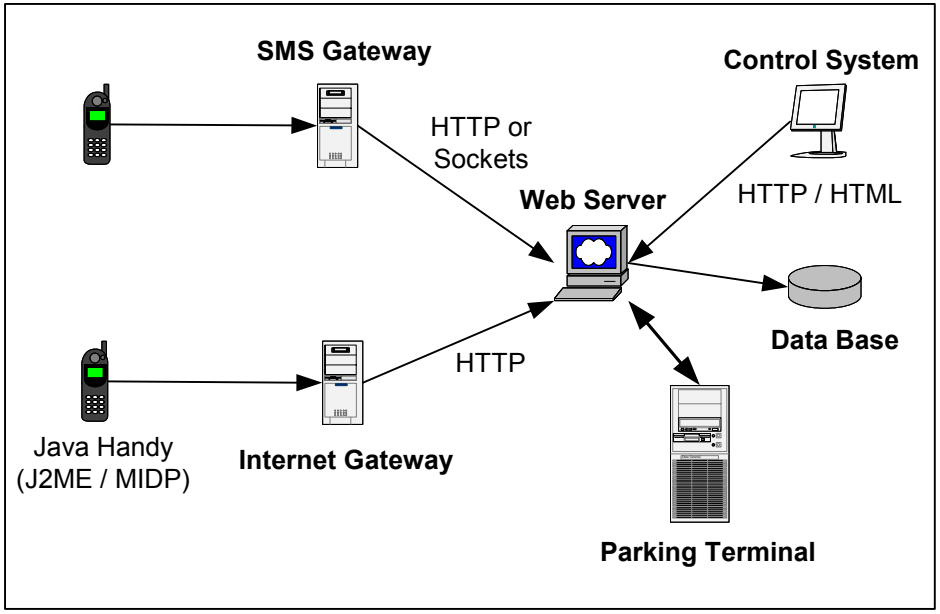
Java Smart Ticket Demo Application Scrutinized

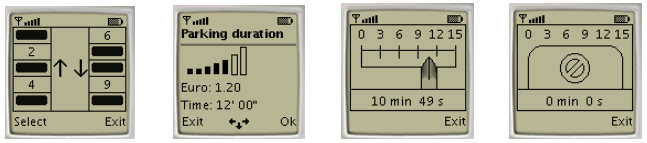
Prof. Dr. Dominik Gruntz
Northwestern Switzerland University of Applied Sciences
Aargau, Switzerland
http://www.cs.fh-aargau.ch/~gruntz
gruntz@fh-aargau.ch

Handy Parking (FHA Project)

- **Frontend: Handy**
  - J2ME (CLDC / MIDP) & SMS
  - Palm / SL45i / Accompli 008 / Nokia 3410
- **Backend: Server**
  - J2EE (Servlets / EJB / JMS)
- **Partner**







