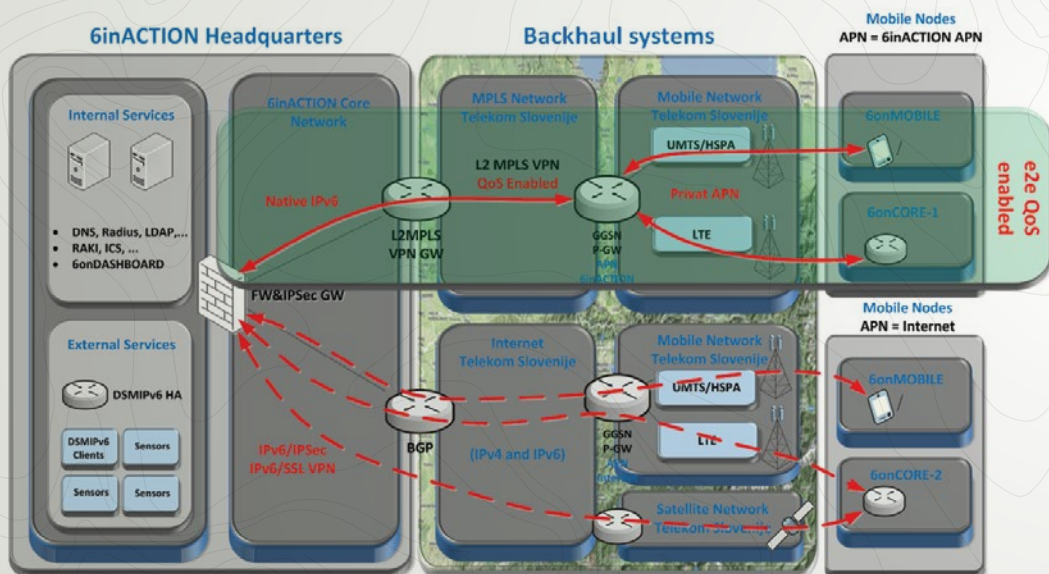
Implementation challenges

- EU regulation: CEPT ECC Report 199 (May 2013), with defined operational environments
- Lite MVNO with SLA assurance
- Private LTE/EPC deployments for vertical markets
- IT/OSS/BSS integration

Business challenges

- Owned, leased and hybrid business models
- Private-public partnership
- Official status of BB-PPDR infrastructure provider

Telekom Slovenije supports first real-world 6inACTION trial

- Provider of premium fixed, mobile and satellite backhaul networks
- Private IPv6 6inACTION APN with L2 MPLS VPN
- Integrated critical communications infrastructure

6inSCIENCE

Scientific and applied research and innovation in communications, IoT and public safety

IPv6 innovation in 6inACTION

Smart IPv6 addressing

- Hierarchical BB-PPDR IPv6 addressing proposal for smart IoT management of users, devices, sensors and services
- Unique identification of nodes and sensors
- Advanced unit and first responder tracking based on IPv6
- Customizable to match procedural structure
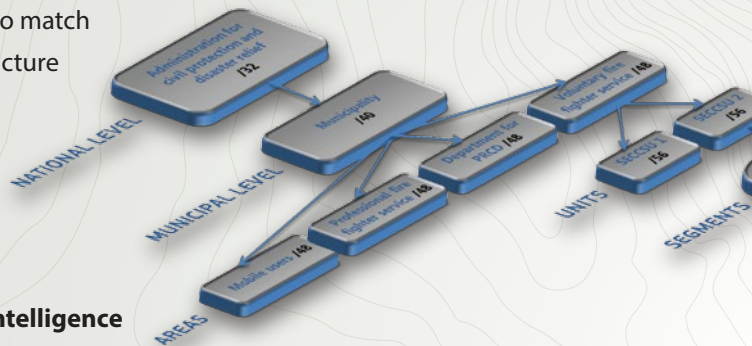
IPv6 network intelligence

- NEMO with MCoA and IPSec for secure and transparent mobility of 6onCORE nodes
- SLAAC and DHCPv6 for host and network nodes auto configuration
- DSMIPv6 for transparent connectivity of 6onFIRE nodes over heterogeneous backhaul networks using transparent tunneling over IPv6&IPv4 networks and NAT and firewall devices

IPv6 service intelligence

- Direct connectivity to each sensor using IPv4 or IPv6 (DSMIPv6) with NAT/FW traversal
- Device, sensor, unit and individual tracking using hierarchical IPv6 addressing
- Automated and dynamic provisioning and access rights management using hierarchical addressing mechanism

