



SPICE

SPACE INTERNETWORKING CENTER

SPICE update

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SPICE Project Coordinator

Prof. Vassilis Tsaoussidis

e-mail: vtsaousi@ee.duth.gr

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SPICE website

www.spice-center.org

- **SPICE Partners**
- **SPICE Collaborators**

Europe



USA

SPICE

progress per

Work

Package

The project is conducted in four separate work packages.

Work Package 1:

Project Management

As part of the project management procedures, an External Advisory Board (EAB) meeting took place during the first days of September. During this meeting, members of the EAB were informed on the progress of SPICE project and precious advices were given by the board members. More details about this meeting will be given later on this newsletter.

Work Package 2:

Exchange of know-how and recruitment of researchers and administrative staff

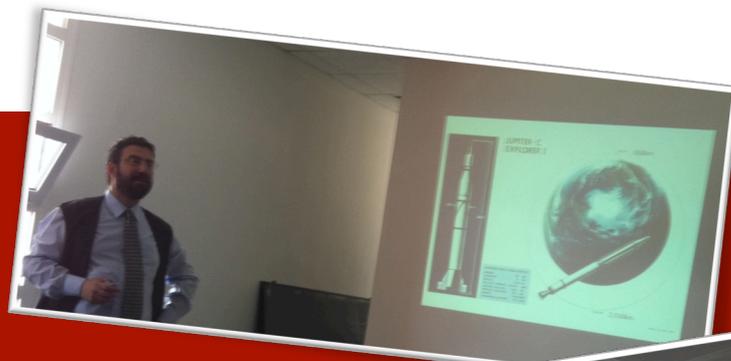
In September 2011, SPICE staff member Ioannis Komnios visited COMNET lab of School of Electrical Engineering, AALTO University, Espoo, Finland for 2,5 months. His visit was part of SPICE active collaboration with AALTO on DTN. During his stay, Mr Komnios worked on a joint research proposal for the EC FP7 Space 2012 call. "GENOISE" proposal is a joint effort of:

- AALTO University, Finland
- Democritus University of Thrace, Greece
- NURC Underwater Research Center, Italy

- Universidade do Porto, Portugal
- Terradue, Italy
- CISMET, Germany

During the past months, two lectures from distinguished scientists were organized at the premises of SPICE. In particular,

- **Prof. Timos Selis** from the Research Center "Athena" and the National Technical University of Athens, Department of Electrical and Computer Engineering described issues of management of a large number of objects in modern monitoring applications.





- **Prof. Georgios Giannakakis** from University of Copenhagen presented the concept of experience-driven procedural content generation.

Moreover a biweekly colloquium was organized among researchers at SPICE, focused on diverse research topics. For details see:

<http://www.spice-center.org/distinguished-speaker-series/>

Work Package 3:

Infrastructure update and state-of-the-art DTN testbed

The main activity of SPICE researchers within WP3 was to incorporate the newly purchased equipment within the existing DTN testbed, developing new mechanisms and convergence layer protocols for the DTN architecture. Moreover, SPICE researchers incorporated ESA's portable satellite simulator and CORTEX CRT system within the DTN testbed.

Work Package 4:

Exploitation and dissemination

This Work Package (WP4) includes all dissemination activities of the project. In this context, we have:

- published research papers in a variety of conferences and journals;
- presented both Space Internetworking Center and our research achievements so far to bodies, such as
 - o AALTO University and
 - o Tampere University of Technology, Finland;
- organised a workshop on "Terrestrial and Space DTN" on September 6th in Xanthi, Greece. The session was moderated by Vassilis Tsaoussidis and included keynote speeches from:
 - o **Scott Burleigh** (NASA, USA)
 - o **Joerg Ott** (AALTO University, Finland)
 - o **Torsen Braun** (University of Bern, Switzerland)
 - o **Eiko Yoneki** (University of Cambridge, UK) and
 - o **Lefteris Mamatras** (SPICE, Greece)

More information on the workshop are provided later on this issue.