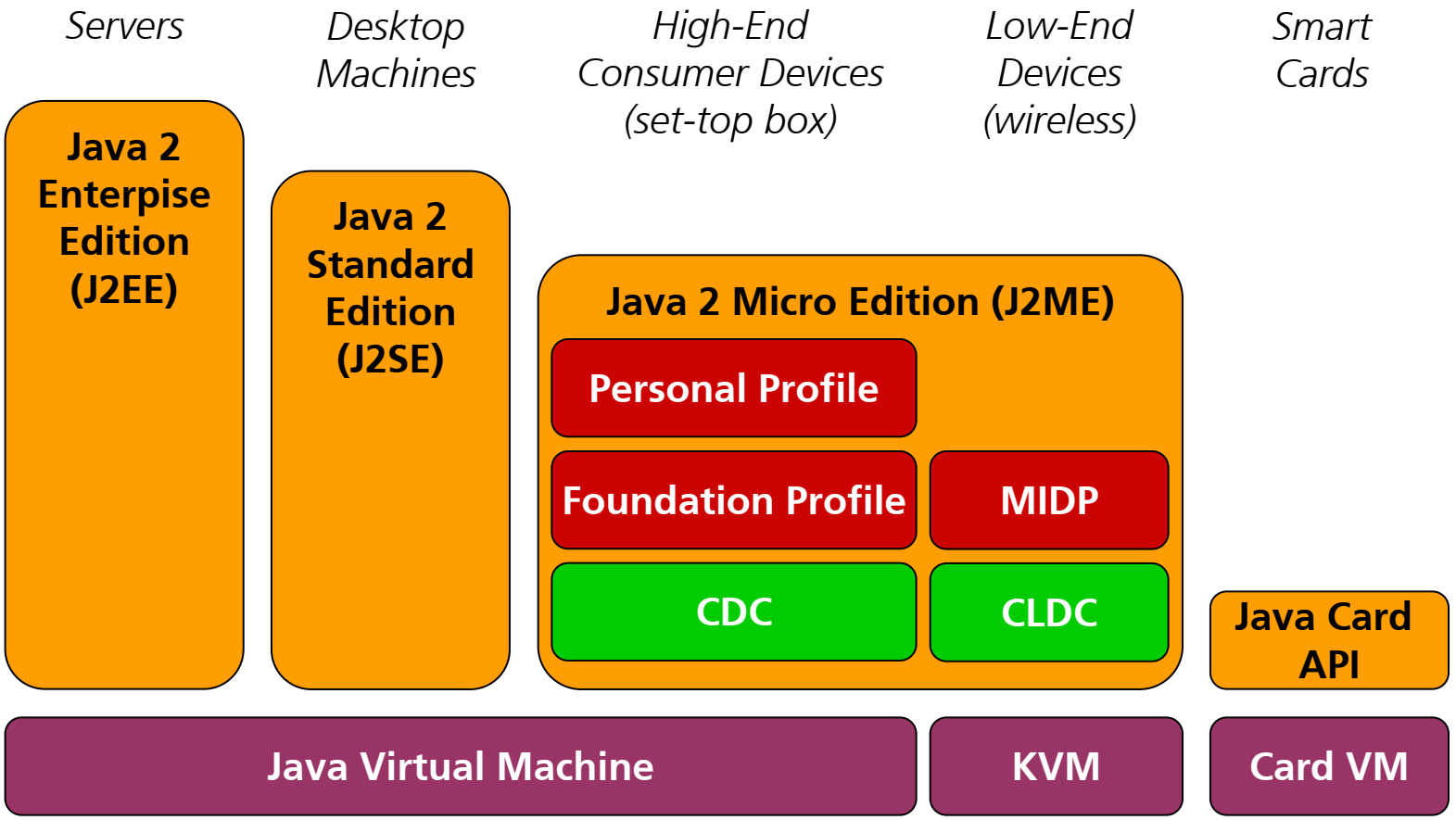
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- **Review of Wireless Technologies**
  - MIDP / CLDC
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    (Siemens SL45i / Nokia 3410 / Motorola Accompli 008)
- **EJBs and Component Software**

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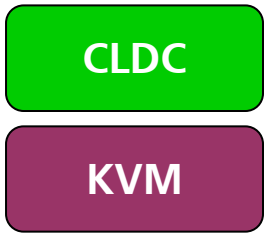
The Java 2 Platforms



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J2ME (CLDC/MIDP) Technology Stack

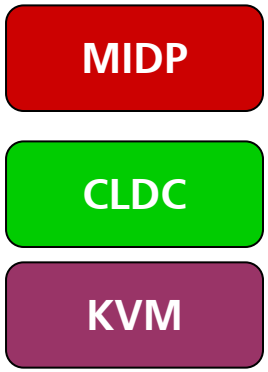
- **Connected, Limited Device Configuration (CLDC) / KVM**
  - Subset of the Java language
    - No floating-point support, no finalization, error handling limitations
  - Subset of VM functionality
    - No float operations
    - Eliminated Features (security reasons or limited libraries)
      - reflection, JNI, weak references, daemon threads & thread groups, user-defined class loaders, finalization
    - no full verification (off-device pre-verification)
  - Subset of Libraries
    - Subset of standard libraries (java.lang, java.util, java.io)
    - Generic connection framework (javax.microedition.io)



