New Zealand

Generating mobile device user interfaces for diagram-based modelling tools

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Te Whare Wānanga o Tāmaki Makaurau

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The University of Auckland

Talk Outline

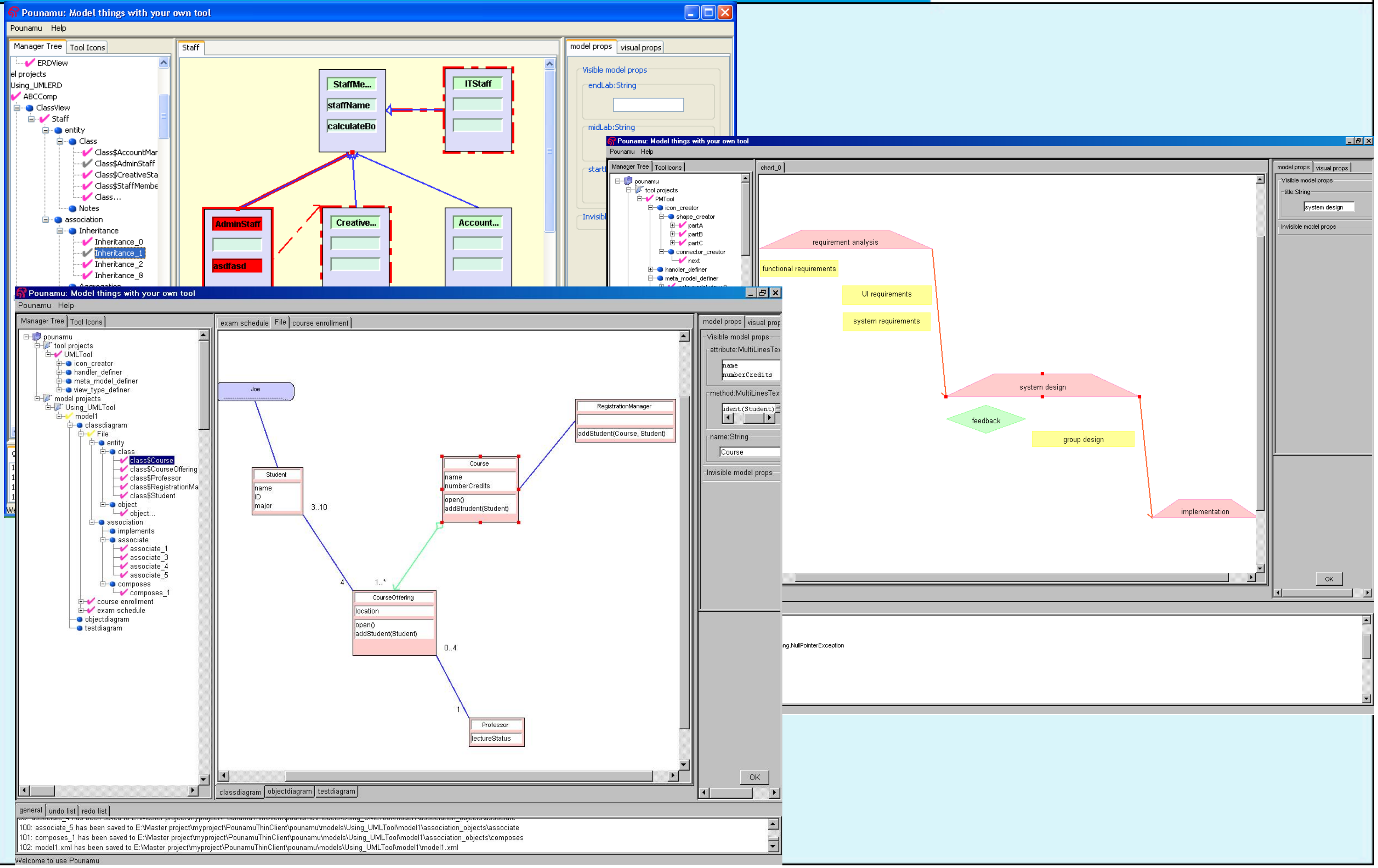
- Background
- Why mobile deployment?
- Constraints and Requirements
- Solution Architecture
- User Interface Adaptations
- Implementation
- Evaluation
- Summary