IoT innovation in 6inACTION

IoT services using sensing
- Use of various COTS sensors with ruggedized enclosures for on-site intervention monitoring and long-term situation surveillance through 6onDASHBOARD
- 6onMOBILE triage application using IoT principles for device, vehicle and first responder tracking based on time and location triggers

Real-time intervention monitoring with IoT
- Real-time tactical sensor dashboard
- Sensor events reporting with GPS location resolution and IPv4/IPv6 tracking and access
- Powerful data analytics and video feeds from intervention sites
- Sensor data analytics, including device and first responder tracks, charts and graphs, event logs and triage reports

SDN innovation in 6inACTION

Communication survivability
- Use of SDN and OpenFlow technologies for virtual channel establishment allowing for transparent communication via one or several available networks represented as a single virtual channel
- Context-driven routing with dynamic QoS support, and dynamic cross-network admission control and service pre-emption
- Very high availability with near-real-time reroute capabilities allowing for (almost) instant fall-back scenarios in case of extreme conditions causing failure of individual networks Information-driven servicing
- Information-driven user, service and network prioritization based on network and service contexts

According to TECC operational requirements, four implementations options are available:

- Ruggedized portable implementation
- Non-ruggedized portable implementation
- Mobile built-in implementation in the SECCSU vehicle
- Fixed built-in implementation

	Ruggedized portable	Non-ruggedized portable	Mobile built-in	Fixed built-in
6onCORE	✓	✓	✓	✓
6onFIRE	✓		✓	
GPS unit	✓	✓	✓	
Custom sensors deployment	✓			
Outdoor video streaming cam	Optional	Optional		
Sys admin laptop	✓	✓	In vehicle	
Printer/scanner		Optional	In vehicle	

Ruggedized portable setup

Ruggedized portable implementation is intended for TECC and field usage. It comes in a ruggedized casing (waterproof, shock-proof, impact resistant PELI suitcase), readily deployable on site as plug-and-play. It comprises 6onCORE, 6onFIRE, GPS positioning unit, custom sensor setups, optional outdoor video streaming camera, laptop for system admin and management. Power supply is needed (230V) on the location.

Non-ruggedized portable setup

Non-ruggedized portable implementation is intended for fixed TECC and temporary SECC usage. It comes in non-ruggedized portable casing (plastic casing or impact-resistant portable suitcase), readily deployable on site as plug-and-play. It comprises 6onCORE, integrated GPS positioning unit, optional outdoor video streaming camera, laptop for system admin and management, optional printer/scanner in hardened portable enclosure. Power supply is needed (230V) on the location.

Mobile built-in setup in the SECCSU vehicle

Mobile built-in implementation is intended for SECSSU usage. It is fixedly installed inside the vehicle as an integral part of customized communications infrastructure. It comprises 6onCORE, 6onFIRE, GPS unit, and is integrated with the ICT infrastructure of the vehicle (laptops, utilities, servers). Power supply is provided from vehicle infrastructure (230V, through pluggable power supply for the vehicle or as an autonomous aggregate-based power supply installed in the vehicle itself).

Fixed built-in setup

This implementation is an integrated setup comprising 6onCORE and an integrated datacentre server. It is intended for fixed implementation at a SECC datacentre level, but can be also provided as a mobile built-in component in the SECSSU vehicle or as a portable implementation.
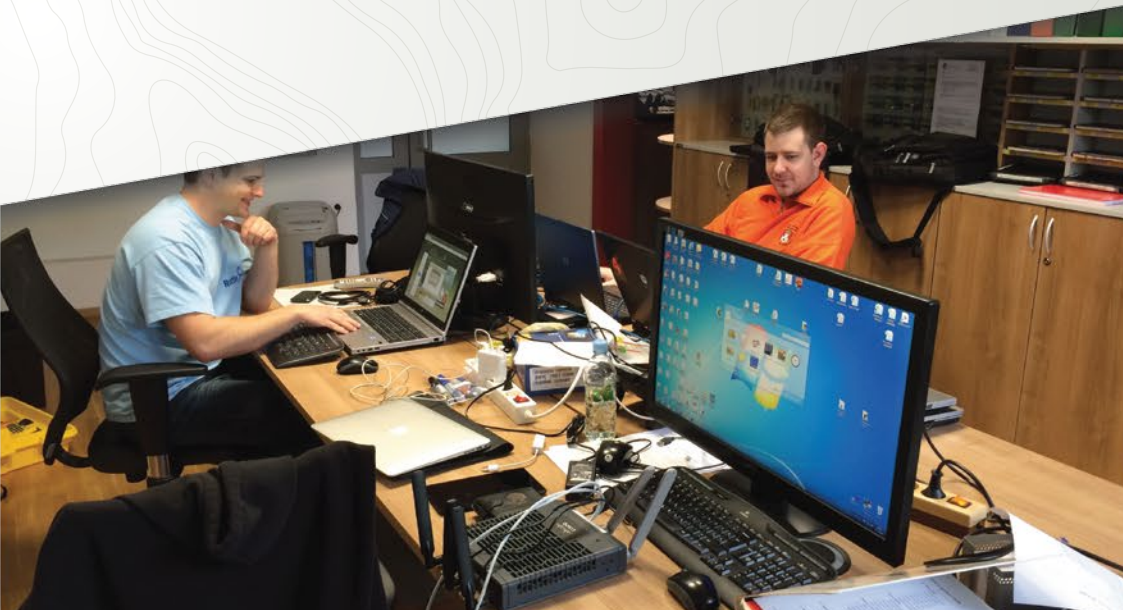
6inACTION for future...