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J2ME (CLDC/MIDP) Technology Stack

- **Mobile Information Device Profile (MIDP)**
  - Application runtime environment for wireless devices
    javax.microedition.midlet
    - MIDlets (MIDP Application Lifecycle), packaged as JAR/JAD
  - User Interface *javax.microedition.lcdui*
    - High-level API, only abstract description of UI
      - Look-and-feel matches the device
      - Forms, Menus, Commands, Lists, Alerts
    - Low-level API ("Gaming")
      - Canvas, native drawing primitives
  - Persistent data storage *javax.microedition.rms*
    - Record oriented, private to the application
  - HTTP 1.1-based networking (using CLDC GCF)
    javax.microedition.io



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Devices for the J2ME Platform

- **Characteristics**
  - 16 or 32 bit processor
  - 160-512 kB main memory budget
    - 128 kB non-volatile at least (libraries)
    - 32 kB volatile at least (runtime heap)
    - 8 kB non-volatile at least (record store)
  - Screen
    - at least 96 x 54 pixels
    - Display depth of 1 bit
  - Input capacity
    - keypad, keyboard or touch screen
  - Two-way network connection
    - <= 9600 bps
    - Constant or intermittent
    - High latency (4-20Sek per roundtrip)

Devices available in Europe:

- **Siemens**
  - Siemens SL45i
  - Siemens M50, C55
- **Nokia** (http://www.nokia.com/java/products.html)
  - 7210, 6610, 3410
  - 6310i, 7650,
  - 9210i (Communicator)
  - 3510i [Q4/02], 3650 [03]
- **Motorola**
  - Accompli 008, T720, V60i, V66i
- **SonyEricsson**
  - T300
- **Palm**

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Smart Ticket Demo Application

- Signing In
- Browsing personalized list of movies, theaters & showtimes
- Reserve seats
- Purchase the tickets