Background

- Our research focus: Meta tools for specifying and generating multiple view, multiple representation diagrammatic tools
  - JViews/JComposer (Java heavy weight UI)
  - Pounamu (Java, light weight UI)
  - Marama (Eclipse platform specific)

  - Typical use: specification of domain specific visual language environments

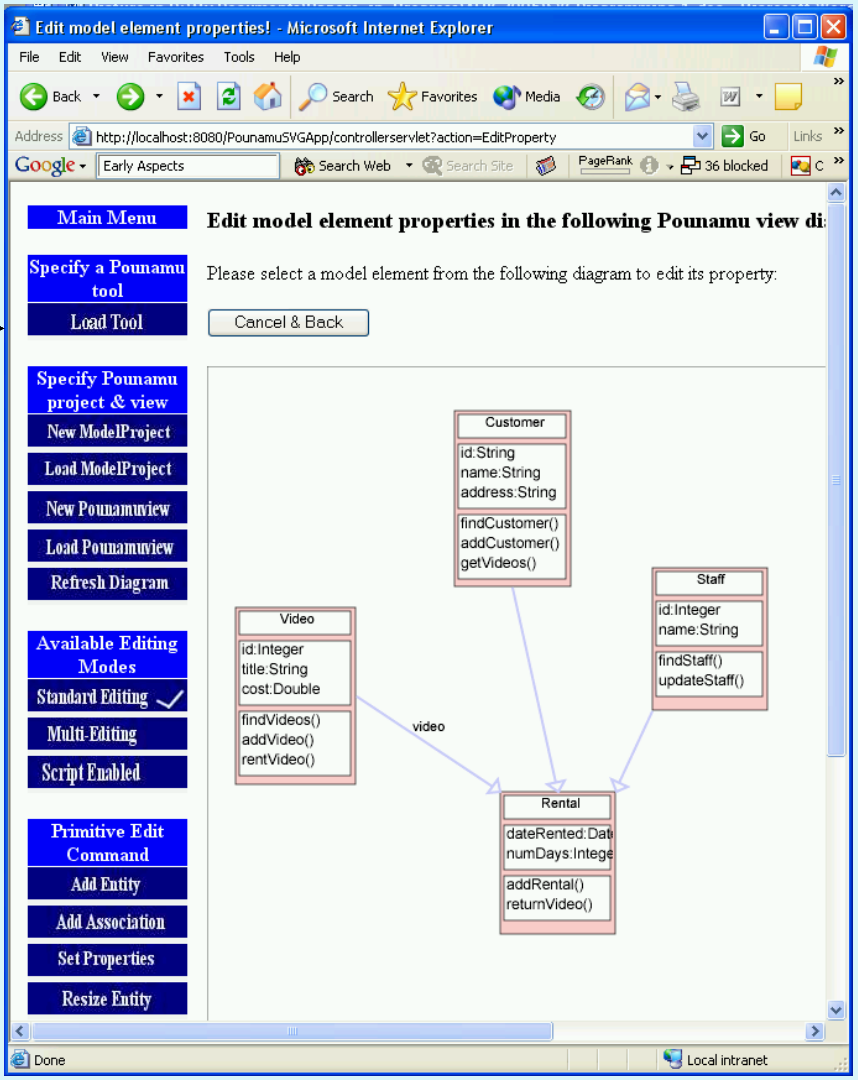
Background



```
100: associate_5 has been saved to E:\Master project\myproject\PounamuThinClient\pounamu\models\Using_UMLTool\model1\association_objects\associate
101: composes_1 has been saved to E:\Master project\myproject\PounamuThinClient\pounamu\models\Using_UMLTool\model1\association_objects\composes
102: model1.xml has been saved to E:\Master project\myproject\PounamuThinClient\pounamu\models\Using_UMLTool\model1\model1.xml
Welcome to use Pounamu
```

Background

- Want to be able to deploy generated tools on a variety of platforms
  - Thick client
  - Thin client (browser based) →
  - **Mobile devices** (thin client, low resolution, low bandwidth)
- With no additional programming needed by the tool designer



Edit model element properties in the following Pounamu view di

Please select a model element from the following diagram to edit its property:

Why mobile deployment?

