



Siren - An Ambulance Simulation System



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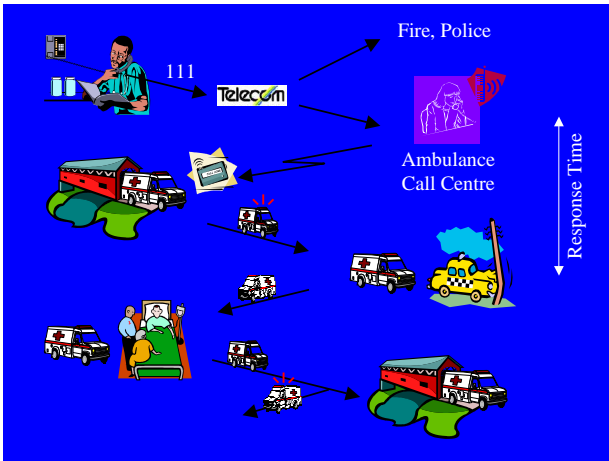
Dr Shane Henderson
CORNELL

Optimal Decision Technologies Ltd

Better Ambulance Rostering Technology (BART) Project



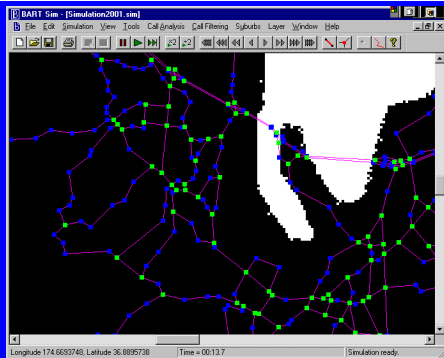
- Auckland University/St John Collaboration
- The Problem
 - Modify staff rosters to better meet targets
 - But how many crews do we need to get the work done?



Simulation with BartSim

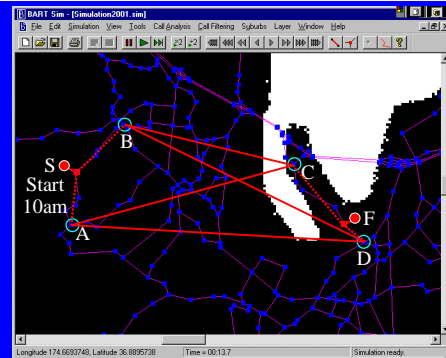
- BartSim system written in C and C++
 - Handles complex ambulance dispatch and routing
 - Specialised data visualisation capabilities
- Replays actual historical calls in the simulation
 - Detailed historical time stamps for each call
 - Locations for calls and destination hospitals
- Detailed travel time modelling
 - Predict travel times under time-varying congestion
 - No automatic vehicle location GPS data available
 - Use AM, PM, and off-peak travel speeds from ARC equilibrium model

Travel Model



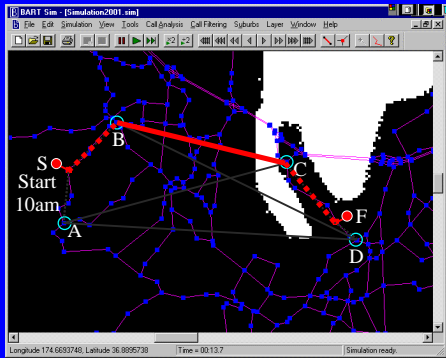
- Nodes identify both joins & positions
- But only 800 decision nodes
 - 800² pre-computed routes to store

Generating Simulated Trips



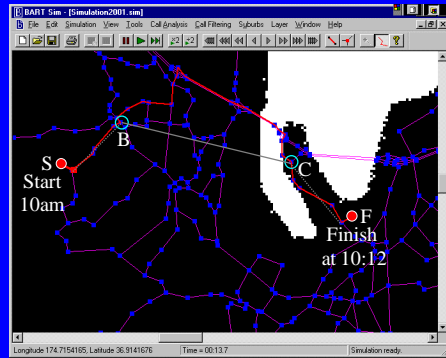
- Choose fastest route traveling via decision nodes
- use pre-computed routes between decision nodes
- use interpolated speeds given by trip start time

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Melbourne Development

- Approached by Melbourne
 - Metropolitan Ambulance Service (MAS)
 - Formal international tender process
- Tender secured
 - Partner: Optimal Decision Technologies (ODT)
- BartSim re-born as SIREN
 - Simulation for Improving Response of Emergency Networks






The Melbourne Operation

- Bigger Problem
 - Population of 3.5 million (3 times Auckland's)
 - Approx 70 bases (4 times Auckland)
- Bigger Road Network
 - Union of two different networks
 - Limited speed information - tuning required
 - Network approx 2.5 times bigger than Auckland model
 - Many pre-computed routes!

The Melbourne Operation



- Many More Vehicle Types (not one!)