As stated by the European Commission,

>>*Critical infrastructure is an asset or system which is essential for the maintenance of vital societal functions. The damage to a critical infrastructure, its destruction or disruption by natural disasters, terrorism, criminal activity or malicious behaviour, may have a significant negative impact for the security of the EU and the well-being of its citizens*.<< (European Commission, >>Home affairs<<, 2013)

Several sectors including, banking and finance, hospitals, law enforcement agencies, federal and municipal services are in need of critical infrastructure and services protection. 6inACTION can equip owners of critical infrastructures with survivable communications and intervention management services.

>>*It is generally believed that the use of LTE and IP standards will greatly enhance communications for emergency response and recovery.*<< (Linda K. Moore, >>The First Responder Network and Next-Generation Communications for Public Safety: Issues for Congress<<, 2013)

The recognition of LTE and IP standards as the next technologies for Public Protection and Disaster Relief opens up opportunities for telcos and services providers to enter new vertical markets with 6inACTION.

>>*Public safety users are an important community both economically and socially but the market for systems based on public safety standards is much smaller than for commercial cellular. Specialised public safety and critical communications technology cannot attract the level of investment and global R&D that goes in to commercial cellular networks. Establishing common technical standards for commercial cellular and public safety offers advantages to both communities.*<< (3GPP News, >>Public Safety<<, 2013)

6inACTION is not yet another professional system. Instead, it provides an overlay solution efficiently reusing already available commercial, professional and ad-hoc systems while relying on well-know COTS equipment.

Inside in Action

1 6onCORE
IPv6 SMART NETWORK ENABLER

- Compact mobile or portable network node
- Provides survivable communication services by selecting best available networks for the required services
- Connects to 6onFIRE and 6onDASHBOARD for real-time intervention management support
- Cisco ISR819 M2M router

Satellite

LTE

Tetra

6onCORE

6onFIRE

3 6onDASHBOARD
INTERVENTION MANAGEMENT SOFTWARE

- Central web-based intervention management and monitoring portal
- Tailor-made for intervention site monitoring
- Customizable views and access control for strategic, command, tactical and operational levels

2 6onFIRE

ON-SITE SITUATION SURVEILLANCE SYSTEM

- IoT-driven on-site sensor gateway
- Connects to 6onFIRE for real-time intervention management
  support
- Connects to 6onDASHBOARD for long-term situation surveillance
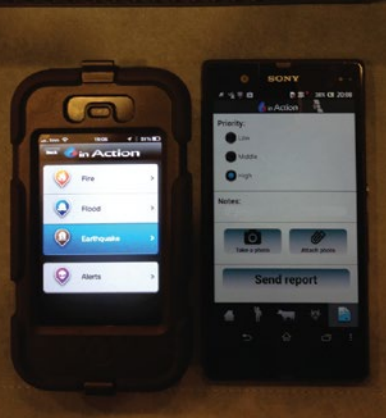- Advantech ARK-3360F ruggedized PC
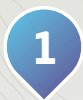

4 6onMOBILE

MOBILE TRIAGE AND TRACKING APPLICATION

- Professional triage application for Android and iOS
- Simple one-touch reporting from the intervention site
- Reporting procedures customizable to match standardized
 protocols

1 6onCORE
IPv6 SMART NETWORK ENABLER

- Compact mobile or portable network node
- Provides survivable communication services by selecting best available networks for the required services
- Connects to 6onFIRE and 6onDASHBOARD for real-time intervention management support
- Cisco ISR819 M2M router