- Increasing need to review and amend diagrammatic information while mobile
  - Particularly useful for:
    - *Project management applications eg Gantt charts*
    - *Design/installation/maintenance diagrams for on site use*
- Increasing convergence of mobile functionality onto one handheld platform
  - Corresponding unwillingness to carry multiple devices around
- Increasing size and resolution of handheld device UIs

Constraints and Requirements

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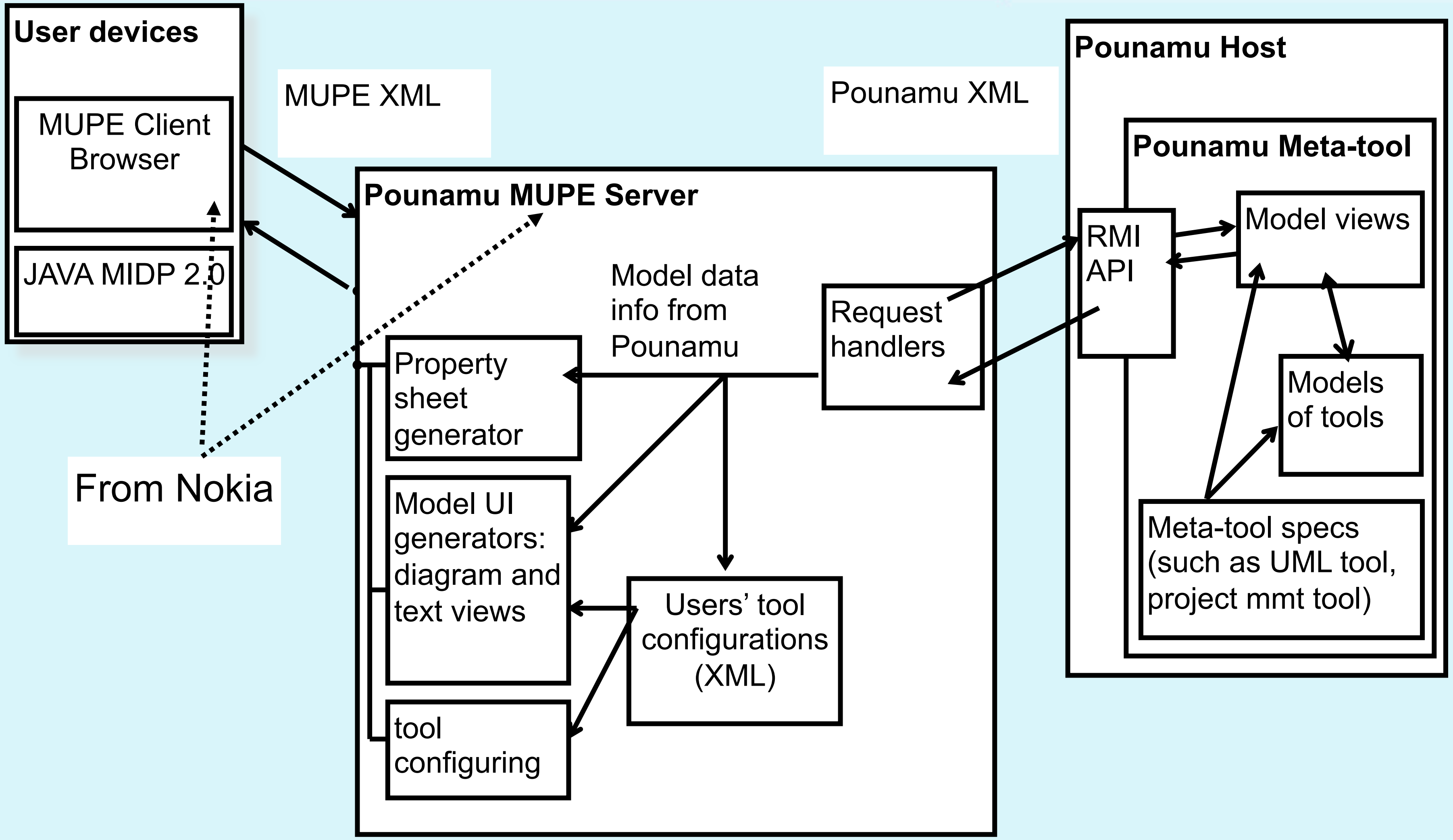
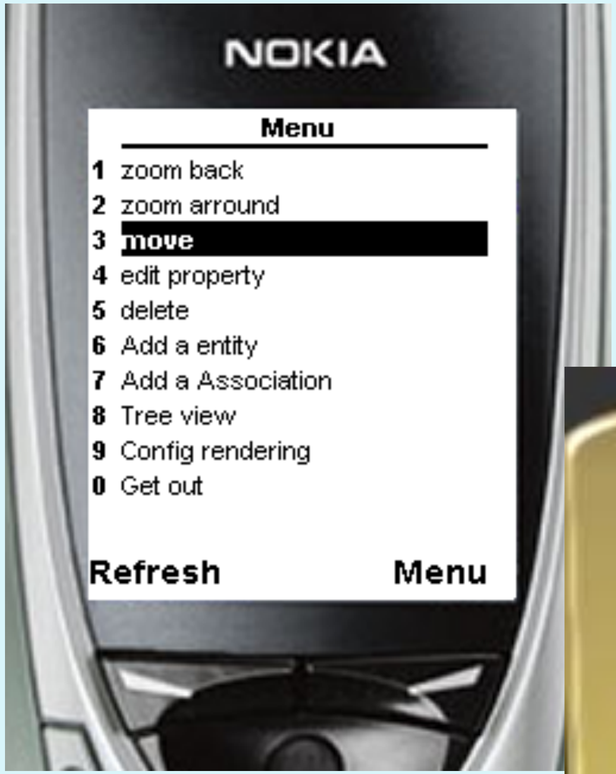
- Constraints imposed by mobile device deployment:
  - Relatively low processor speed, small memory and storage
  - The wide range of devices with a variety of different operating systems
  - Diagram rendering limitations of most current mobile devices
- Requirements resulting from these constraints
  - Need for techniques to display large diagrams on small screens and yet still keep the diagram meaningful
  - Need for techniques to navigate large diagrams and between multiple views (diagrams) of a model
  - Need to support user preferences so that different users can specify different diagram content rendering, zooming and navigation configurations via their mobile device