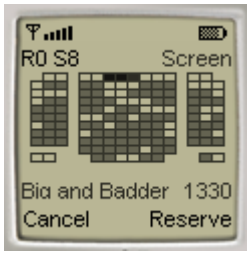










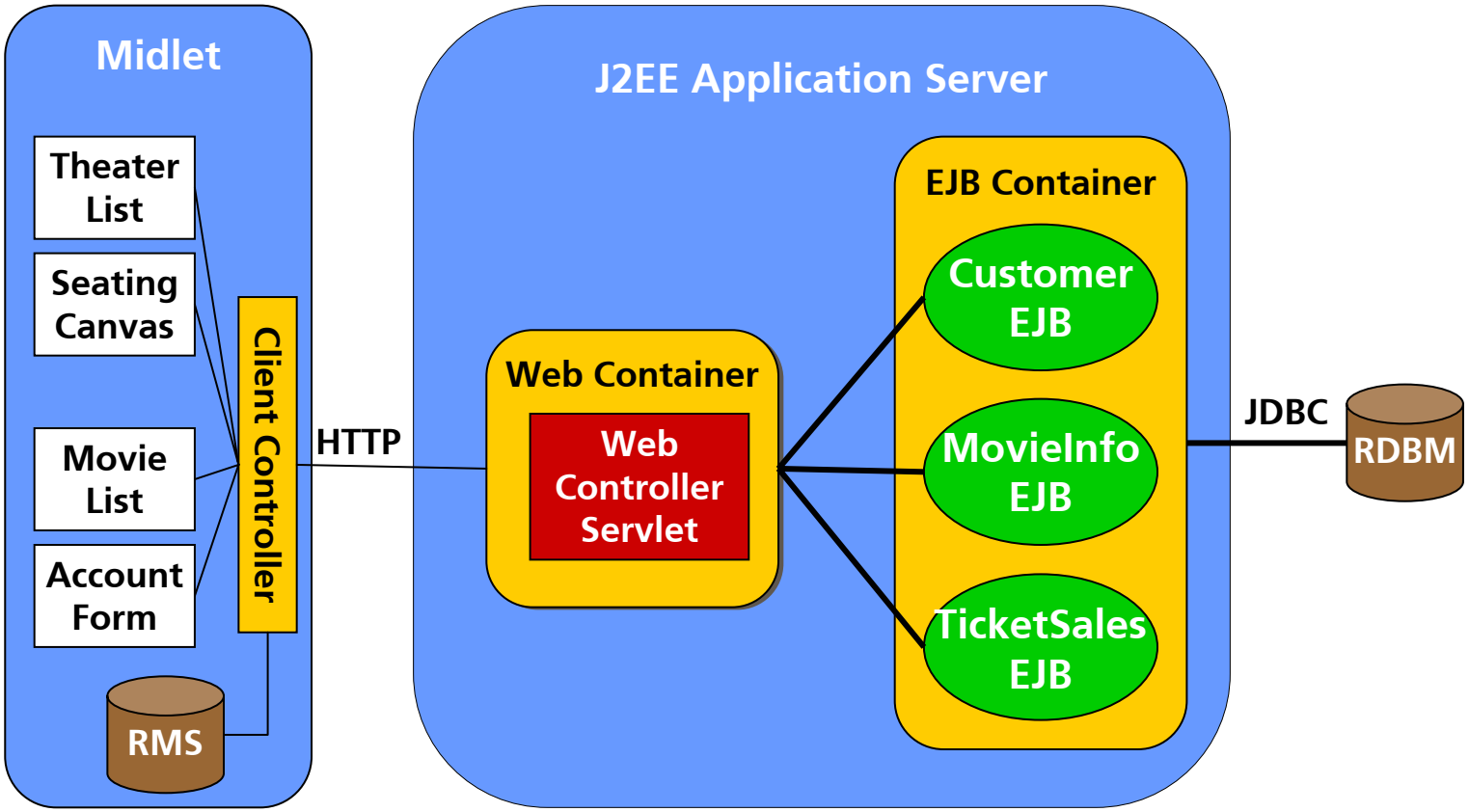






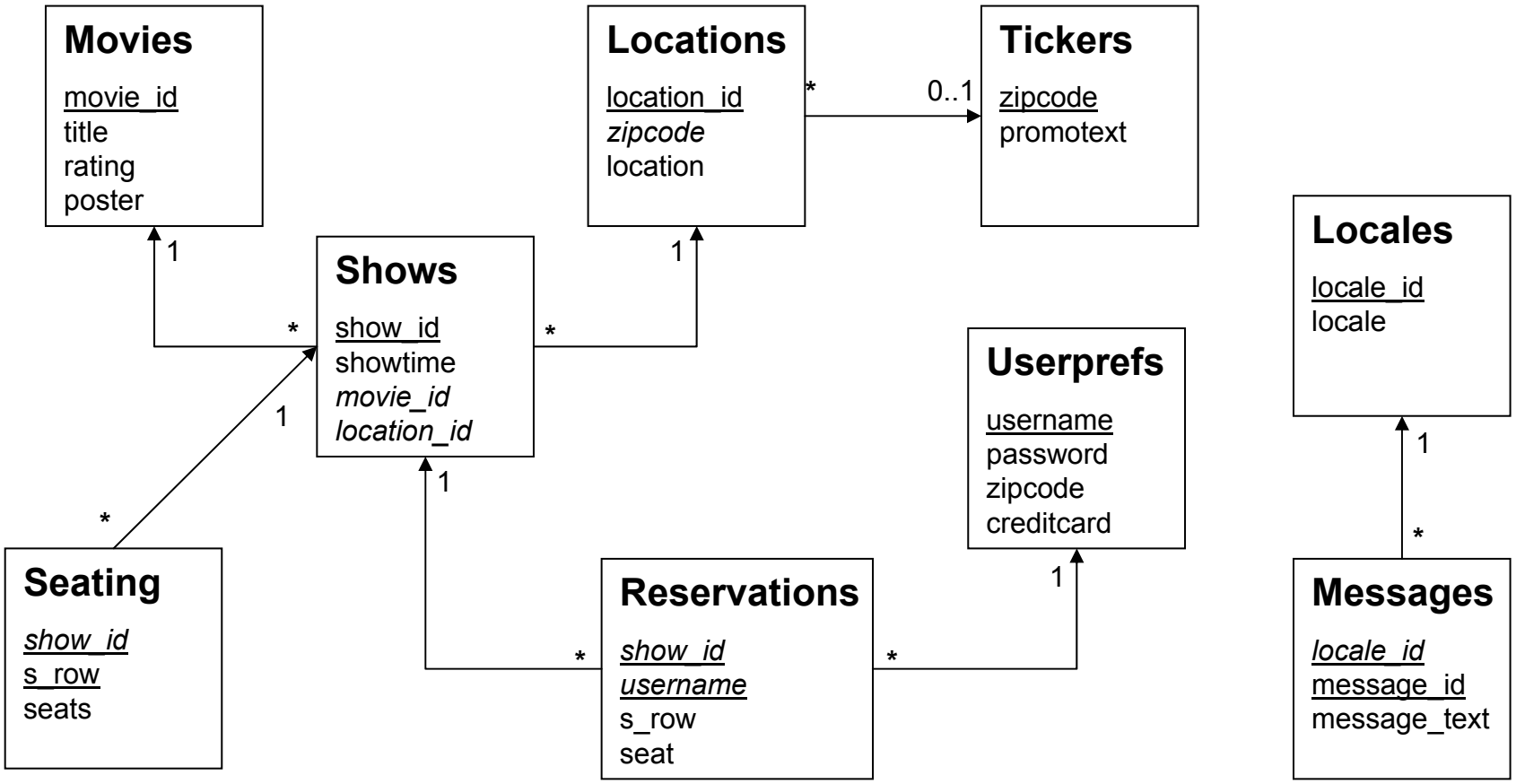
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Smart Ticket Demo Architecture



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Database Tier



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EJB Tier



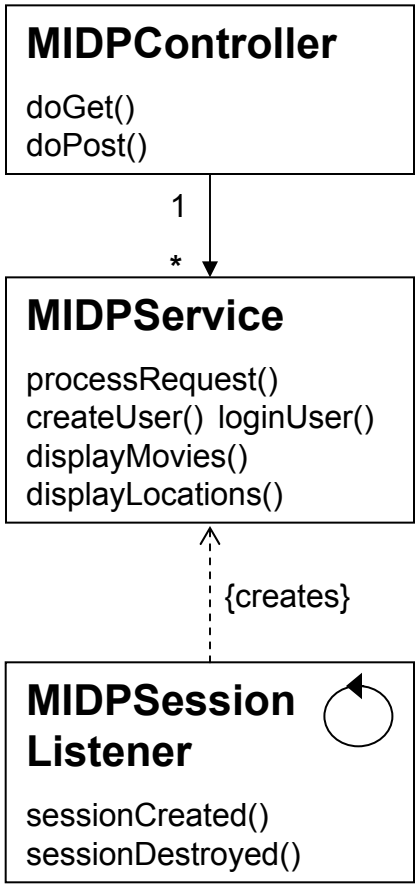
- **CustomerEJB** *entity bean*
  - CustomerInformation getInformation()
- **MovieInfoEJB** *stateless session bean*
  - List getMovies(String zipCode);
  - List getLocations(String zipCode, int movieID);
  - List getShowtimes(int movieID, int locationID);
- **TicketSalesEJB** *stateful session bean*
  - TicketSales create(String customerID, int showID)
  - SeatingPlan getSeatingPlan();
  - boolean reserveSeats(Set seats);
  - boolean cancelSeats();
  - boolean confirmSeats();

