

## Hermes: A Software Framework for Mobile, Context-Aware Trails Applications

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# Presentation Contents

- Introduction to Trails Concept
- Hermes Project Overview
- Current State of the Art

# Trails

A trail is...

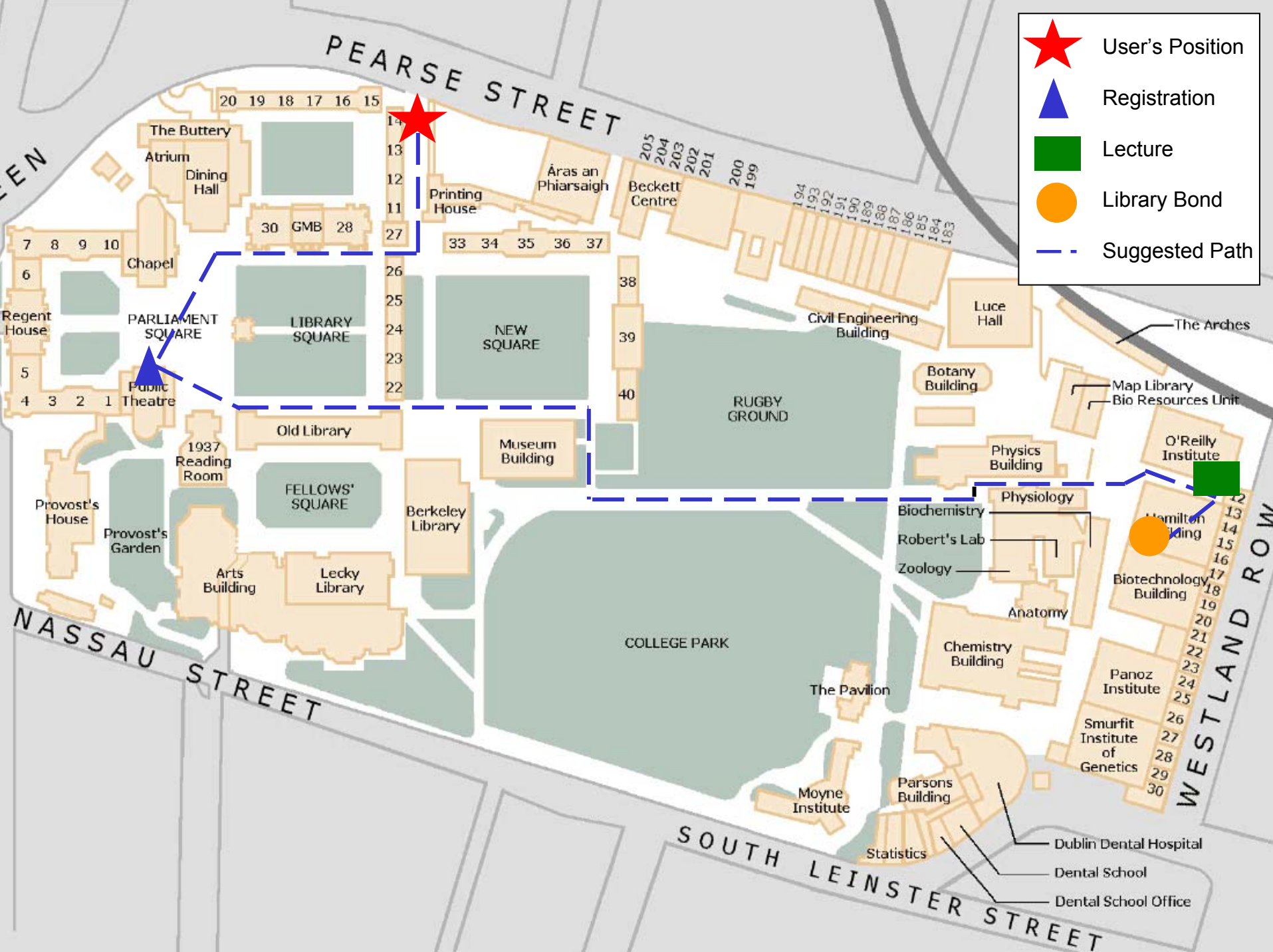
- A collection of locations
  - a collection rather than a strict sequence
- together with associated information and activities
  - can be mandatory or optional, associated priority
- and a dynamically reconfigurable recommended visiting order

# Mobile, Context-Aware Apps

- Mobile, context-aware applications are those that...
  - run on wireless devices e.g., PDAs
    - Afford the possibility of moving with the device
  - have an awareness of the physical and social situation in which they are deployed

# Trails – Example

- Student assistance application
- First day at Trinity College Dublin
- Mandatory tasks
  - Register
  - Submit signed library bond
  - Attend introductory lecture with course director
- Optional Activities
  - Joining societies
  - Viewing buildings of interest