MC	2 MICA officers
PR	Paramedic Response Unit
AP	2 Ambulance Paramedic officers
MR	MICA Responder
OC	On call

The Melbourne Operation




Emergency Ambulance Network 10 June 2005

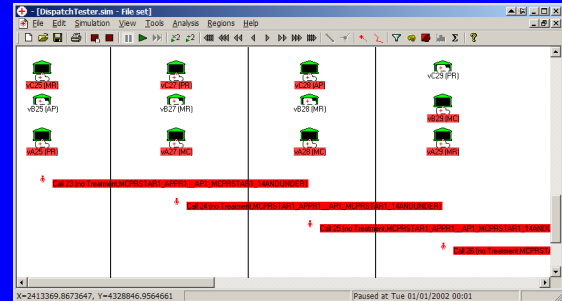
LEGEND

- Emergency Ambulance Roamers (24 Hour)
- Single Paramedic Response Units (24 Hour)
- Single MICA Paramedic Responders
- Paramedic Response Units (24 Hour) to be converted to MICA
- Pink Street Ambulances

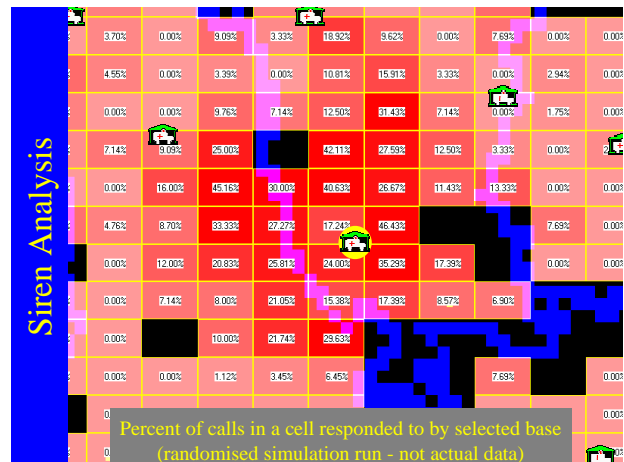
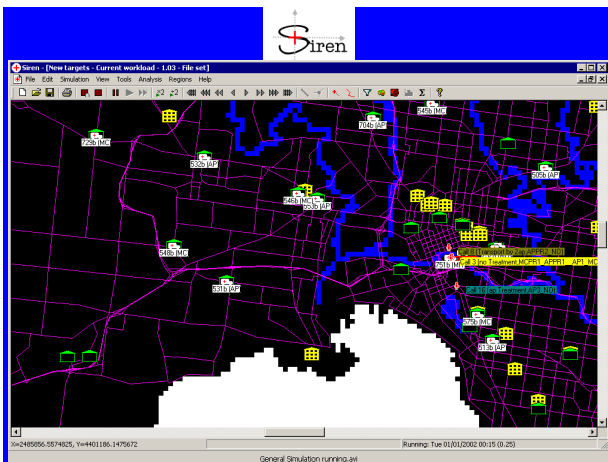
The Melbourne Operation

- Detailed Case Classification System
 - Many case types
- Complex Dispatch Rules
 - Depend on case type
 - Multiple vehicle dispatch
 - More than 1 vehicle often sent to a scene

Dispatch Logic Testing



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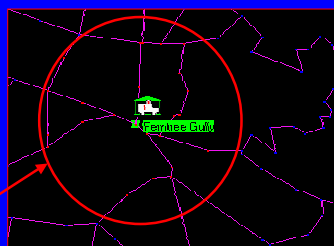
Better Base Locations using Siren

Sarah Kirkpatrick, Engineering Science, 2004

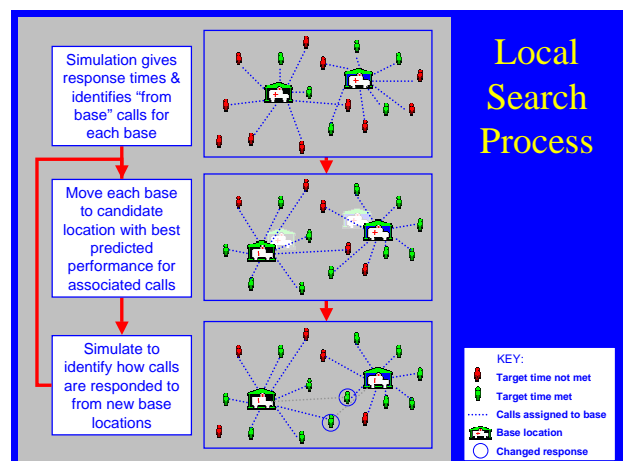
- Exploit realism of simulation and historical call data

- Start with existing base locations and repeatedly test small base movements for improvement

Candidate Base Location Nodes

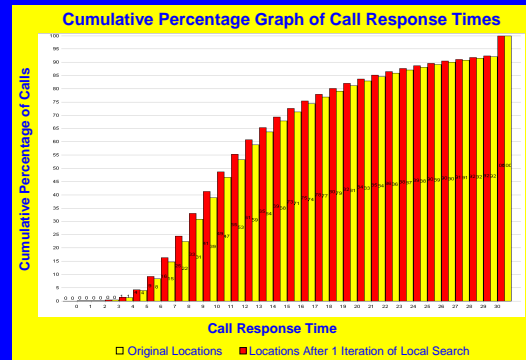


- Only consider effect on calls responded to "from base"
 - these calls will be impacted most by changed base locations



Local Search Results

- All call data was randomised so the results presented do not reflect the actual performance of the Melbourne Metropolitan Ambulance Service
- New base locations were tested using a second independent set of calls
- Improvements made in all response targets
 - 9.0% more priority code 1 calls reached within 8 minutes
 - 2.0% more priority code 1 calls reached within 13 minutes
 - 1.5% more priority code 2 calls reached within 25 minutes
 - 0.5% more priority code 3 calls reached within 60 minutes



Base locations from the Local Search resulted in a higher percentage of calls with shorter response times (randomised data - actual results will vary)

Ongoing Siren Developments

- New implementations planned for
 - Australia
 - Canada
 - United Kingdom
- New research challenges
 - Faster simulation results
 - Using GPS vehicle data

