

COST-ARTS: Working Group 1 (WG1)

Aims and Objectives

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Outline

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ARTS Objectives

● Main objectives:

- Unite and align groups from transportation engineering and computer science
- to prepare and deliver a world leading research community
- that will develop radically new ways of designing transportation support systems
- based on the concepts of *autonomic systems*

● Secondary objectives:

- Assemble critical mass of expertise from academia and stakeholders
- Identify and classify the role of autonomic systems in *current* transportation applications and research
- Establish connections between academia and industry
- Coordinate research and development efforts covering technical, legal & institutional aspects
- Deliver a detailed assessment and quantification of the potential benefits of ARTS

Means of achieving ARTS objectives

- Workshops, conference events, themed challenges and/or competitions
- Short term scientific missions (SMTS)
- Summer/training schools
- Gap bridging stakeholder seminars

All work is organised into four Working Groups (WG)

Working Groups in ARTS

- WG1: Architectures, methods and models for ARTS
- WG2: Exploiting the results of previous research and technological development
- WG3: External factors, environmental benefits and application scope
- WG4: Human interaction and human factors

Role of ARTS WG1

WG1 is concerned with collecting, assessing and reporting back on a number of research questions pertaining to:

- System architectures
- Methods of monitoring and managing road traffic
- Knowledge formulation and representation
- Models and Modeling
- Emerging technologies

Research area: Systems architectures

- **Background and approaches, e.g.:**
 - Hierarchical, layered, behavioural, opportunistic, action-planning, peer-to-peer
 - Service-oriented, systems-of-systems, cooperative, market-based etc.
 - Note: Not to be confused with ITS architecture frameworks. We want to build based on these, not replicate that work.
- **Research questions:**
 - How can we incorporate and adapt those architectures into modern complex systems paradigms, such as multi-agent systems, cloud, ubiquitous computing, and ambient intelligence?

Research area: Methods of monitoring and managing road traffic

● **Background and approaches, e.g.:**

- State estimation, disturbance prediction, automatic incident detection
- Ramp metering, route guidance, variable speed limits
- Motorway-to-motorway control, lane management, junction signal control

● **Research questions:**

- How can we endow monitoring and management loops with autonomic properties?
- How do methods comply with requirements (e.g., scalability, flexibility, robustness) of open transport systems architectures?

Research area: Knowledge formulation and representation

- **Background and approaches, e.g.:**

- AI (neural networks, fuzzy logic, evolutionary systems, semantic technologies, learning)
- Logic (knowledge engineering, propositional inference, logical resolution)
- Decision-making methods (Markov decision processes, Bayesian networks)
- Data interpretation (aggregation, regression analysis, time series, outliers and change point detection)

- **Research questions:**

- How can we use these techniques to develop service oriented and semantic approaches to enable dynamic self-management system behaviour?
- How can we embed meta-data within traffic management systems so that they become self-aware?

Research area: Models and modeling

- **Background and approaches, e.g.:**

- Abstract models for analysing autonomic traffic systems
- Decision and information models
- Simulation models (multi-agent, discrete event, finite element analysis, fluid dynamics)

- **Research questions:**

- How do we develop and define the scope of such models?
- How can they help us develop system specifications?
- How can autonomic system design be based on them?

Research area: Emerging technologies

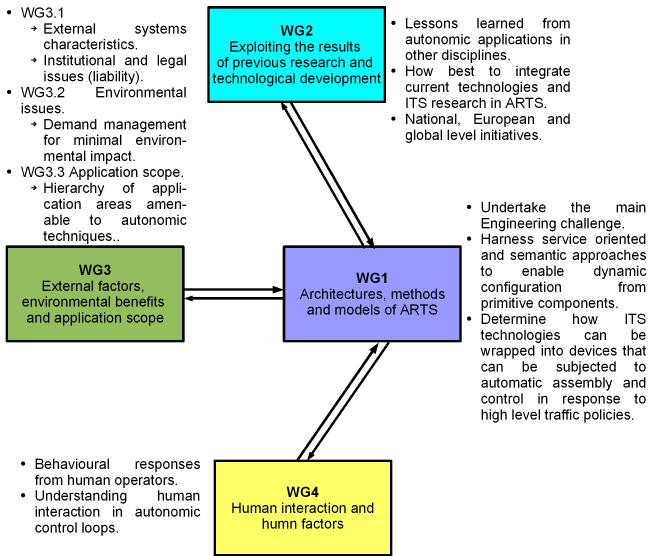
- **Background and approaches:**

- Personalised devices are becoming more and more popular
- Route planners, GPS trackers, cell phones, tablets and trackers are used by drivers and authorities

