Demonstration programmes for security innovation: reflections based on Mass transportation security phase 1

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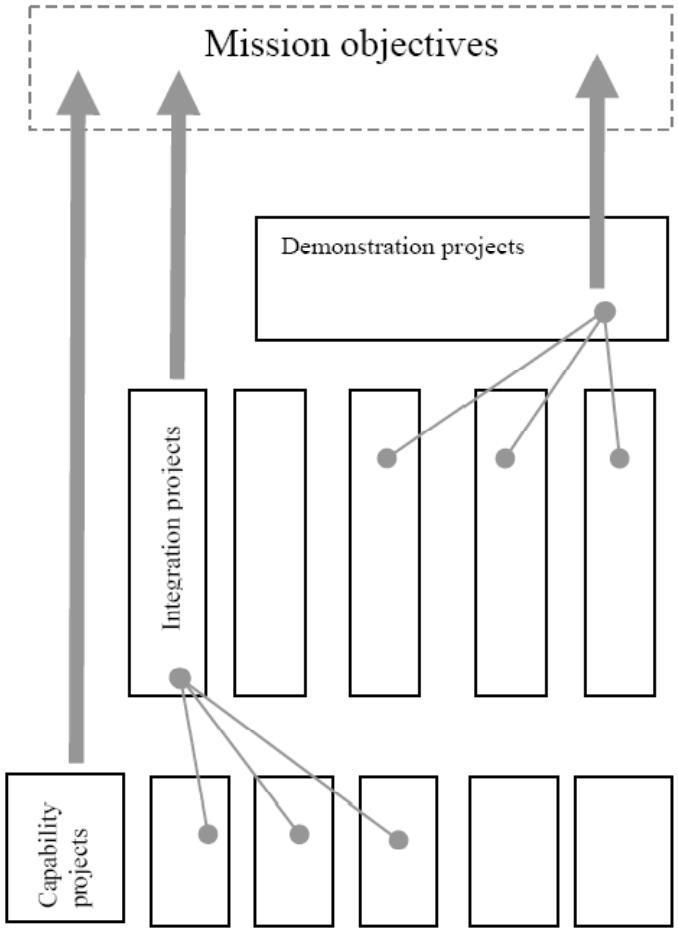
SEVENTH FRAMEWORK PROGRAMME

DEMASST
Mass transportation security

- **Are demonstration projects all about demonstration activities?**
  - Demonstration activities could – and should – be performed both in CPs, IPs, and DPs
  - The term DP can therefore be slightly misleading
  - DPs = programmes at system-of-systems level
  - Before something can be demonstrated it must be developed
  - In the system-of-systems world this requires extensive experimentation
  - Hence DEP = Demonstration and experimentation programme as alternative to DP



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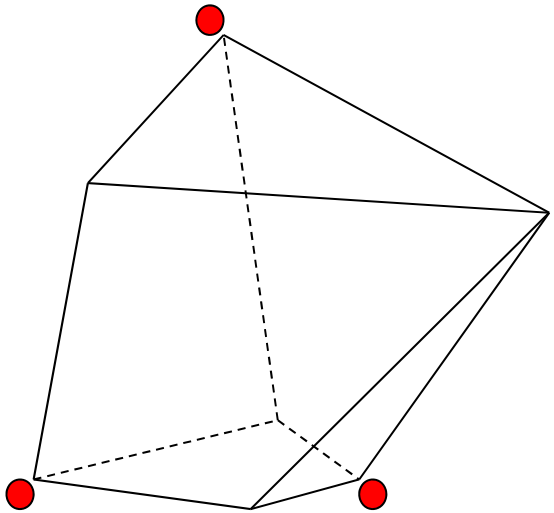
- FP7-SEC has five DPs in the pipeline
  - Border security
  - Mass transportation security
  - CBRNE (Chemical, Biological, Radiological, Nuclear agents and Explosives)
  - Logistic and supply chain security
  - Aftermath crisis management
- *These five problem areas are quite different*
- *This is good experimental design in order to fast develop an effective approach to system-of-systems level security research and innovation!*



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DEMASST – the phase I study of the FP7-SEC Mass Transportation Security programme