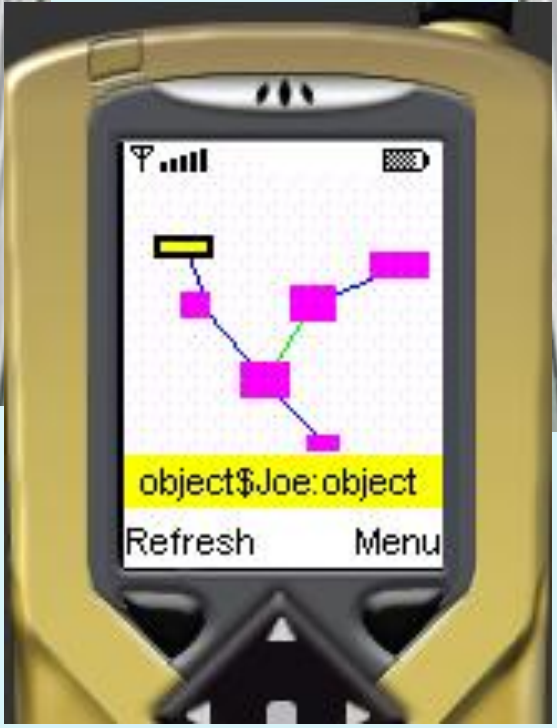
Mobile Deployment Architecture

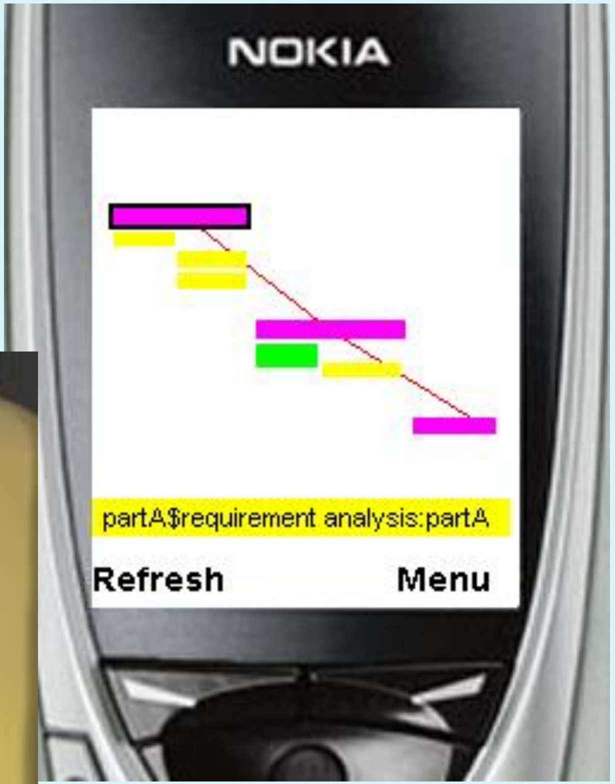


Example usage


Menu
1 zoom back
2 zoom arround
3 move
4 edit property
5 delete
6 Add a entity
7 Add a Association
8 Tree view
9 Config rendering
0 Get out

Seperate button accessible menu


object$Joe:object


partA$requirement analysis:partA

Overview views use proportional diagram shrinking & omit details

User Interface Adaptations

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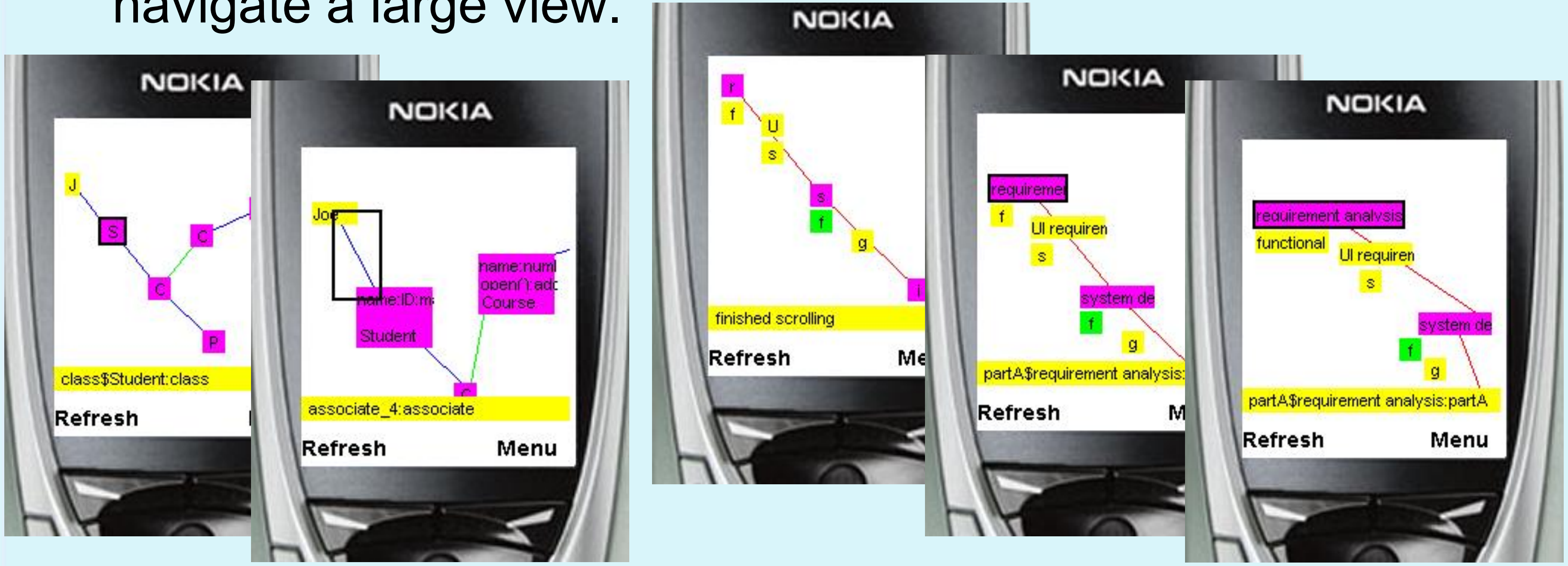
- Goal is to eliminate additional programming
  - Aim to directly generate diagrams from same Pounamu XML spec as for thick client
- But direct representation of complex diagrams on mobile devices is problematic
  - Screen size and resolution
  - Navigation and selection difficulties
- Thus need some adaptations but need these to be generic so no programming required, just minimal end user configuration
- Specific adaptations:
  - Multiple configurable levels of detail for diagram elements
  - Navigation/zooming support
  - Editing support
  - End user configuration support