- ★ User's Position
- ▲ Registration
- Lecture
- Library Bond
- - - Suggested Path

PEARSE STREET

EEN

Regent House

The Buttery  
Atrium  
Dining Hall

Chapel

PARLIAMENT SQUARE

Public Theatre

1937 Reading Room

Provost's House

Provost's Garden

Arts Building

Lecky Library

NASSAU STREET

Old Library

FELLOWS' SQUARE

Berkeley Library

Museum Building

LIBRARY SQUARE

NEW SQUARE

RUGBY GROUND

COLLEGE PARK

The Pavilion

Moyne Institute

Parsons Building

Statistics

20 19 18 17 16 15

14

13

12

11

30 GMB 28

Printing House

Áras an Phiarsaigh

Beckett Centre

205 204 203 202 201

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194 193 192 191 190 189 188 187 186 185 184 183

33 34 35 36 37

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Civil Engineering Building

Luce Hall

The Arches

Botany Building

Map Library

Bio Resources Unit

O'Reilly Institute

Physics Building

Physiology

Biochemistry

Robert's Lab

Zoology

Anatomy

Hamilton Building

Biotechnology Building

Chemistry Building

Panoz Institute

Smurfit Institute of Genetics

27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

WESTLAND ROW

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SOUTH LEINSTER STREET

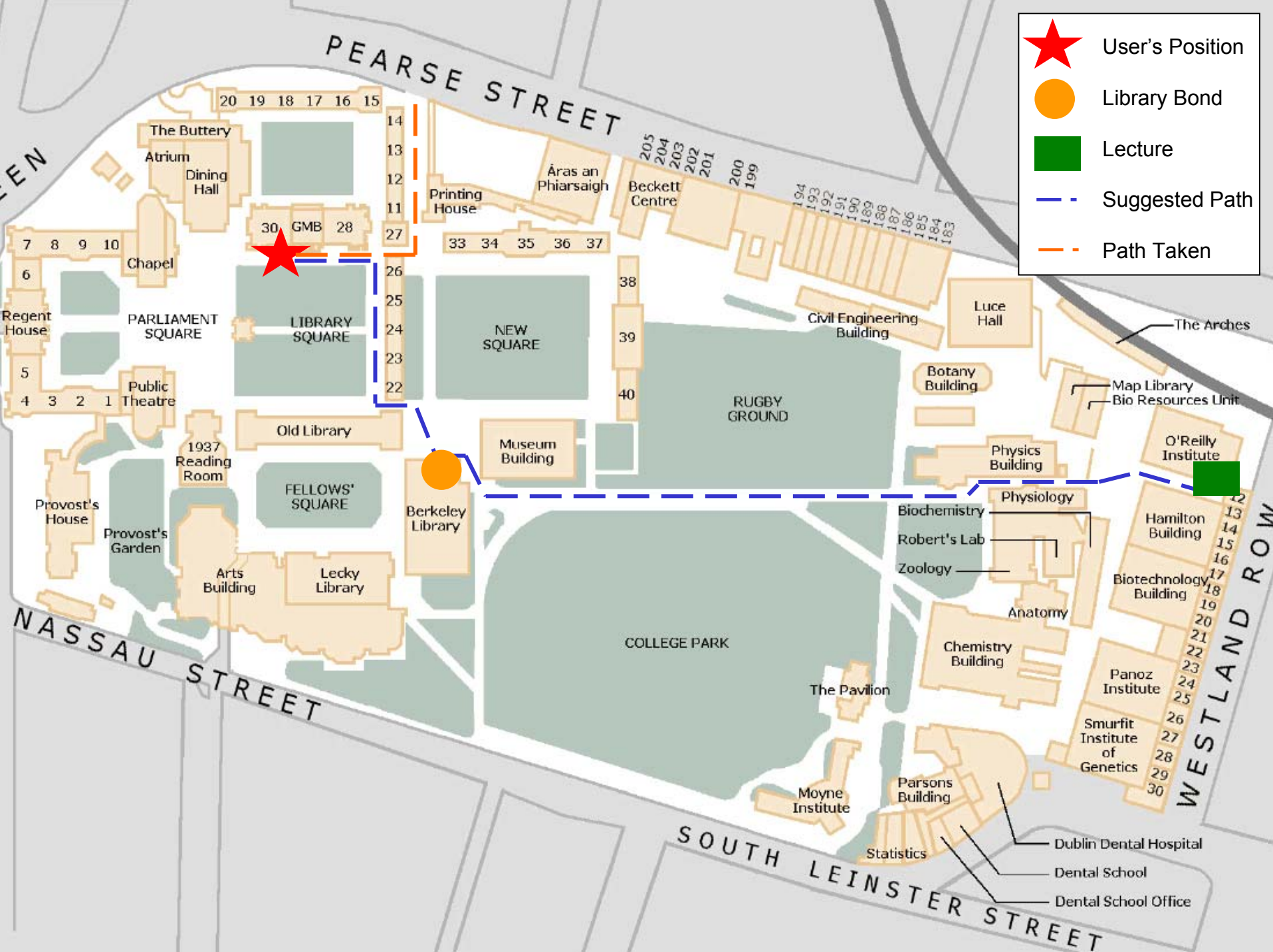
Dublin Dental Hospital

Dental School

Dental School Office

## Trails – Example: II

- On the way to the registration point new context information is sensed
- A significant number of other system users are attempting to register, increasing the original estimated registration time
- Registering will make the user late for her next activity, which has a higher priority than registration



- ★ User's Position
- Library Bond
- Lecture
- - - Suggested Path
- - - Path Taken

PEARSE STREET

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The Buttery

Atrium Dining Hall

Chapel

PARLIAMENT SQUARE

Public Theatre

Provost's House

Provost's Garden

1937 Reading Room

Arts Building

Lecky Library

NASSAU STREET

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NEW SQUARE

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Anatomy

Chemistry Building

The Pavilion

Moynes Institute

Parsons Building

Statistics

Dublin Dental Hospital

Dental School

Dental School Office

SOUTH LEINSTER STREET

WESTLAND ROW

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# Why Study Trails?

- We consider trails applications to be archetypal ubiquitous computing applications
  - Intermittent network connectivity
  - Context-based application adaption
  - An intuitive representation of the user's environment is required
- In developing mobile, context-aware trails based applications we must consider
  - Impact on social environment (privacy, HCI)
  - Task dynamism and task support
  - Device characteristics