1st External Advisory Board meeting

The 1st External Advisory Board meeting for SPICE project took place in Xanthi, Greece, on September 5th, 2011. The meeting consisted of two parts:

- During the first part, members of the External Advisory Board were informed on the currently active projects of the center –including a detailed presentation on SPICE project activities so far- in order to get acquainted with SPICE research agenda.
- At the second part, research staff of SPICE presented part of their most recent research achievements, in order to trigger in-depth discussion on specific research topics.

Project coordinator Prof. Tsaoussidis was moderator of the meeting. The total duration of the meeting was approximately 5,5 hours.



The External Advisory Board consisted of:

- i) **Torsten Braun**, Professor at University of Bern, Switzerland,
- ii) **Eiko Yoneki**, Researcher at Cambridge University, United Kingdom,
- iii) **Scott Burleigh**, Senior researcher at Jet Propulsion Laboratory, NASA, USA and
- iv) **Spyros Mavridis**, Head of Industry, Energy and Natural Resources Development at the Development Directorate of East Macedonia and Thrace region, Greece.



DTN Queue Management (DTQM)

by Sotirios-Angelos Lenas

During the last years, the interest in Delay/Disruption Tolerant Networks (DTN) has been significantly increased, mainly because DTN covers a vast spectrum of applications, such as Deep Space, satellite, sensor and vehicular networks. Even though the Bundle Protocol seems to be the prevalent candidate architecture for delay-tolerant applications, some practical issues hinder its wide deployment. One of the functionalities that require further research and implementation effort is *DTN Queue Management (DTQM)*. Queue management in traditional networks is used mainly to regulate traffic fluctuations, as well as to assign priorities to specific traffic classes. It often utilizes dropping mechanisms that signal end-users, implicitly or explicitly, for impeding congestion events. Nevertheless, queue management in Delay/Disruptive Tolerant Networks, with long delays and disruptions has to address additional issues. While fair resource allocation and traffic classification are still important, queue management needs also to exploit every available contact opportunity and reschedule traffic prioritization and data storage to handle communication disruptions and delays.

Relevant work on DTN queue management is limited, and usually focuses on specific problems, such as policies or scheduling, providing a narrow approach to the queue management, occasionally isolating joint problems. We have designed a Queue-management approach that employs an enhanced classification scheme that integrates both network (i.e., connectivity) dynamics and traffic requirements by integrating connectivity status into buffering and forwarding

policy, eliminating the possibility of stored data to expire and promoting applications that show potential to run smoothly. Therefore, scheduling is not a product of packet marks and hence, application alone, but rather a joint decision of data priority, application potential to survive disruptions and the network disruptions *per se*.

The designed DTQM architecture is composed by three main components:

- a) an *Admission Control* unit, which determines the criteria that DTN nodes use to accept or reject incoming bundles,
- b) a *Buffer and Storage Management* unit, which determines how accepted bundles should be stored, and
- c) a *Scheduling* unit, which determines bundle service priorities.

We have primarily two goals:

- i) to increase the DTN device throughput via efficient link exploitation and
- ii) to increase application satisfaction.

In order to achieve these goals we have presented the DTQM model analytically and compared it with standard solutions. Moreover, we have developed an evaluation tool by extending ns-2 modules and, based on selective scenarios primarily from Space Communications, we demonstrate the suitability of our model for use in low-connectivity/high-delay environments.

Throughout the numerical analysis and experimental procedure, we assume

DTN Queue Management (DTQM)

by Sotirios-Angelos Lenas

three sending nodes, S1, S2, S3, which are located in space and send traffic generated by various applications (Real-time, Telemetry and Telecommand; all constant bit rate with different sending intervals) and a receiving node R, which is located on earth. All traffic generated by the sending nodes is routed through the routing node Q in which we deploy DTQM. Furthermore, the traffic generated by each sending node is considered to belong to a different class of service with a predefined priority. Thus, we use three queues, one per flow, and three priority classes.

The numerical results of our analysis are presented in Figure 1. We compared classic queuing schemes, such as FIFO and PQ, based on the average delay for each queue in each system. The results show that our approach achieves a performance clearly better than FIFO and in some cases better than PQ, especially when the system utilization factor is high.