6onCORE features

- Voice services, data and video transmission, sensor and M2M services
- Seamless connectivity via best available professional (TETRA, satellite), commercial (UMTS/HSPA, LTE, FTTx) or ad-hoc networks (WiFi, compact LTE/EPC)
- Compact mobile or portable deployments with professional COTS equipment

IPv6 network intelligence

- NEMO with McoA and IPSec for secure and transparent mobility
- SLAAC and DHCPv6 for autoconfiguration
- Multicast with MDL, PIM-SM and scope options support for multimedia streaming
- IPv6 hierarchical addressing for fast system-level provisioning
- BGP and OSPFv3 for network-level self-healing capabilities
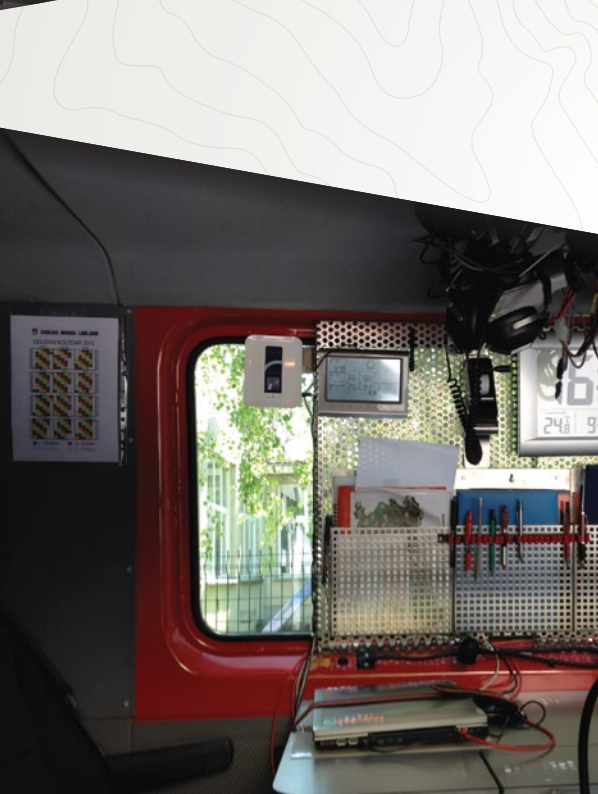
2 6onFIRE
ON-SITE SITUATION SURVEILLANCE SYSTEM

- IoT-driven on-site sensor gateway
- Connects to 6onFIRE for real-time intervention management support
- Connects to 6onDASHBOARD for long-term situation surveillance
- Advantech ARK-3360F ruggedized PC

6onFIRE features

CCGeneral and dedicated COTS support – GPS module, mini weather station, video camera, environmental hazard sensors (temperature, humidity, CO, light ...), vital signs sensors etc.
- Direct connectivity to each sensor from 6onDASHBOARD via IPv4 or IPv6 (DSMIPv6) with NAT/FW traversal

First responder sensor deployments in use

- 6onMOBILE triage and tracking application
- Environmental sensors (temperature, humidity, butane level, CO level, noise level, illumination level, weather station parameters)
- Video monitoring with web cameras and IPv6 multicast streaming
- First responder vital signs (heart rate, galvanic skin response, body position, GPS position, blood oxygen saturation)

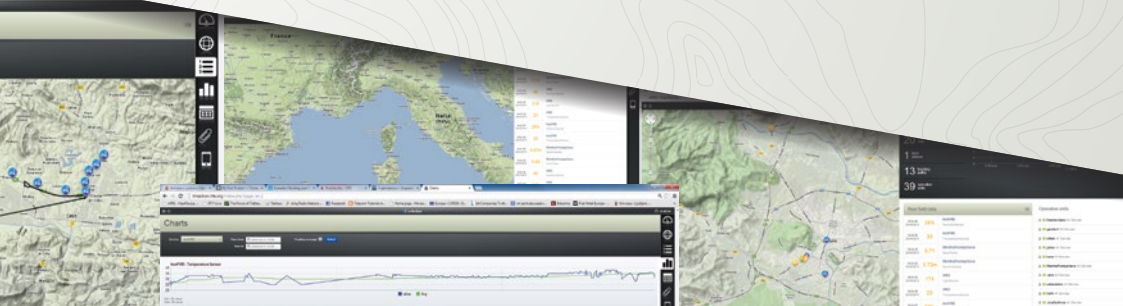# ③ 6onDASHBOARD
INTERVENTION MANAGEMENT SOFTWARE

• Central web-based intervention management and monitoring
  portal
• Tailor-made for intervention site monitoring
• Customizable views and access control for strategic, command,
  tactical and operational levels