- Started late due to security scrutiny procedure – January 2009, ends May 2010
- Strives to inform phase II as it evolves
  - Input to European Commission
  - Input to prospective phase II consortia (most deliverables and workshops are public)
  - Input to the selected phase II project(s)
  - Berlin workshop first step
- But also to identify “low-hanging fruit” and future research needs
- Strong partnership with much knowledge in house
  - but also important to learn from others via interviews and workshops
- DEMASST members keen to participate in phase II with mass transportation key players
  - but also in helping to develop the DP instrument for European security innovation in general
- See also www.demasst.eu

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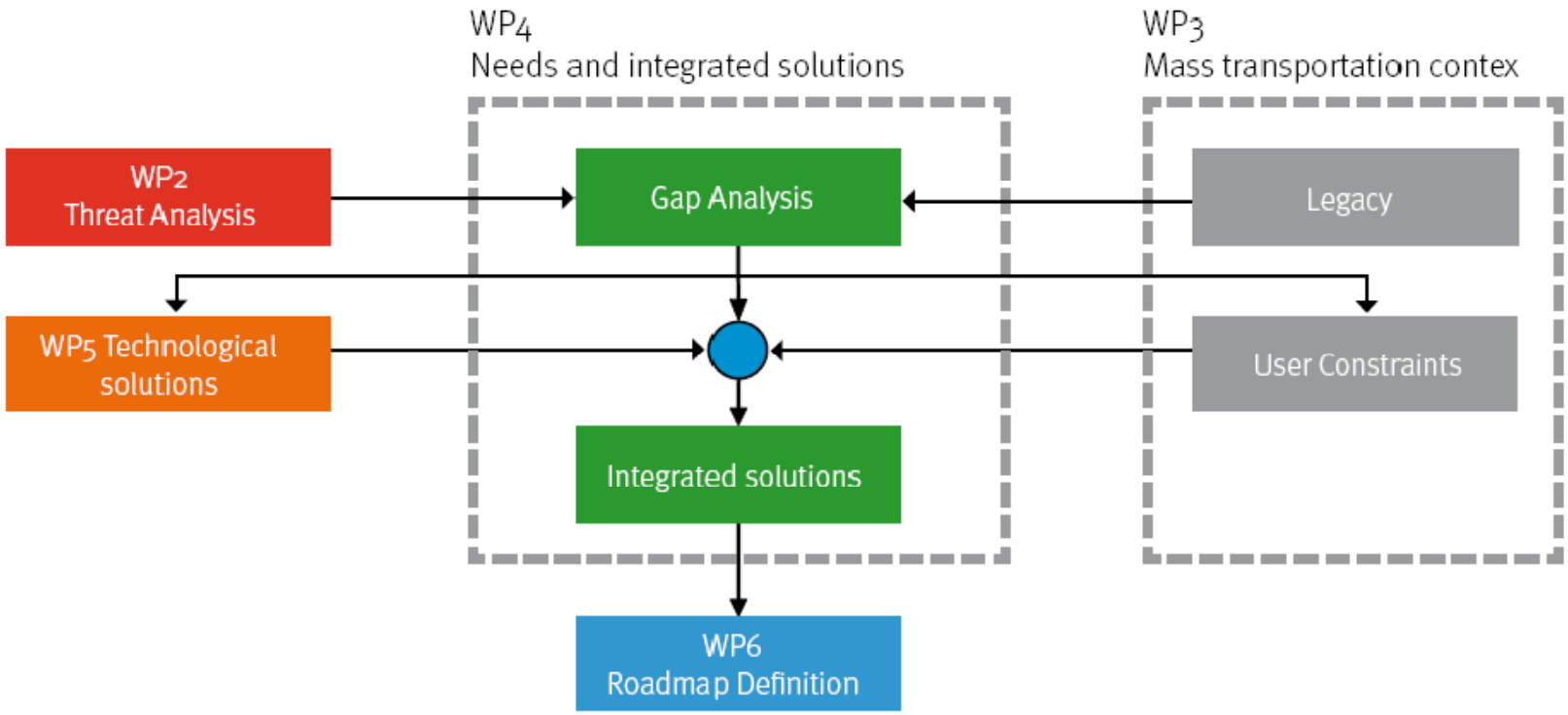
DEMASST Work package structure



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Mass transportation security

Why is mass transportation security important?