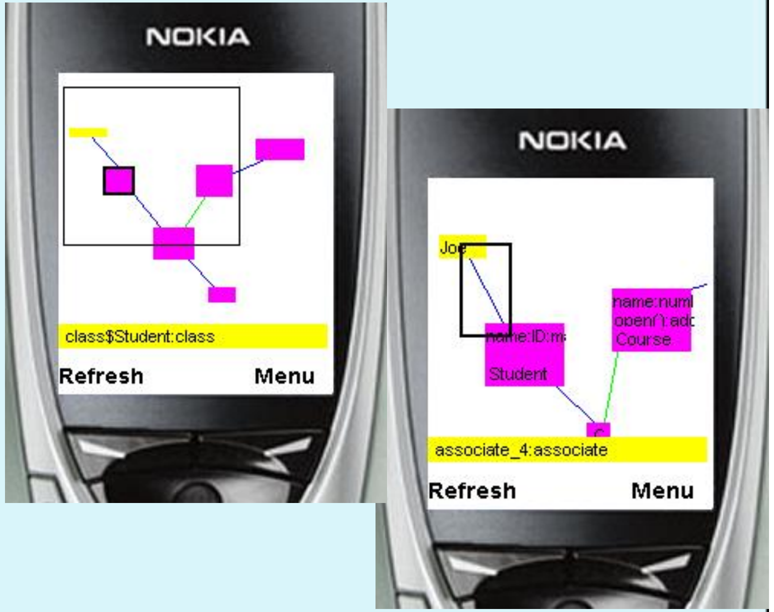
Levels of detail

- Allows users to define multiple representations for a diagram at different levels of detail.
- Each diagram element can be separately selected and zoomed between its multiple levels of representation.
- Automatic zooming of elements is supported as users navigate a large view.