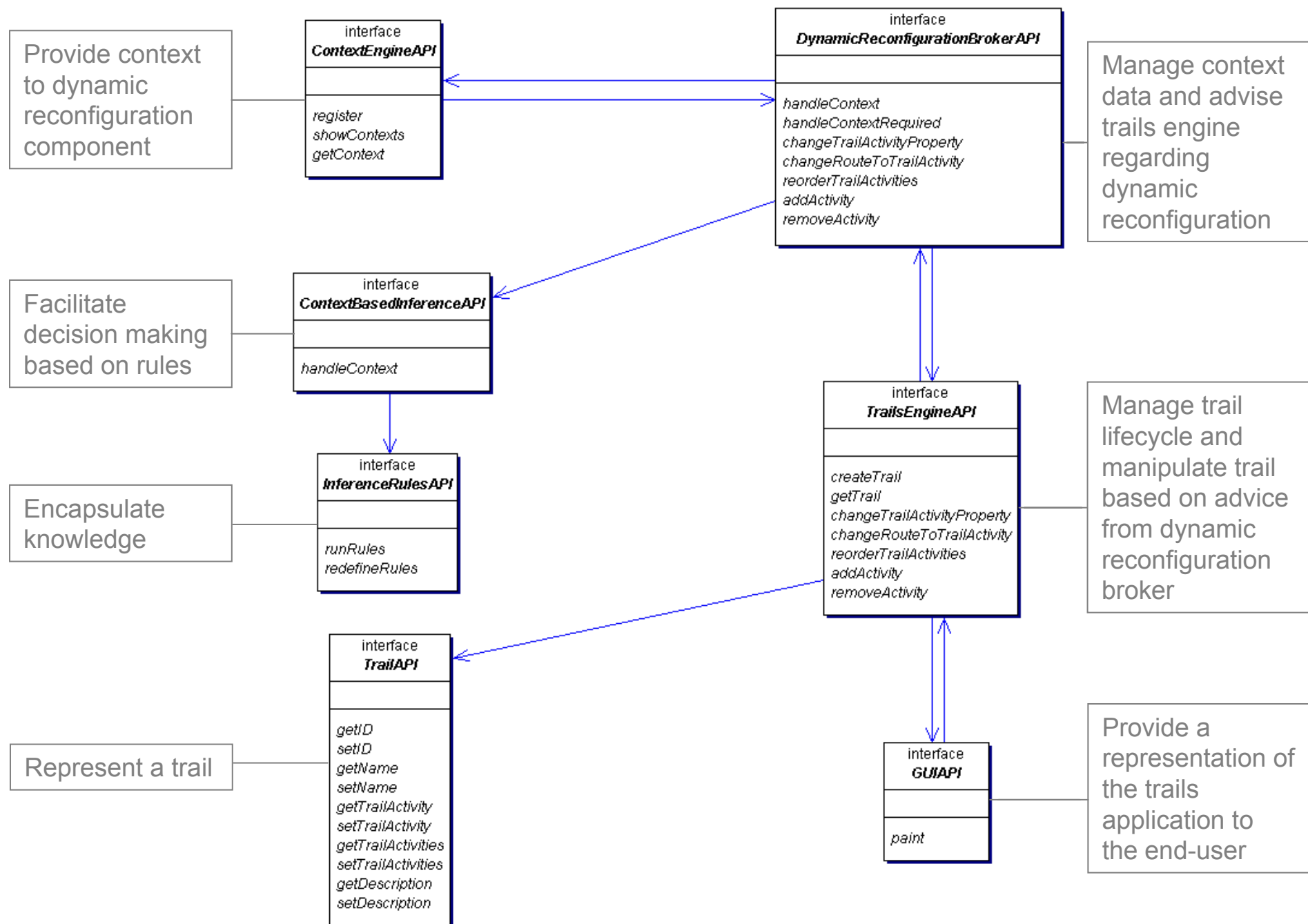
# Hermes

- Hermes: a software framework for mobile, context-aware trails-based applications
- Support developers by providing components common to all trails-based applications
- Key focus areas
  - Providing realistic trails based on a wide range of context
    - location, time, activity, weather, user preferences, historical data, and awareness of other application users
    - Context-based trail generation
    - Automatic dynamic context-based reconfiguration
  - Rich task specification
    - priorities, dependencies, mandatory/optional, subtasks
  - Collaborative context

# Hermes: Initial Framework Design

- Four mobile, context-aware trails-based apps
  - Specified requirements
  - Designed using UML (use-case, component, class)
  - Analysed commonality

	Navigation	Context Awareness	Trail Adaptability	Compulsory Activities	Optional Activities	Group Communication
Route Planner	➤	➤	➤	-	➤	-
Courier Support	➤	➤	➤	➤	-	➤
Treasure Hunt	➤	➤	➤	➤	➤	➤
Student Support	➤	➤	➤	➤	➤	-



# Framework Development

- Framework development is an iterative process driven by multiple application development efforts
- Framework refinements should occur following the development of each application
- The resulting product is a generic framework that can cater for the requirements of many different domain specific applications
- We will implement the four trails applications mentioned earlier and derive the Hermes framework

# Current Work

- Implementing the student support application described in the example presented earlier
- The application will be validated by user study involving masters students at Trinity College Dublin – October 2004
- Focus areas
  - Context-based dynamic reconfiguration of active trails
  - Rich task specification
  - Collaborative context

# State of the Art

- The GUIDE project, Lancaster University, UK
- A dedicated mobile, context-aware tourist guide system
- Structured tours, generated based on context which dynamically changes during use
- However...
  - Dynamic reconfiguration only occurs periodically