- (NB: mass transportation defined as urban & regional public transport)
- Extremely high densities of people
  - accidents, terrorist attacks, contagious diseases, etc. may create very major casualties
- Public transport is a critical infrastructure for the good functioning of all metropolitan regions
  - disturbances very costly
- Increased market share for Public transport has big environmental upside
  - requires improvement in security and other dimensions of quality of service

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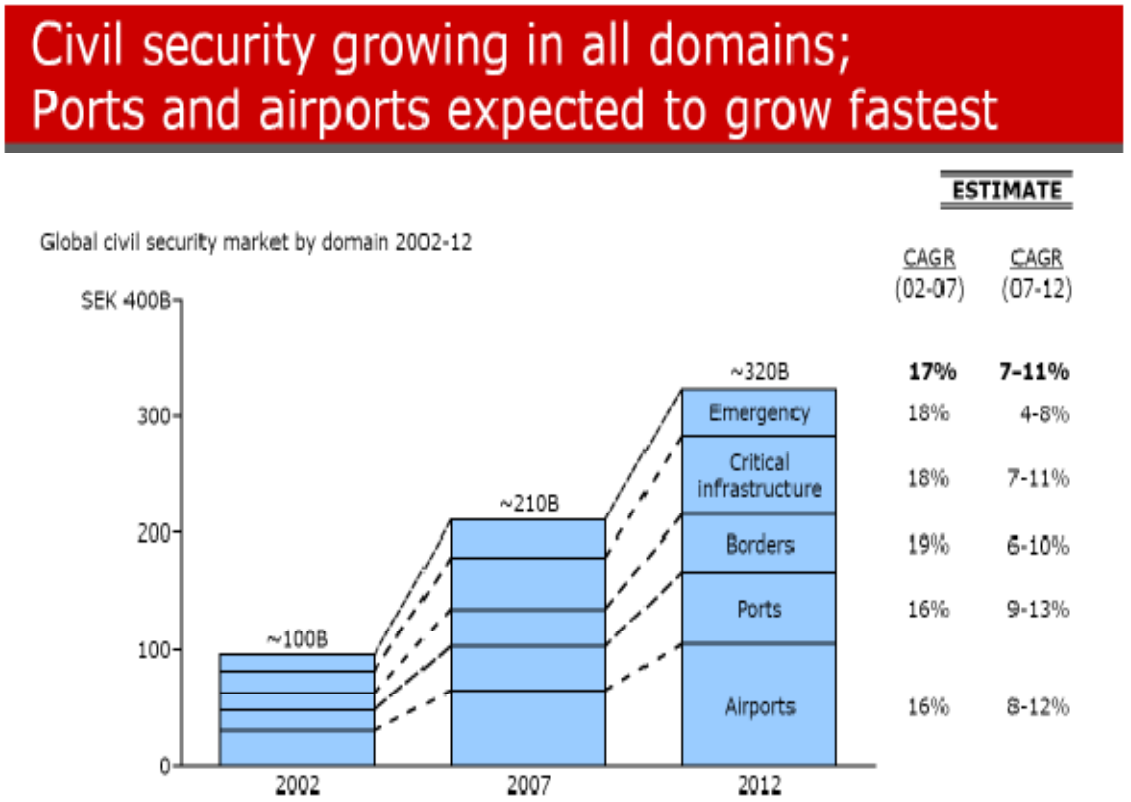
If mass transport is so important – why isn't it even on the investment map?



Source: Bain analysis for Vinnova

Why is mass transportation security so difficult?

- Generally no acceptance of cost increase
- Generally no acceptance of delay and discomfort
- Varying but generally low acceptance of intrusions of privacy
- Each regional MT system a unique system-of-systems
  - with its unique security system-of-systems
- A wide range of risks and threats
  - perceived and prioritised quite differently among European regions
- Fragmented ownership and responsibility structures – unique for each region
- *How can we avoid solving but a very limited part of the problem???*

