A Goal Driven Dynamic Event Subscription Approach

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Overview of presentation

- Introduction
- Event Subscriptions Recommender (ESR)
- Illustrative Scenario
- Evaluation
- Conclusions
The Event Marketplace (1/2)

- Event-driven World: services exchange events asynchronously
- Events are input for services
- Just as Services should be tradable, so should events
- To receive events, the sources of events must be known
- A marketplace like a search engine provides visibility to distributed sources of events

- Nowadays, Everything can generate Events
The Event Marketplace (2/2)

- The drastic increase in the amount of event sources and subscription possibilities requires efficient utilization of active capability in order to
  - Conserve resources such as network, memory and processing power associated with rule processing, event handling and maintaining of subscriptions (Cost).

- Sometimes in Event Marketplaces it is impossible to know in advance all the event sources that might relevant or needed

**Motivation** - A Mechanism for Dynamic Event Subscriptions that will enable how a service in the distributed EDA will "decide" which (complex) event to subscribe to and for how long.
Situation Action Networks (SANs)

- SAN is a Goal-directed hierarchical modeling approach that targets automatic search for new goals when specific circumstances, i.e. situational and contextual settings, arise and adjust active capability in order to satisfy the currently active goals.

- In goals-directed modeling, goals are typically refined into sub-goals that elaborate how the goal is achieved, creating in such way hierarchical structure.
**A Basic SAN**

- **Goal** expresses *what* is pursued, i.e. the purpose.
- **Situation** "monitors" *when* a situation occurs. Blocks meanwhile.
- **Context - Condition**
  - Updates and enriches application context from situation metadata.
  - Checks whether context conditions hold.
- **Action** to take if situation occurs and context condition is true.
  - Situation-driven execution or Goal decomposition.

*The black arrow indicates the order of visiting child nodes. Parent is visited first.*
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**Event Subscriptions Recommender (ESR)**

- Event Subscription Recommender (ESR): undertakes the task of providing recommendations based on service context and event semantics.
- recognizes significant situations in order to recommend event subscriptions to new event sources and complex events.

**ESR provides added value to services by enabling them to subscribe:**
- to the “right events”
- at the “right time” and
- for the appropriate duration, reducing the cost and network traffic.

*“significant situations”:*
- interesting situations referring to the states of a system along with its environment that create improvement opportunities
- critical situations referring to the need for mitigating a risk or hazard.
Event Subscriptions Recommender (ESR)

- ESR is a Java based software component that
  - exploits SAN’s dynamic active capabilities for providing event subscription recommendations
- ESR interacts with an external event middleware that provides functionalities such as
  - Relaying and Storing events
  - Subscribing/Unsubscribing to event streams
  - Deploying/Undeploying CEPATs to a CEP engine
- ESR’s main subcomponents are:
  - SAN Editor
  - SAN Engine
  - Recommendation Manager
ESR Architecture
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The International Maritime Organization (IMO) requires all vessels to carry an AIS (Automatic Identification System) transponder on board, which transmits their position, speed, and course, among some other static information, such as vessel’s name, dimensions and voyage details.

A vast amount of real time events are available from portals (e.g. http://www.aishub.net/) connected to automatic identification systems (AIS) that contain important vessel information worldwide.
A challenge is to provide a global service to port authorities that will allow them to exploit efficiently all these events in an automated way in order to enforce safety measures to specific type of vessels (High-speed Crafts).

We examine two safety goals related to high-speed crafts that are under the jurisdiction of a China port authority:

- i) observe whether vessels maintain low speed during windy conditions and issue fines otherwise,
- ii) observe whether or not these vessels reduce their speed when smaller boats or other high speed boats appear in proximity.
AISHub Scenario

Speeding in Windy Conditions

Small Boats in Proximity
Safety in high Speed Crafts SAN

- Safety in High Speed Crafts
  - HighSpeed Craft is Speeding
    - Located in China Sea?
      - //any
        - Stop Observing High Speed
          - Vessel in Proximity
            - Is it a Small Boat or High-speed vessel?
              - Observe Speed
                - Issue Warning
                  - Wind Direction Opposite or Sideways of Course?
          - Stop Observing High Speed Craft
            - Speed wasn’t Reduced when Proximity Increased
              - High Speed Craft Distance to Small Boat is not Increasing?
                - Issue Fine
      - Keep Low Speed Close to Small Boats or High-Speed Vessels
        - Keep Low Speed in Windy Conditions
          - High Speed in Windy Conditions
            - Issue Warning
              - Issue Fine

- HighSpeed Craft has Low Speed
  - HighSpeed is being Monitored?
AISHub Scenario

Event Subscription Recommendations

ESREvent_AISHUB_UC_Sailing_in_Windy_conditions

<http://events.event-processing.org/ids/esr1341576653036#event>

a : ESREvent_AISHUB_UC_Sailing_in_Windy_conditions;
:endTime "2012-07-06T12:10:25Z"^^xsd:dateTime;
:stream s:ESRRecom;

<http://imu.ntua.gr/play/esr/examples/aishub/2#id>

"esr1341576653036";

<http://imu.ntua.gr/play/esr/examples/aishub/2#recommendation>

"WS: CC-z: Vessel THEOLOGOS F (240521000) current speed is 22 Knots, v:

ESREvent_AISHUB_UC_Subscription_to_Proximity_Events_Stream

<http://events.event-processing.org/ids/esr1341577297563#event>

a : ESREvent_AISHUB_UC_SUBSCRIPTION_TO_PROXIMITY_EVENTS_STREAM;
:endTime "2012-07-06T12:14:14Z"^^xsd:dateTime;
:stream s:ESRRecom;

<http://imu.ntua.gr/play/esr/examples/aishub/2#id>

"esr1341577297563";

<http://imu.ntua.gr/play/esr/examples/aishub/2#recommendation>

"ESRRecom: Subscribe to Vessel's S/Y AFRODITI (239054100) Proximity Event stream in order to monitor its distance from a near boat";

<http://imu.ntua.gr/san/esr1.1/recommendation/esr1341577297563>
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AISHub Scenario

- We’ve created a dataset based on Vessel Event Stream and Proximity Event Stream of AISHub.net

Dataset details:
- Events spanning about 3 days
- Around 1,54 millions of events from all over the world
- 2885 unique Vessels
- 64456 Vessel events
- 1470642 Proximity Events
- 49704 events with wind information
- 8498 events about Vessels located in China sea
- 7488 events about High-Speed Vessels in China Sea

Results
- 22 Recommendations
- 20 weather warnings
- 2 fines due to high-speed near small boats
SANs Utilization

Number of SANs vs Number of Events in Marketplace (in Thousands)
Events Utilization Comparison

The graph shows the comparison of events utilization over time. The x-axis represents the number of events sent, and the y-axis represents the number of events received, both measured in thousands. The line graph indicates a steady increase in both received and sent events over time, with a notable spike in the latter part of the timeline.
Subscriptions, Unsubscriptions and Active Subscriptions

![Graph showing the relationship between the number of events in the marketplace and the number of subscriptions, unsubscriptions, and active subscriptions.](image-url)
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Future Work

- Define necessary extensions to our model in order to
  - reduce the upfront design effort that is currently needed for creating SAN models.
- We are working towards the introduction of “Abstract Situations” and “Action Pools” as means to abstract situations and actions, respectively
  - along with techniques that will allow for run-time deduction of the most appropriate Action or SubGoal.
- Action Pools will be used coupled with search and selection methods (e.g. semantic similarity, multicriteria methods etc.).
Thank you for your attention!!!