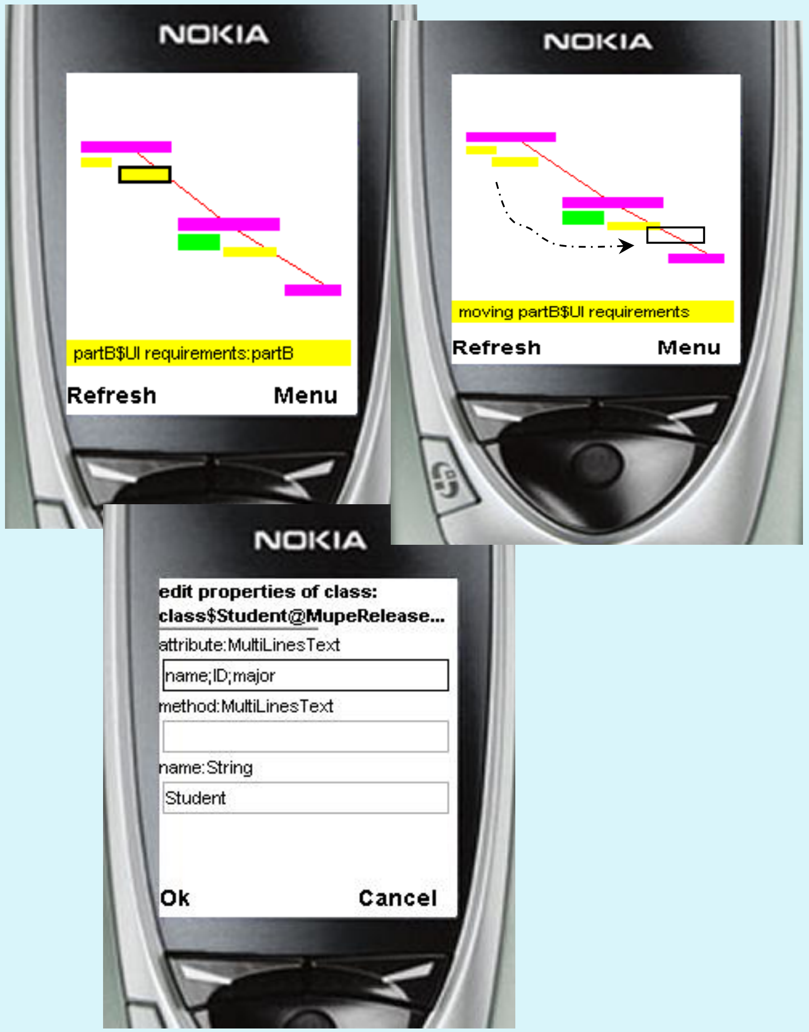
Navigation/zooming

- Mobile phone arrow keys can be used to navigate between elements
  - Selected element highlighted and status info shown at bottom
- Hot key used to zoom selected element between levels of detail
- Auto zoom magnifies selected element and surrounding elements
  - Rudimentary distortion oriented display
- Pan navigation provides floating panel on overview view which is used to select where to pan to



Editing support

- Limited interaction capability of mobile devices require additional adaptation for editing diagrams
- Direct manipulation of elements replaced by 2 step selection & modal modification
  - Elements moved via direction keys
  - Elements added by narrowing pan selection region to show place to add
- Element properties edited via separate form-based property sheet
  - This is the major editing need
  - Hot key selected



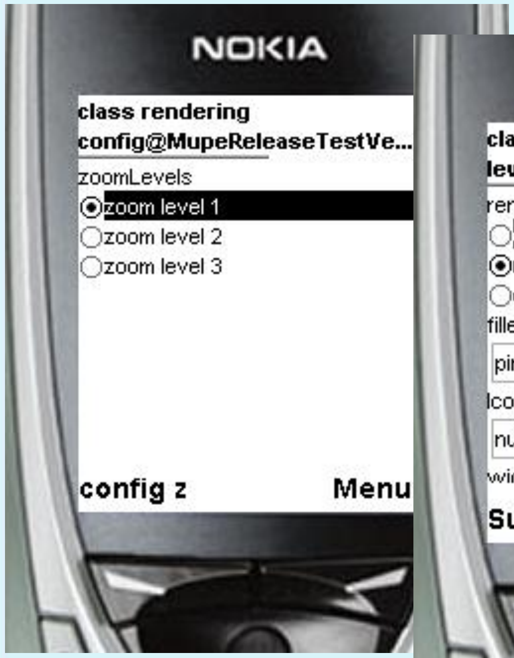
edit properties of class:
class$Student@MupeRelease...
attribute:MultiLinesText
name;ID;major
method:MultiLinesText