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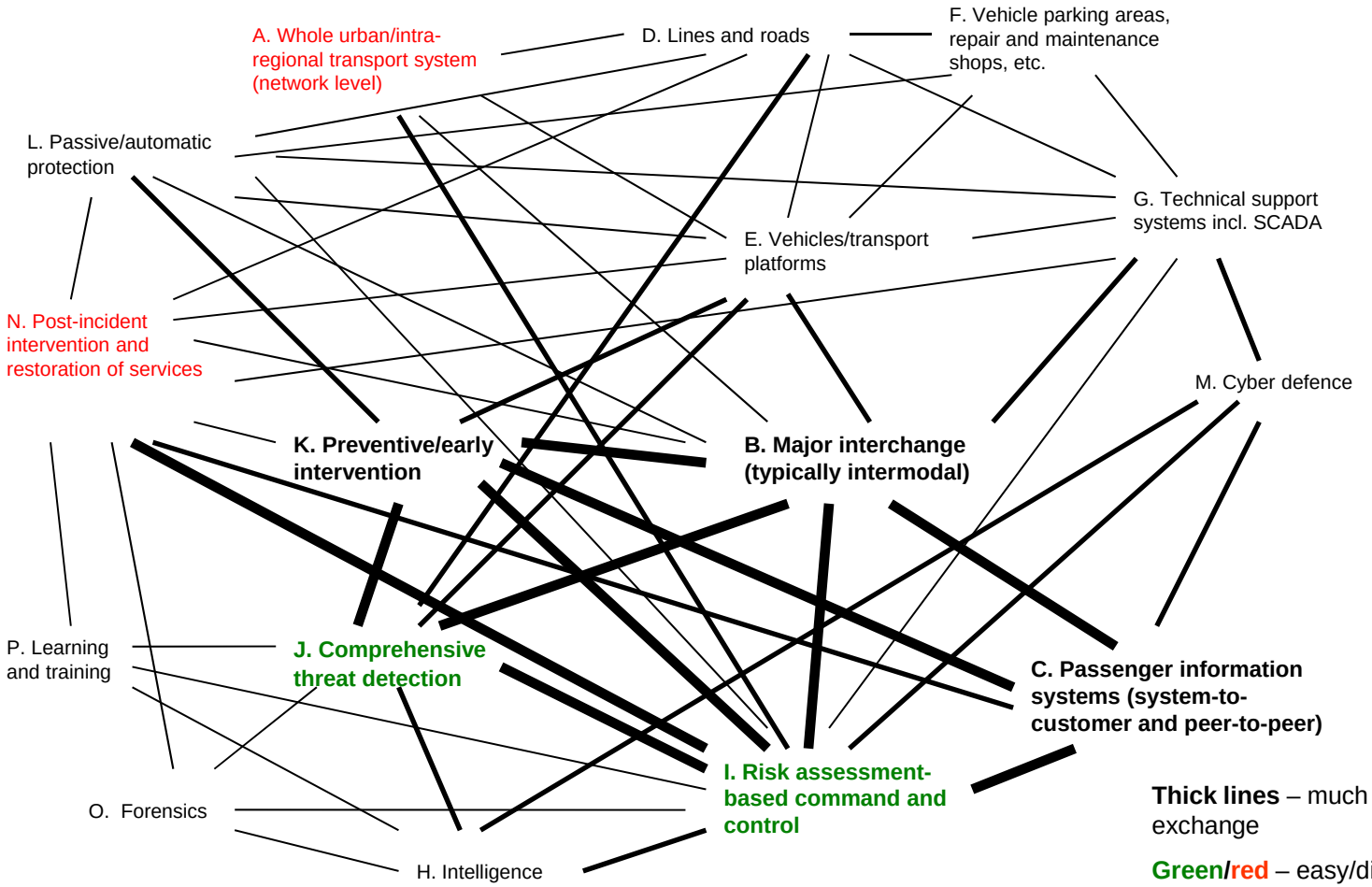
Why a systems-of-systems (vs. an integrated systems) approach is particularly pertinent to mass transportation security - 1

- A “[s]ystem of systems is a collection of […] systems that pool their resources and capabilities together to obtain a new, more complex, 'meta-system' which offers more functionality and performance than simply the sum of the constituent systems.”
- A highly integrated system can typically be made very cost-effective for a narrow range of tasks.
- In contrast a system of system approach has its strength
  - when confronting a wide range of tasks, solvable by composing constituent systems in different ways, as enabled by an overall architecture and standardised interfaces
  - in utilising legacy systems and COTS.

Why a systems-of-systems (vs. an integrated systems) approach is particularly pertinent to mass transportation security - 2

- A system of systems is typically characterised by the following properties:
  - operational independence of elements
  - managerial independence of elements
  - evolutionary development
  - emergent behaviour
  - geographical distribution of elements.
- Due to this, modelling and analysing systems of systems typically involves:
  - inter-disciplinary study
  - heterogeneity of systems
  - networks of systems
- *Such meta-system approach is necessary to enable a major boost of MT security without excessive costs*
- *This does not, however, mean that the system-of-systems thinking is easy to sell to MT stakeholders!*

First step towards road-map: System-of-Systems Map for Mass Transport Security Demonstration & Experimentation