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Servlet Tier



- **MIDPController**
  - Servlet which reads the request
- **MIDPService**
  - Request Handler (processRequest)
    - parses request
    - executes command (big switch statement)
  - Service instance per session
- **MIDPSessionListener**
  - Controls servlet sessions
    - Initialization
    - Clean-up after time-out



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Client Tier



- **SmartTicket**
  - MIDlet which controls user interaction (Command Handler)
- **Session**
  - Responsible for communication with servlet, command encoding & de- coding
- **AccountForm, ConfirmForm**
  - Form for entering account information & user preferences or for reservation confirmation
- **GaugeForm**
  - Progress meter
- **MovieList, LocationList, ShowtimeList, LocaleList**
  - Lists for selecting movies, locations, showtimes & locales
- **SeatingCanvas**
  - Custom component for the selection of seats on the seating plan
- **ImageCanvas**
  - Displays a preview image

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Blueprint Best Practices

- **Preference Data**
  - Device-specific data: Stored on client (poster-mode, messages)
  - Customer-specific data: Stored on Server
- **Message Format**
  - <int> "^" [<arg> { "," <arg> }]
- **Session Management**
  - URL Encoding:
    - http://www.gruntz.ch:8080/SmarTicketApp/servlet/;jsessionid=C2D9BD3C142509C4922DE676F22943B5?command=21^0,7,0,8,0,9
- **Internationalization**
- **MVC Separation**

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Smart Ticket on Real Cell Phones

- **Siemens SL45i**
  - Firmware version 49
- **Nokia 3410**
- **Motorola Accompli 008**







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Verification

- **Problem**
  - Compilation with JDK 1.4 generates JVM 1.2 code

    => Error in verification step:

    Error preverifying class C

    Class loading error: illegal constant pool index

    => Installation failure on Accompli 008 !!!

- **Solutions**
  - Use JDK 1.3
  - With JDK1.4: generate class files for JVM 1.1 with target option
    - javac –target 1.1 *.java

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HTTP POST

- **Problem**
  - HTTP POST is not properly implemented on Siemens SL45i [FW49]
    - From time to time, the handy opens a second connection and reacts with an error *No Data Returned.*

- **Solution**
  - We switched from POST to GET
  - MIDlet has to do URL-rewriting (no MIDlet support)

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HTTP 1.1 Chunked Encoding

- **Problem**
  - Siemens SL45i does not accept chunked HTTP 1.1 encoding
    (occurred in the context of another application, fixed in FW 52)

```
HTTP/1.1 200 OK
Content-Type: application/binary
Date: Tue, 10 Sep 2002 15:21:59 GMT
Transfer-Encoding: chunked
Server: Apache Tomcat/4.0.3 (HTTP/1.1 Connector)

1a
□□□□□□□□□□en_GB□□□□□□fr_FR
0
```

- **Solutions**
  - Downgrade to HTTP 1.0 (e.g. with Apache)
    - Set User-Agent to “MIDP” (microedition.profiles property)
    - BrowserMatch "MIDP" nokeepalive downgrade-1.0 force-response-1.0

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HTTP 1.1 Chunked Encoding (cont)

- **Solutions (cont)**
  - Disable chunking (e.g. with Tomcat)

    <Connector className = "org.apache.catalina.connector.http.HttpConnector“
    port = "8080" minProcessors = "3" maxProcessors = "10"
    enableLookups = "true" **allowChunking="false"**
    acceptCount = "10" debug = "0" connectionTimeout = "60000"/>

    => Problem: Not supported by Accompli 008

  - Set content length in the Servlet, i.e. using a ByteArrayOutputStream

```
ByteArrayOutputStream bout = new ByteArrayOutputStream();
DataOutputStream out = new DataOutputStream(bout);
.... // write to out
out.flush(); out.close();
res.setContentLength(bout.size());
res.getOutputStream().write(bout.toByteArray());
```


