

# Enabling Integrated Emergency Management: Reaping the Akogrimo Benefits



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## Abstract

Disasters require careful management and still have clear capability gaps. Mobile Grids and the Virtual Organisations they can support hold much promise for addressing the technological difficulties that Integrated Emergency Management still suffers from. Many forms of device, content, and human roles require safe, simple and seamless integration. Mobile Grids developed on the EU IST Integrated Project Akogrimo provide an infrastructure for efficient development, provision and maintenance that could support complex Integrated Emergency Management (IEM) applications. This is the scenario focus of one of the Akogrimo prototype testbeds. This white paper gives an introduction to how Akogrimo Mobile Grid technologies will be used within an IEM scenario and indicates enhanced business opportunities.

SIXTH FRAMEWORK PROGRAMME

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Information Society

*Grid for complex problem solving*

## 1. Summary

This white paper motivates the use of Mobile Grid infrastructures within a disaster handling and crisis management domain. We start with an introduction into current challenges and perspectives of this domain.

We then provide details of the capability gaps that Akogrimo Mobile Grids could address.

This is followed by the relevant information that supports the requirements used in the disaster handling and crisis management testbed. The complex trans-organisational aspects are particularly highlighted along with the recurring themes for Akogrimo of: Mobility, Grid and Knowledge.

Descriptions of services employed such as Risk Management are related throughout and relevant issues such as how actors are grouped and interact with chain of command are illustrated. Of interest are phase changes and the need to make transitions robust during these periods pointing to workflow adaptation.

The paper concludes with a description of changing value-creation processes influenced by (Mobile) Grids or inducing new business opportunities for Network and Application Service Providers.

## 2. Technical Difficulties Endemic in Disasters

It is an imperfect world we live in. And one whose history is punctuated with disasters of many types and scales. Some disasters are clearly of our own making, and technology has also been the instrument by which catastrophe has struck. But whatever the cause, it is in our

nature to use technology resourcefully in avoiding, coping and remedying the terrible human, financial and environmental costs when disaster strikes. These attempts are typically blighted by problems in joining up and managing all the resources required ([5] and [6]). Indeed this is the fundamental lesson frequently cited as being needed to be learnt [7].

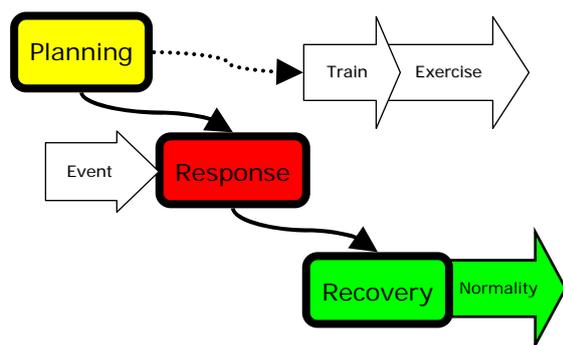
So why is this so? There is little shortage of initiative, investment or insight. *Some* blame must be apportioned to the technological state of the art, and how far organisations are able to react given that state of the art. Technology has yet to fully provide situational awareness, auditability, accountability, ability to delegate, and command and control in most disaster situations. Rightfully this adversely affects the appetites and decisions of those organisations involved. This can tend to render them unable to react beyond their normal envelope in times of crisis. When this occurs much is squandered, as modern organisations enjoy rich resources in terms of messaging, multidimensional content that increasingly represents semantically encoded knowledge that could otherwise better inform decisions and more usefully drive events.

That notwithstanding, it is only through demonstrably practical technology, rather than idealistic visions, that research can hope to find real exploitation in this domain.

## 3. The Integrated Emergency Management Watershed

We will return to technology as our focus, but we should first note a turning point in recent

years for the longstanding crisis management disciplines. The trans-organizational nature of disasters coupled with their extreme demands has culminated in doctrine that practitioners term “Integrated Emergency Management” (IEM). Roles, responsibilities, resources and activities are defined falling into three distinct phases: Planning, Response and Recovery.



**Figure 1: the IEM Phases**

Akogrimo is ideally placed and well timed to address the residual IEM technical capability gaps and barriers that clearly remain across all phases but are most demanding during response.