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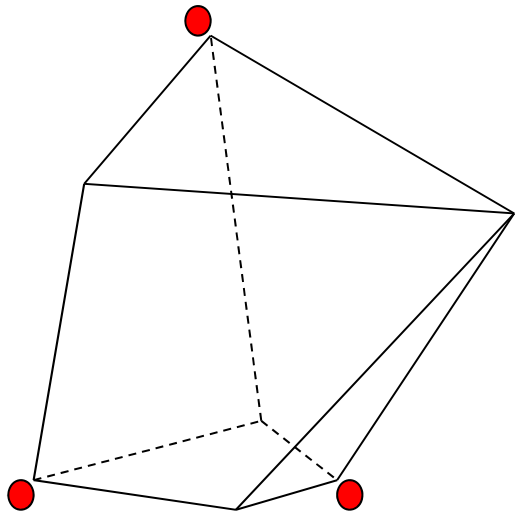
What is needed for a successful MTSDEP? - 1

- Literally speaking a programme with limited time and resources can only *solve but a very limited part of the problem* in a concrete and directly demonstrable way
- However, by selecting a varied set of demo tasks (risks and threats) we can create a sufficiently broad knowledge platform to enable sustained innovation:
  - transferring solutions to new cities,
  - modifying them for new risks & threats,
  - inserting new technologies into them…



What is needed for a successful MTSDEP? - 2

- But this requires structural capital – knowledge infrastructure that remains after the project:
  - standards for architecture and interfaces, security procedures, cost-effectiveness assessment…
  - field labs (ranging from man-in-the-loop simulators through to instrumented real operational facilities)
  - modelling and simulation resources (indispensable for difficult, dull, and dangerous experimentation tasks)
- *Can we expect the market to sustain this infrastructure or is there a need for continuing public funding also after the end of the programme?*

Back-up slides

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Demonstration & Experimentation methodology

- D&E needs combination of real systems and *in silico* work. Simulation needed when tasks are:
  - Difficult – typically complex interfaces
  - Dull – typically very many possible parameter combinations
  - Dangerous – including ethically problematic
- …and for transfer/generalising of results
- Exploit the full range of D&E methods:
  - "Live" experiments under conditions of ongoing real operations
  - Experiments in real operational setting but not under conditions of real operation
  - Experiments in dedicated facilities emulating real operational settings
  - "System-in-the-loop" simulation test-beds
  - Man-in-the-loop simulation (including Virtual Reality applications)
  - All computer simulation.
- …and also "non-experiments":
  - "natural experiments"
  - "discursive experiments"

System-of-systems architecture: identifying operational systems

A. The whole urban/intra-regional transport system including also private means of transport inasmuch as there are opportunities for substitution between private and public transport (network level)

B. The major interchanges (typically intermodal), with
   - big passenger flow densities
   - services for passengers
   - transport platforms passing on different lines – high density of infrastructure

C. Passenger information systems
   - system-to-customer
   - peer-to-peer

D. Lines and roads including smaller stations and other entry points, tunnels, bridges, etc.

E. Vehicles/transport platforms

F. Vehicle parking areas, repair and maintenance shops, etc.

G. Technical support systems (control, power supply, ventilation, etc.) including SCADA systems.

System-of-systems architecture: identifying security systems

H. Intelligence
   - provision of background information for setting alert levels and help contextualise threat detection systems

I. Risk assessment-based command and control

J. Comprehensive threat detection

K. Preventive and early intervention,
   - i.e. intervention before many passengers have noticed a (potential) attack

L. Passive and automatic protection

M. Cyber defence

N. Post-incident intervention and restoration of services

O. Forensics

P. Learning and training

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Demonstration & Experimentation Programme design

- Consider coupling within the operational and security system-of-systems
  - which are the links requiring high information flows?
  - for which links are these information flows time critical?
  - which are the nodes possible to engage in D&E activities performed in real operational systems (in particular not too dangerous)?
- Match Mass Transportation complexity in programme design
  - handle tightly coupled systems in a tightly managed federation of sub-projects
- Other systems can be dealt with in a more off-line fashion
  - pre-existing knowledge
  - separate projects in parallel
  - information added afterwards
  - simulation models to integrate knowledge off-line