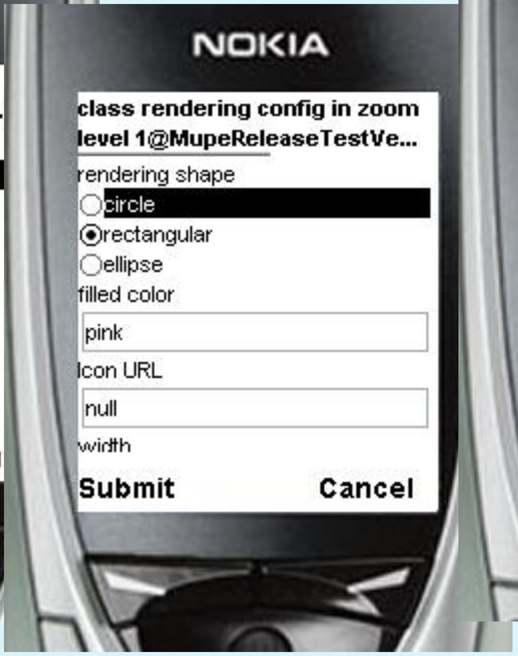
name:String
Student

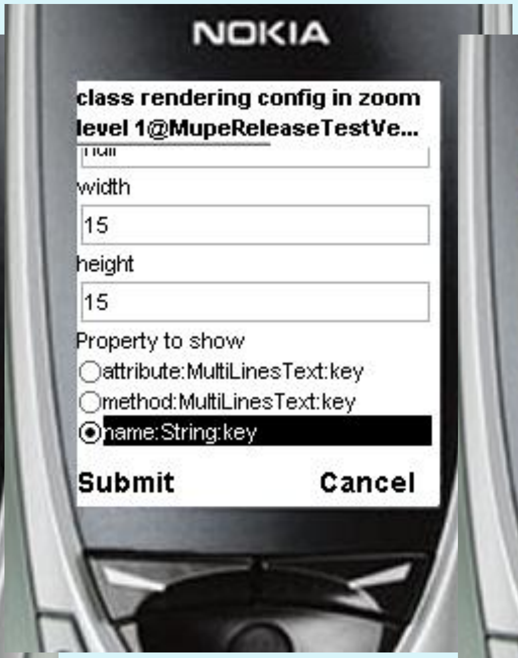
Ok Cancel

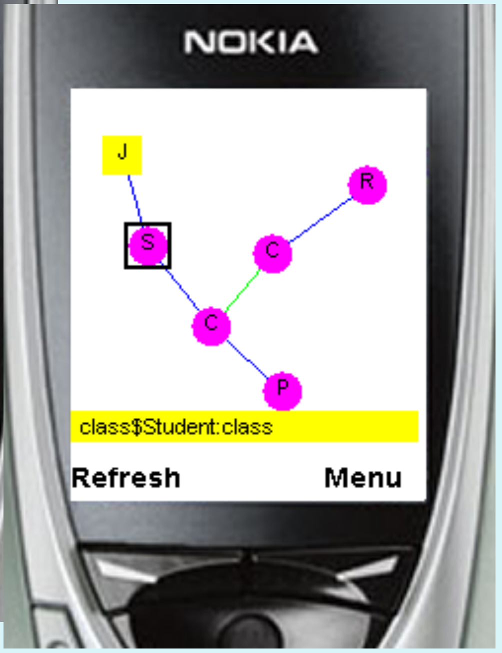
End user configuration support

- Principal support is for specifying level of detail representations
  - Shape, size, colour of icons by diagram and icon type
  - Properties shown


class rendering config@MupeReleaseTestVe...
zoomLevels
[✓ zoom level 1]
zoom level 2
zoom level 3


class rendering config in zoom level 1@MupeReleaseTestVe...
rendering shape
circle
[✓ rectangular]
ellipse
filled color
pink
Icon URL
null
width


class rendering config in zoom level 1@MupeReleaseTestVe...
width
15
height
15
Property to show
attribute:MultiLinesText:key
method:MultiLinesText:key
[✓ name:String:key]



Evaluation

- Limited user evaluation undertaken

- Viewing capability compares well to thick client
- Zoom features found to be essential for understandability
  - Users suggested these features might be useful for thick client
- Editing awkward but fine for most common operation of property editing
- More than 15 iconic elements proved problematic
- Automatic layout of diagrams would be useful
  - Contrary to thick client
  - Due to limited placement controls on mobile devices used

Conclusions

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- Have demonstrated automatic generation of diagram-based editing environments for deployment on mobile devices
  - Generic – works for any Pounamu generated tool
  - Integrates a set of user adaptations that together mitigate screen resolution and interaction limitations
    - *None are particularly novel, but their integration is*
- Future work
  - Generalising from the mobile and thin client interfaces we have developed to provide a more general adaptation framework
    - *Apply to other interfaces, eg 3D*
  - Port our work to our new Eclipse-based Marama meta tool
    - *Thin client and mobile interfaces for Eclipse tools*