These include:

- Simultaneous treatment of fundamental constraints such as resilience *and* agility
- Uncertainty of where/how to find resources
- Making trans-organizational resources secure, punctual, appropriate, non-reputable, auditable, (there are special cases relating to public/media information releases)
- Provide insight of provenance, trust accuracy when conflicts in content are encountered
- Preventing isolation due to organizational boundaries
- Address regional and political boundaries
- Optimising the brokering of finite expert and specialist resources (including human)

- Improving integration and interoperability of resources and workflows in extremely heterogeneous environments
- Safely handing control over of active workflows between phases and organizations
- Detecting and managing context changes (often subtle and risk driven in IEM)
- Dealing with rapid shifts in priority and activity modes (through adaptive workflows)
- Identifying and obtaining best utilisation of prior investment (training, infrastructure) for all activities in all phases
- Exploit latent advantages of the number of skilled mobile resources

Existing technology is at best questionable in the extent to which it allows resources to assemble, assimilate and act regardless of resource nature and parent organisation; let alone to do this safely, simply and seamlessly.

The technology arising through the Akogrimo project has diverse resources that include both human and non-human, both mobile and static; and on our networks both as services and content. The Akogrimo project calls such an arrangement of resources, along with the required providers, infrastructure, workflow etc. a Mobile Dynamic Virtual Organisation (MDVO).

There is a marked difference in the potential of MDVO that the Akogrimo Framework allows compared to traditional Grid research. It provides a vehicle that for national and local governments, as well as commercial enterprises and the public to conduct their daily business, while being better able rally to the cause of protecting citizens, commerce and environment when adversity threatens.

The difference and potential Akogrimo brings is born out of its particular mix of inventions, their implementation details and that these novel aspects are undertaken in a single, cohesive framework. Akogrimo inventions and novelty relevant to IEM MDVO include: specialised context extraction, context adaptation (especially in regards to risk in IEM), personalisation (e.g. content and view), dynamic workflow, this being delivered over networks with strong virtualisation aspects and both nomadic and static resources.

In summary, Akogrimo is timely in that it can provide a practical and impressively comprehensive framework to go a great way in addressing IEM capability gaps highlighted in this section through MDVO. Akogrimo-based decision support infrastructure should also contribute to reducing the threat and impact of crises.

#### **4. Scenario overview**

The Akogrimo Mobile Grid Framework supports the creation of multiple types of application starting from simple applications like field operator monitoring to complex applications like enabling Common Operational Pictures (COP), exploring the Geography of Risk at a mobile response centre deployed close to a disaster scene.

The Akogrimo Framework enables the integration of services provided by mobile resources, legacy applications, and data and computing intensive services within a Mobile Grid to offer applications to mobile, nomadic, and stationary users.

The scenario itself centres on a terrorist dirty bomb attack. An important reason for this

choice is that it has a rich set of organisations involved and some of the most stringent demands placed on the resources.

Other features of note include:

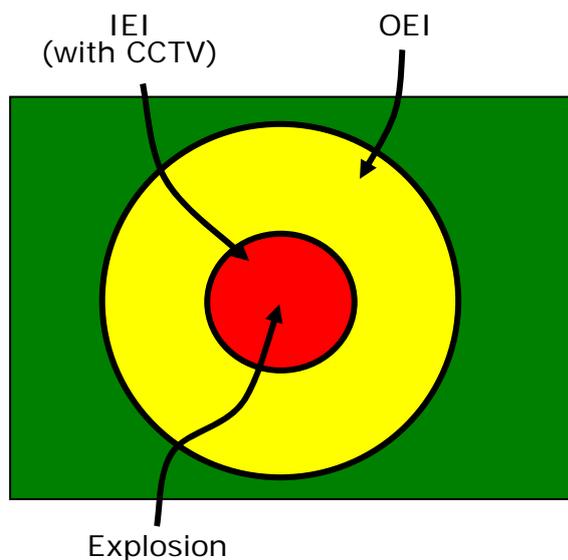
- No lead time
- Specialist resources e.g., decontamination
- Panic, confusion, conflicting information
- Lives of responders at high risk

In contrast, some natural disasters have different features:

- Lead time hours/days
- Reduced agency set (e.g. no military resources)
- local, regional, cross border

We have chosen to focus on actors and services that reuse and contribute further to the Akogrimo e-Health and e-Learning testbeds that highlight Mobility, Grid and Knowledge and using realistic scenes and interactions.

Through the IEM phases we follow the changing story of two educational institutions: an Inner Education Institute (IEI) and an Outer Educational Institute (IEO). They are so called because of their relationship to the city shopping centre where the explosion occurs. We follow these institutions through normal business, the trauma of crisis and eventually the return to normality.