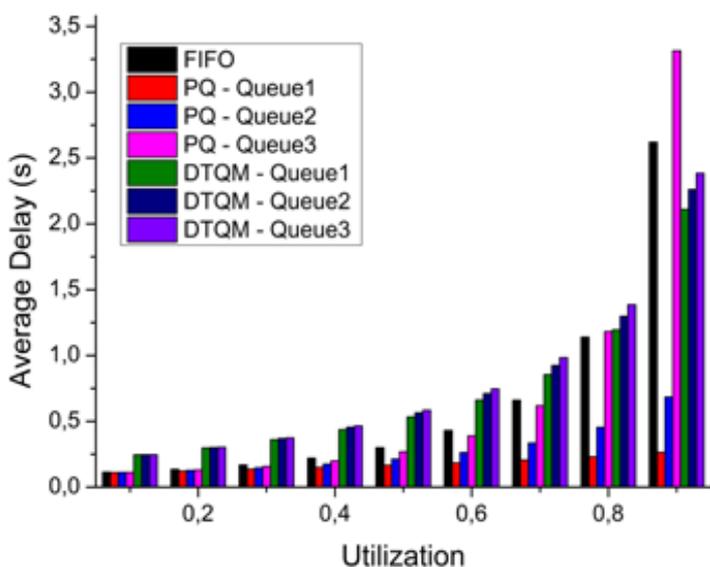


Figure 1. Numerical analysis results

The performance of DTQM was also evaluated in ns-2 by using five connectivity scenarios, each one utilizing a different (randomly generated) connectivity schedule. We compared the obtained results with the corresponding results of a FIFO policy. The results are presented in Figure 2.

The first observation that we can make is that DTQM outperforms Droptail in any case. In particular, we experience a 60% delay decrease on average and in some cases it can reach up to 90% reduction of the corresponding bundle delay using a typical FIFO scheme.

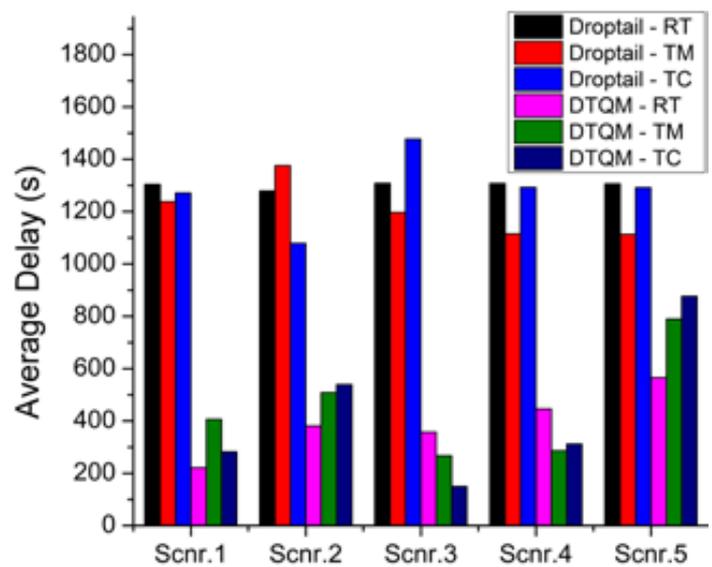


Figure 2. Experimental results

DTQM has the potential to achieve smaller queuing delays and higher application satisfaction when connectivity is scarce.

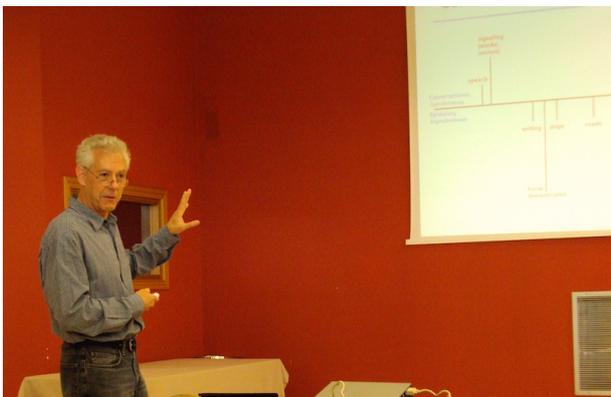
Workshop on “Terrestrial and Space DTN”