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Memory Restrictions

- **Problem**
  - Restricted main memory *Runtime.totalMemory()*
    - Siemens SL45i: 144kB
    - Accompli 008: 647kB
    - Nokia 3410: 160kB
  - Siemens:
    - Poster cannot be displayed
    - No compacting garbage collector

- **Solution**
  - Obsfuscation (reduction of memory foot print or jar file, approx. 10%)
  - Preallocation of large memory blocks

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Real-World Experience: Summary

- **Siemens**
  - Problem with memory
  - Small bugs in the GUI implementation (color mapping / round rect)
- **Nokia 3410**
  - Application can only be used once (sign-in button inactive)
  - Wrong character mapping, "^" => "Ð" (capital letter eth)
- **Accompli 008**
  - Flickering GUI
  - Updating problem when value of gauge is changed

"We work with things that you can throw against the wall", Lars Bak, Sun microsystems, JavaOne 2002

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Software Components

- **MVC Pattern allows to reuse the EJB components**
  - Web Client
  - SMS Client
  - USSD Client

- **Component Definition**
  - A software component is a unit of composition with contractually specified interfaces and explicit context dependencies only. A software component can be deployed independently and is subject to composition by third parties.

    Clemens Szyperski, Component Software, 2nd ed, 2002

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TicketSalesEJB Component

- **Home Interface**

```
public interface TicketSalesHome extends EJBHome {
    TicketSales create(String customerID, int showID)
                                    throws CreateException;
}
```

- **Remote Interface**

```
public interface TicketSales extends EJBObject {
    SeatingPlan  getSeatingPlan();
    boolean  reserveSeats(Set seats) throws UnavailableSeatsException;
    boolean  cancelSeats();
    boolean  confirmSeats();
}
```

=> ***What does it mean to "contractually specify" an interface?***
Two examples:

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TicketSalesEJB Interface Specification

- **What happens with the *seats* parameter in *reserveSeats*?**

```
TicketSales sales = home.create("gruntz", 7);
Set set = Collections.singleton(new Seat(5, 9));
sales.reserveSeats(set);
sales.confirmSeats();
```

=> RemoteException [UnsupportedOperationException]
Reason: *confirmSeats* clears the set.

=> EJB works in context of *MIDPService* since a (mutable) *HashSet* is used

=> It should be specified that seats parameter must be mutable (cannot be expressed in the Java language) or code should be changed to support immutable sets.

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TicketSalesEJB Interface Specification

- **What happens with the following statements?**

```
TicketSales sales = home.create("gruntz", 7);
Set s1 = new HashSet(); s1.add(new Seat(6, 0));
Set s2 = new HashSet(); s2.add(new Seat(6, 1));
sales.reserveSeats(s1);
sales.reserveSeats(s2);
sales.cancelSeats();
```

=> Only seat 6/1 is cancelled, seat 6/0 remains marked as unavailable

=> EJB works in context of *MIDPService* since *reserveSeats* is never called more than once

=> It should be specified in which order the methods have to be called! Objects are state machines!

Conclusion

- **Component Software**
  - Developing reusable components is hard
  - Contractually specifying component interfaces is demanding
  - Specification weaknesses often only reveal after reuse in a different context
  - A component is only reusable if it has been reused in different contexts
- **EJB**
  - Working with EJBs does not automatically lead to reusable components
- **Smart Ticket**
  - Blue-Prints should be a shining example …
  - Bugs & weaknesses have been reported to Sun

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References

- **Java Smart Ticket Demo Release**
  - http://developer.java.sun.com/developer/releases/smarticket/
  - http://java.sun.com/blueprints/code/
  - http://www.gruntz.ch/projects/ejb/smarticket.html
- **J2ME Technologies**
  - http://java.sun.com/j2me/
  - http://java.sun.com/products/midp
- **Midlets**
  - http://www.midlet.org
  - http://www.midletcentral.org
- **Java Devices**
  - http://www.javamobiles.com
  - http://wireless.java.sun.com/device/

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