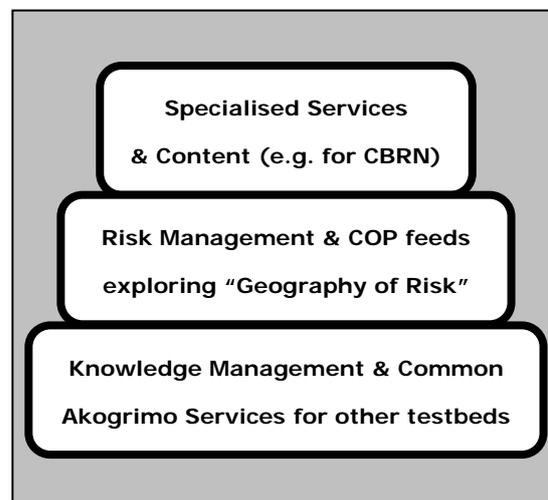
**Figure 2: Geographic Overview**

This starts with their usual business during **Planning** that includes regular Health and Safety Risk Management (RM) involving both more generalised Knowledge Management (KM) services and dedicated RM services. Part of the story involves treating a risk of unauthorized entry with a CCTV. During this time the local government will be doing its normal business which for the Civil Contingencies Unit (CCU) will include drawing up response workflow, training and exercising.

After the trigger event, the explosion, **Response** ensues and soon a COP is setup with various government and non-government Grid resources which are searched, subscribed to and consumed. In order to be fully exploited these resources are often used in different modes than is usual.

Finally, during **Recovery** one institute remains closed for some time and this resource is exploited as a depot for Recovery Action Teams (RAT) while the other institute accommodates some of the displaced pupils from the first.

The scenario generated knowledge content is continually revisited, re-evaluated and reused with a recurring them of the “Geography of Risk” being explored with a Proximity Analysis Service (PAS) and the RM services.



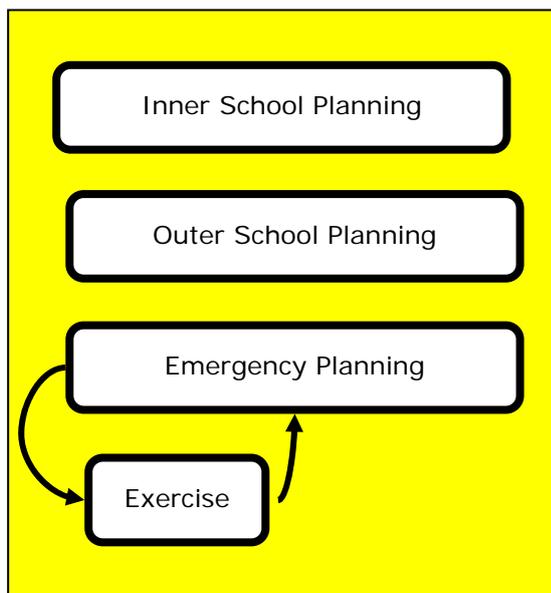
**Figure 3: Service & Application Groupings**

The details of the scenario requirements driven and validated by UK stakeholders will be complemented through international projects and forums to maintain wider relevance.

## 5. Planning Phase

We intentionally keep the planning activities of local government and both educational institutions realistically separate during this phase, though during exercises it would be the case that the repositories managed by the RM services would be called upon to contribute.

There are many aspects to examine here with regards to how the e-Learning testbed can contribute to IEM MDVO especially in contributing to the continual learning activities of those involved in IEM to the more practical aspects of MDVO for exercises hosted on the educational institutions MDVO infrastructure to experiment with agility measures.



**Figure 4: Planning Actor Groupings**

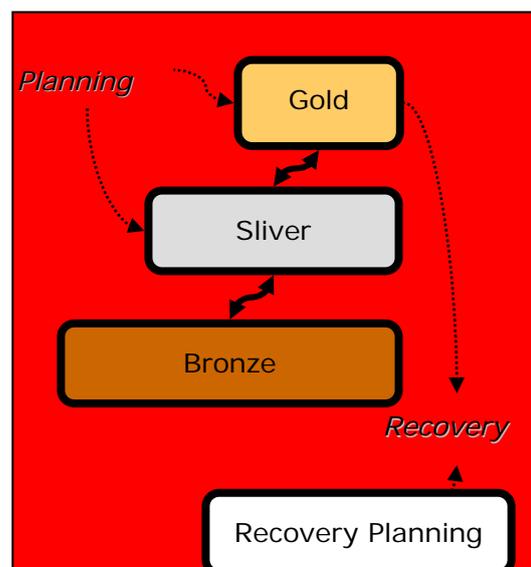
Services and activities in this phase include:

- Risk Identification & Risk Analysis
- Knowledge generation & repositories
- Expert system creation & data mining
- Base VO creation

## 6. Response Phase

The pace and demands on the Grid resources increase during this phase. First responders become in effect the first level of command until they are relieved by superiors if the situation escalates. In the UK, the deployed operational units are termed “Bronze”. Those that manage the operation units are called “Silver” command and are set up later if necessary. Strategic policies for major incidents are determined by “Gold” command which will be the last grouping to form. It is also best practice to identify Recovery groupings and plans during this stage.