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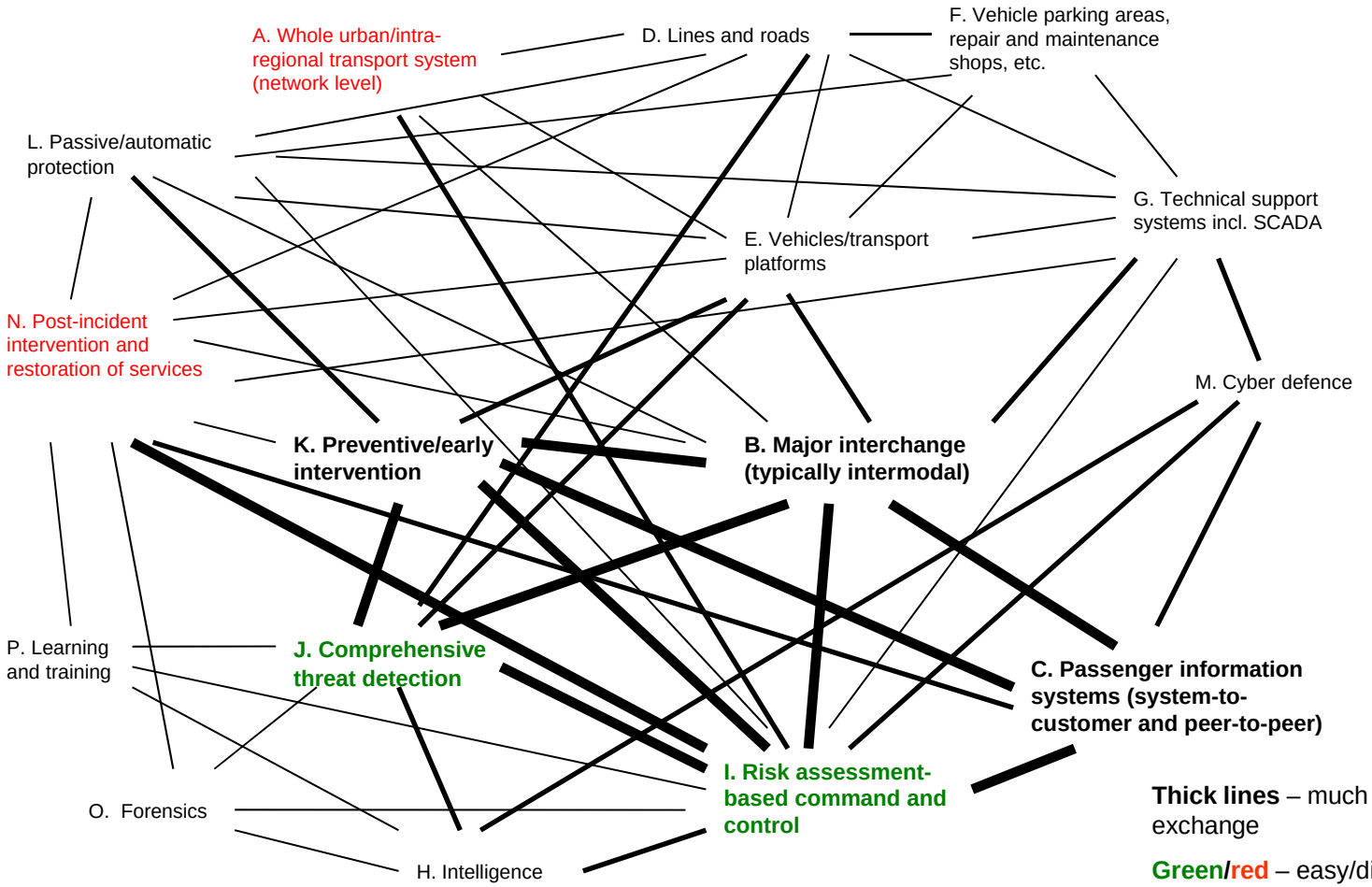
First step towards road-map: System-of-Systems Map for Mass Transport Security Demonstration & Experimentation



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Proposed core for a Mass Transport Security Demonstration & Experimentation Programme

- Five systems form a strongly connected core representing high requirements on time critical info exchange, while being reasonably amenable to live experimentation:
  - B. Major interchange (typically intermodal)
  - C. Passenger information systems (system-to-customer and peer-to-peer)
  - I. Risk assessment-based command and control
  - J. Comprehensive threat detection
  - K. Preventive/early intervention
- It is important for the success of phase II to keep these five systems within a single project or a tightly managed federation.
- Live experimentation needs to be complemented by test-beds and simulators for tasks that are too difficult, dull, or dangerous to do in real life.