Xanthi, Greece, September 6th, 2011

Space Internetworking Center (SPICE) organised a workshop on “Terrestrial and Space DTN” in Xanthi, Greece, on September 6th, 2011. The workshop consisted of five keynote presentations by:

- **Scott Burleigh**, senior researcher at Jet Propulsion Laboratory (NASA);
- **Joerg Ott**, Professor at Aalto University, Finland;
- **Torsten Braun**, Professor at University of Bern, Switzerland;
- **Eiko Yoneki**, senior researcher at Cambridge University, United Kingdom;
- **Lefteris Mamatas**, senior researcher at SPICE, Greece.

Scott Burleigh presented “Tortoise and Hare: Ways of thinking about mission communication”, which acted as an introduction to DTN and highlighted DTN’s main characteristics and advantages, as well as challenges that need to be tackled.



Prof. Joerg Ott presented a novel concept of sharing information in urban areas with his presentation “Floating content: Information sharing in urban areas”. The topic has been



studied both through analytic modeling and simulations.

Eiko Yoneki’s presentation “Towards Data Centric Networking in Cloud and Crowd” was based on four research projects in which University of Cambridge currently participates or has participated in the past years. All projects study novel networking methods and interconnect them with social aspects.

Prof. Torsten Braun gave a presentation on “Delay Tolerant Networking and Content/Service Centric Networking”. In the first part of the presentation, Prof. Braun focused on content-centric networking, while in the second part focus was given on service-centered networks.

Dr Lefteris Mamatas gave a presentation on “Extending Internet infrastructure with DTNs”. Dr Mamatas presented the modeling considerations that should be taken into account, in order to extend the internet architecture with DTN assets; a model that consists of a hybrid network that utilized both UPNs and DTNs and some hybrid routing mechanisms that can be implemented in the aforementioned model.

- Giorgos Papastergiou, Christos V. Samaras and Vassilis Tsaoussidis,
"Where Does Transport Layer Fit into Space DTN Architecture?",
5th Advance Satellite Multimedia Systems Conference and 11th Signal Processing for Space Communications Workshop, ASMS-SPSC 2010, 13-15 September 2010, Cagliari, Italy
- Nikolaos Bezirgiannidis and Vassilis Tsaoussidis,
"Packet size and DTN transport service: Evaluation on a DTN Testbed",
International Congress on Ultra Modern Telecommunications and Control Systems 2010, Moscow, October 2010
- Avi Arampatzis, Pavlos Efraimidis and George Drosatos,
"Enhancing Deniability against Query-Logs",
The 33rd European Conference on Information Retrieval, ECIR 2011, LNCS 6611, pp.117-128, Dublin, Ireland, 2011
- S. Lenas, S. Dimitriou, T. Tsapeli and V. Tsaoussidis,
"Queue-Management Architecture for Delay Tolerant Networking",
WWIC 2011, Vilanova i la Geltrú, Barcelona, Spain, on June 15-17, 2011
- D. Vardalis and V. Tsaoussidis,
"Energy-efficient Internetworking with DTN",
WWIC 2011, Vilanova i la Geltrú, Barcelona, Spain, on June 15-17, 2011
- E. Koutsogiannis, L. Mamas and I. Psaras,
"Storage-enabled Access Points for Improved Mobile Performance: An evaluation study",
WWIC 2011, Vilanova i la Geltrú, Barcelona, Spain, on June 15-17, 2011
- T. Spyridopoulos and V. Katos,
"Towards a forensically ready cloud storage service",
6th International Annual Workshop on Digital Forensics and Incident Analysis (WDFIA 2011), London, UK, July 7-8 2011