6onDASHBOARD features

• Real-time monitoring and tracking of units, users, devices and sensors in a
  web-based GUI
• Connects to 6onFIRE sensor deployments on site
• API to connect to 3PTY data sources
• Connects to 6onMOBILE for triage reporting, alerting and real-time
  first responder tracking

6onDASHBOARD GUI tools

• Real-time event-driven sensor dashboard
• Sensor event recordings – GPS location, IPv4/v6 information, sensor
  status, data
• Real-time unit, sensor and device tracking
• Intervention and triage reports
• Real-time alerting
• Full data storage for intervention revisions
• Group and access rights management customizable to procedural
  structure
• Support for cross-agency operations and international cooperation

GirionFIRE
Location:
Vidmarjeva ulica 5, 1000 Ljubljana,
Slovenia
IP information:
212.101.131.112
Status:
EARTHQUAKE alarm
Triggered on: 17:45:22 29/04/2013

14 tracking paths

39 operative units

New field data			14
17:45:35 29/04/2013	3.25m	MerilnaPostajaSava SavaVodostaj	
17:45:35 29/04/2013	5.65	MerilnaPostajaSava SavaTemp	
17:45:22 29/04/2013	47	UMU HumiditySensor	
17:45:22 29/04/2013	!!!	GirionFIRE EARTHQUAKE	Alert
17:45:09 29/04/2013	224	UMU LightSensor	

Operative units

- Gasilec Samo All Devices
- gasilec1 All Devices
- urban All Devices
- jakec All Devices
- Luka All Devices
- MerilnaPostajaSava All Devices
- Jaka All Devices
- urbanalarm All Devices

MOBITEL 16:47

Back in Action

Fire >

Flood >

Earthquake >

Alert

MOBITEL 16:47

Back in Action

Fire   Flood   Earthquake

## 4 6onMOBILE

MOBILE TRIAGE AND TRACKING APPLICATION

• Professional triage and tracking application for Android and iOS
• Simple one-touch reporting from the intervention site
• Location tracking of frontline teams and vehicle fleets
• Reporting procedures customizable to match standardized
  protocols

6onMOBILE features

• Instant alerting in real time – Fire, Flood, Earthquake, Tree down,
  Avalanche, Heavy snow, Line down, Power outage, Unknown
• Full triage reporting for fire, flood and earthquake interventions –
  with detailed reporting on Facility, Person, Animal and Hazardous
• Time-based and distance-based location tracking
• Reports, alerts and tracks transmitted to 6onDASHBOARD in real
  time

6inACTION powered by partnership
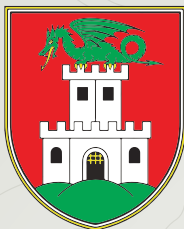
Municipality of Ljubljana (MOL),
Department for Protection Rescue and Civil Defence (OZRCO)
Pilot requirements and testing, live emergency response environment & infrastructure

Municipality of Ljubljana (MOL),
Department for informatics
Municipality public network support

TelekomSlovenije

Telekom Slovenije, d. d.
Real-world trial support, premium PPDR backhaul provider

CISCO ™

Cisco System
Networking equipment support

Go6 Institute
Federating and consultancy role

REPUBLIC OF SLOVENIA
**MINISTRY OF EDUCATION,
SCIENCE AND SPORT**

Ministry of Education, Science and Sport
Integration of project in Slovenian government

Water Science Institute
Pilot system requirements and testing

Powered by partnership

6inACTION is powered by the Laboratory for telecommunications at the Faculty of Electrical Engineering, University of Ljubljana. Work was in part supported by the European Commission as part of the project »Governments Enabled with IPv6« (GEN6).

GEN6 is about stimulating EU-wide deployment of IPv6 by means of best practices and guidelines.

- National pilots to make a step further in IPv6 deplyoment in different sectors
- Cross-border pilots to demonstrate EU-wide interoperability of IPv6
- Communication activities and road shows to ensure dissemination in public administrations and with other relevant stakeholders

European Commission

University *of Ljubljana*
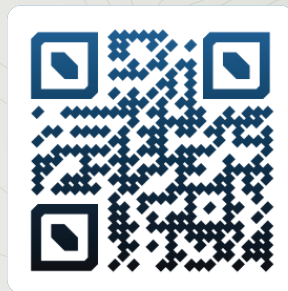Faculty *of Electrical Engineering*

Laboratory for Telecommunications
Faculty of Electrical Engineering
University of Ljubljana

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ICT Innovations for Life and Business

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Luka Mali, Jaka Cijan, Urban Sedlar, Janez Sterle

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6 in Action

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