- **Research questions:**

- How can ITS technologies be effectively wrapped into devices (software and hardware)?
- How can automated assembly and control in response to high level policies be enacted upon these devices?

Relationship with other WGs



Overall Purpose of WG1

- Direction towards facilitating collaborations and setting a research agenda addressing the research questions.
- There is no direct research funding.
- Act as catalyst for exchanging information and establishing collaborations between the interested research groups.
- Stimulate discussion and enable it through common vocabulary that will allow transport engineers and computer scientists to
 - speak a common language and express problems in mutually understandable terms
 - set out common conceptual models
 - identify and develop common demonstration and validation scenarios and benchmarks
 - ultimately set out a commonly agreed research agenda
- Key WG1 performance indicators: degree of collaboration developed among research groups.

WG1 Objectives

According to the Technical Annex, the objectives of WG1 are:

- 1 To identify the major technological challenges in ARTS
- 2 To acquire demonstration systems to display the potential benefit of ARTS
- 3 To provide insights into appropriate platforms and methods for engineering ARTS systems
- 4 To investigate relevant abstract models for ARTS development and analysis
- 5 To make a contribution to relevant areas of the ARTS Road Map document

Objective 1: Major technical challenges in ARTS

A report outlining these challenges will be a WG1 deliverable in year 1, addressing the following issues:

- 1 Definition of autonomic properties for transport management
- 2 Smart networks of sensors and mobile ubiquitous technologies
- 3 Internet based services and applications for traffic management

⇒ Deliverable: Report (end year 1)

Objective 2: demonstration systems to display the potential benefits of ARTS

To be achieved by year 3/4, addressing the following issues.

- 1 Selection of possible simulated or physical TCC/vehicle subsystems that can be designed to display autonomic behaviour (year 3).
- 2 Identify common aspects of such systems (year 3).
- 3 Prepare and run WG competition 1 (year 3) and competition 2 (year 4).

⇒ Deliverable: Report (end year 4)

Objective 3: insights into platforms and methods for ARTS systems

To be achieved by year 2; objective should contribute towards a WG1 “Land Map” document. This document will receive input from three areas of investigation:

- 1 System design methodologies and tools for endowing traffic management systems with self-* properties
- 2 Runtime platforms for autonomic systems
- 3 Validation of methodologies, tools and platforms for traffic surveillance/control systems

⇒ Deliverable: Report (end year 2)

Objective 4: abstract models for ARTS development and analysis

To be achieved by year 2 and should contribute to the WG1 “Land Map” document, addressing the following issues: The following should be considered.

- 1 Systems architectures
- 2 Algorithms for adaptation and self-* organisation
- 3 AI for traffic control applications

⇒ Deliverable: Report (end year 2)

Objective 5: Contribution to the Road Map document

The ARTS Road Map document is going to be completed by the Action by the final year.

- 1 Contribution to the ARTS Road Map document according to Objectives 1–4.

⇒ Deliverable: Report (end year 4)

WG1 Timeline

- By end of year 1:
 - WG dedicated workshop 1.
 - Report supporting Objective 1.
- By end of year 2:
 - Report supporting Objective 3.
 - Report supporting Objective 4.
 - 1st draft of WG1 “Land Map” document (working paper).
 - WG competition 1 (Objective 2).
- By end of year 3:
 - Co-located workshop.
 - 2nd draft of WG1 “Land Map” document (working paper).
- By end of year 4:
 - Report supporting Objective 2.
 - Final draft of WG1 “Land Map” document as contribution to ARTS Road Map document (Objective 5).
 - WG1 competition 2 (Objective 2).
 - Training school.