In a CBRN scenario such as ours the lead organization would be the police.



**Figure 5: Response Actor Groupings**

During this phase the IEI is closed. Its car park is used as an ambulance control centre. The RM content from Planning is searched as a matter of course and the CCTV Grid service is discovered as a surveillance type mitigation and its feed is brought in to enhance the COP.

Services and activities in this phase include:

- Operational VO creation
- IEM workflow
- Common operational picture
- Knowledge generation
- Expert system use
- Context-based delivery

An investigative phase continues until all efforts to save life, property and gather evidence are complete.

There is the potential to investigate how IEM MDVO could both contribute to warning and informing the public and enabling the public to contribute to Response and Recovery in scenarios where it may be more prudent e.g., some floods [8].

## 7. Recovery Phase Processes

The recovery phase will be led by local government in the UK. There is the difficult task in re-scoping, rescaling and re-commanding the actor groupings between these phases. This is a uniquely complex demand on MDVO and will test the Akogrimo Framework to its full extent in terms of dynamic workflow, contexts etc.

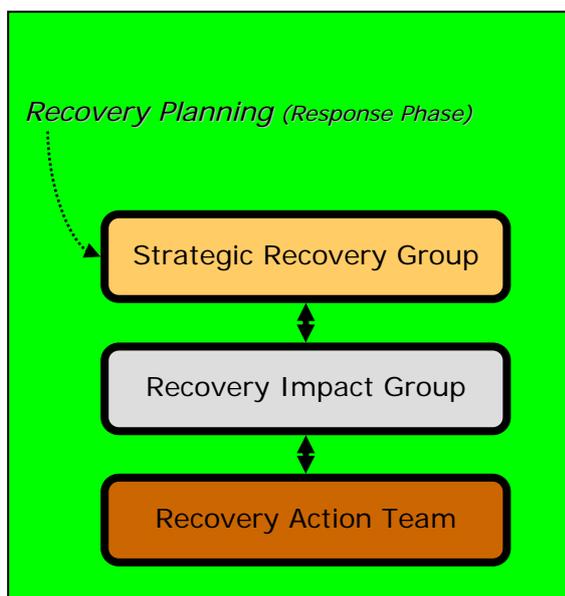


Figure 6: Recovery Actor Groupings

The IEI remains in use this time as a RAT depot and the displaced students are accommodated in the OEI. This places a burden on the OEI to re-evaluate its risk registers re-using content from earlier on.

The process of remediation may require a phased approach and will tackle issues such as:

- How effective will the recovery option be?
- Is this environmentally acceptable?
- What clearance level will adequately protect public health?
- What levels of residual contamination will be acceptable?

- How will the authority establish public confidence in its clean-up strategy?
- How quickly can options be implemented?
- What resources will be required?
- What wastes will be generated?
- How will they be managed and disposed of?
- What are the environmental impacts of the disposal options?

The resulting recovery efforts may demand a broader spectrum of services than those found during response. Recovery also provides the best opportunity to demonstrate how specialised value chains could be mobilised and managed through MDVO that would not be otherwise possible that:

- Re-stimulate commerce
- Accelerate return to normality
- Better integrate authorities and contracted agents.

## 8. Profitable Development of Complex Applications on Mobile Grids

We include the normal business during the planning phase which improves matters as governments, both local and national, are expected to achieve more with less resources. Akogrimo Mobile Grid Solutions have much to offer many parts of government as the extent of services that are delivered through e-Government continues to accelerate.

This is important to the Akogrimo Value Network with the Business Modelling Framework [4] providing many ways in which a wide range of businesses could contribute to government services. This would obviously generate new income streams but would also allow government to reduce cost, outsource

more, increase productivity and be more flexible in the way they deploy staff.

Interesting points can be made through the improvements made to accounting which will help in resolving mutual assistance issues. Typically such charging between organisations are resolved after the event, but with Akogrimo in place better awareness would improve the continual fanatical management of IEM operations and clearer public accounting.

On the strength of the flexible accounting capabilities, the support of service level and mobile dynamic virtual organisation management and the seamless integration of network resources into a Grid environment which is provided by the Akogrimo platform, conventional business models of network operators, network service providers and application service providers can be easily extended with value added Grid operation and domain specific services.

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## 10. Acknowledgments

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