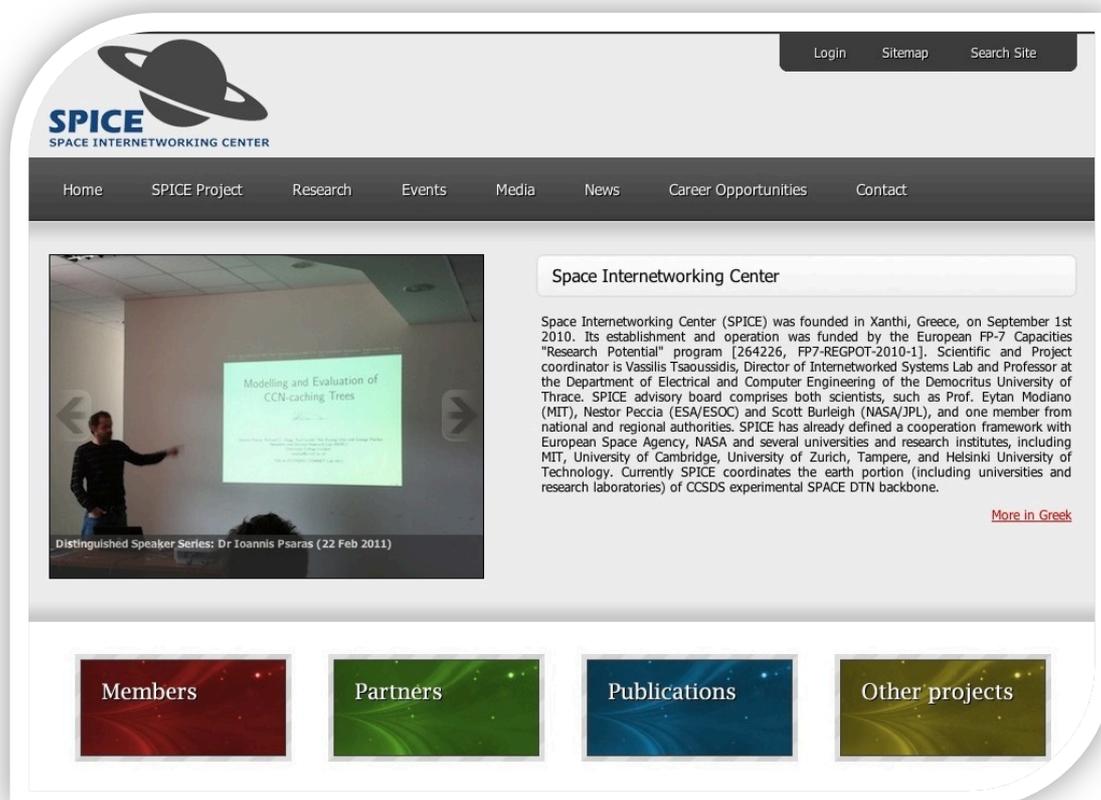
SPICE Newsletter and Website

Space Internetworking Center (SPICE) website can be found at:

www.spice-center.org

Here you will find:

- ❖ Previous issues of SPICE Update newsletter
- ❖ A comprehensive overview of the project, including details about partners and the various work packages
- ❖ Information on Space Internetworking Center, research interests and members
- ❖ Event information – a complete list of lectures, colloquia and relative events
- ❖ Publications



Upcoming Events

Journal of Internet Engineering (JIE)

Special Issue on “Future Network Architectures”

*New call for the recruitment of
senior researchers at SPICE*

Workshop on the “Evolution of DTN”

Santorini, Greece

CCSDS Spring 2012 Meeting,

Darmstadt, Germany

**Space Internetworking Center
can host eight researchers
for a time period of one month top.
During that period incoming researchers
will work together with researchers from
SPICE on various networking topics.**

Join us!

Newsletter Editor

■ Ioannis Komnios

Newsletter Advisor

■ Prof. Vassilis Tsaoussidis

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Space Internetworking Center



Democritus University of Thrace

School of Engineering

Panepistimioupoli Xanthi

Kimmeria

Building A

67100

Xanthi, GREECE

Professor Vassilis Tsaoussidis

Telephone/Fax: 0030.25410.79.554

E-mail: contact@spice-center.org

www.spice-center.org

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