  - A limited number of contexts are sensed automatically
  - Designed from the ground up with only GUIDE in mind, opportunity to reuse GUIDE components in future development efforts is limited

## State of the Art: II

- Cyberguide/CyBARguide – context-aware tourist guides
- The Stick-e Document – electronic post-it note
- Mobile Aquarium tour guide
- HyCon – a framework for mobile hypermedia which supports trail creation

## State of the Art: III - Limitations

- Tourist guide applications featuring trail generation and basic dynamic reconfiguration capabilities represent the current state of the art
- Two main limitations with current state of the art
  - Not diverse in terms of target audience
  - Unable to accurately reflect the user's environment

# References

- [1] K. Cheverst, N. Davies, K. Mitchell and A. Friday. "Experiences of Developing and Deploying a Context-Aware Tourist Guide: The GUIDE Project". In Proceedings of the Sixth Annual International Conference on Mobile Computing and Networking, p. 20-31, Boston, Massachusetts, 2000. ACM Press.
- [2] G. Abowd et al. "Cyberguide: A Mobile Context-Aware Tour Guide". ACM Wireless Networks - Special issue: Mobile Computing and Networking: selected papers from MobiCom '96, p. 421-433. New York, 1997.
- [3] P.J. Brown. "The Stick-e Document: a Framework for Creating Context-aware Applications". In Proceedings of International Conference on Electronic Documents, Document Manipulation, and Document Dissemination (EP 96), Palo Alto, California., 1996, pp. 259-272. Proceedings published in Origination, Dissemination, and Design (EP-ODD), vol. 8, no. 1, John Wiley & Sons, New York, 1996, pp. 1-13.
- [4] F. Bellotti, R. Berta, A. De Gloria and M. Margarone. "User Testing a Hypermedia Tour Guide". IEEE Pervasive Computing, Vol. 1, No. 2, April-June 2002.
- [5] N.O. Bouvin, B.G. Christensen, K. Grønbæk, F.A. Hansen. "HyCon: A Framework for Context-aware Mobile Hypermedia". Department of Computer Science, Aarhus University. New Review of Hypermedia and Multimedia (NRHM). Vol 9. 2003.