ð BEDCON 2013

JSR 354 – Money & Currency Introduction

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Bio

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Agenda

- History and Motivation
- Overview
- Currencies and Amounts
- Precision and Rounding
- Formatting and Parsing
- Currency Conversion
- Provider and Extensions

- Demo

Platform (SE) Scope

Standalone Scope

History and Motivation

Earlier Approaches

Martin Fowler:

A large proportion of the computers in this world manipulate money, so it's always puzzled me that money isn't actually a first class data type in any mainstream programming language. The lack of a type causes problems, the most obvious surrounding currencies…

see http://martinfowler.com/eaaCatalog/money.html

Eric Evans – Time and Money:

On project after project, software developers have to reinvent the wheel, creating objects for simple recurring concepts such as "money" and "currency". Although most languages have a "date" or "time" object, these are rudimentary, and do not cover many needs, such as recurring sequences of time, durations of time, or intervals of time. …

To be quite frank, their code isn't more than an academic POC, factories called dollars() or euros() are useless in real globally deployed frameworks, but he made a good point.

Motivation

- Monetary values are a key feature to many applications
- Existing `java.util.Currency` class is strictly a structure used for representing ISO-4217 standard currencies.
- No standard value type to represent a monetary amount
- No support for currency arithmetic or conversion
- JDK Formatting features lack of flexibility

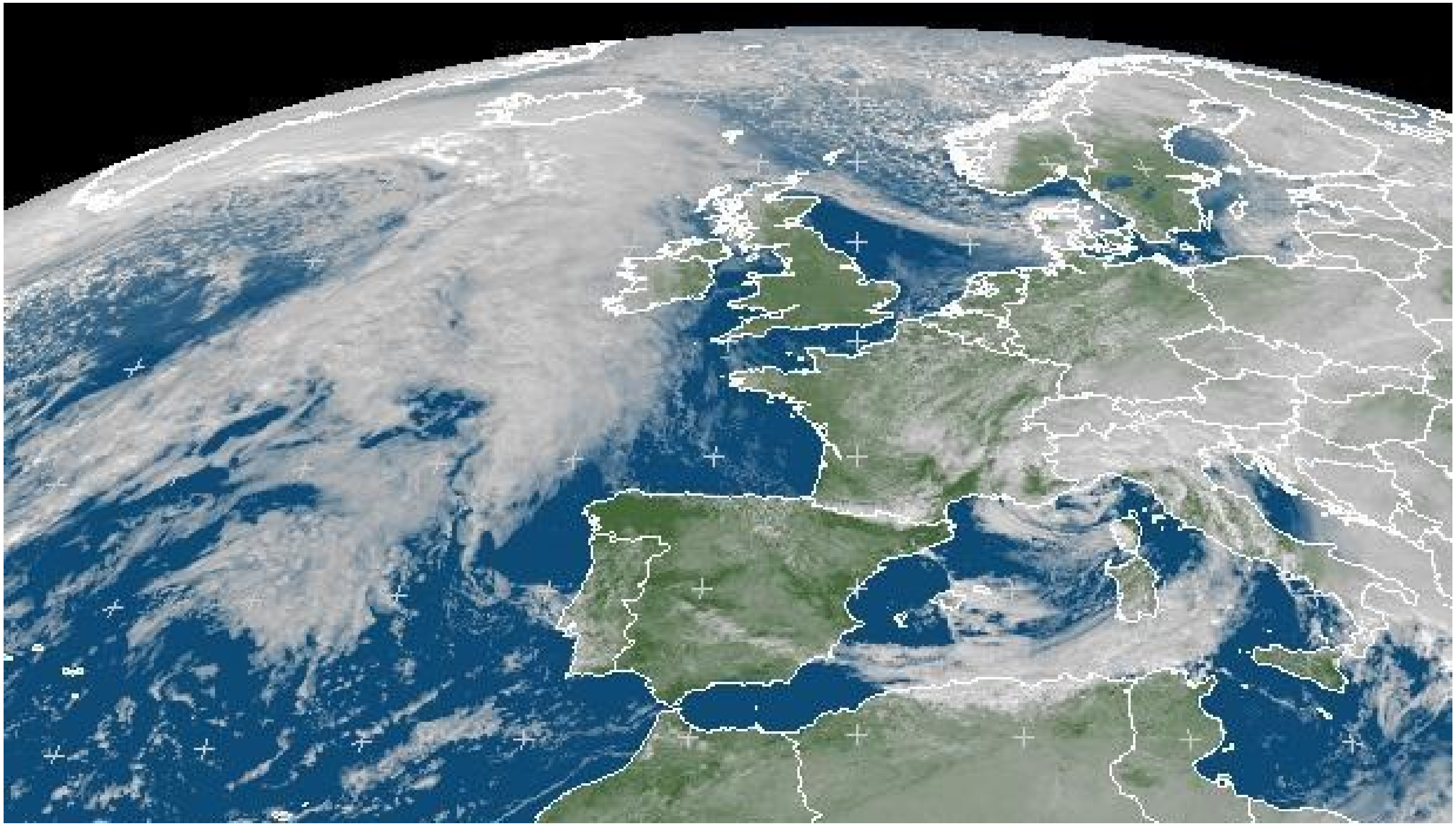
Schedule

- Java SE 9
- Java ME/Embedded 8 oder 9

  Following the EC Merge and Standard/Embedded harmonization, no JSR should be SE/EE or ME only. Money is so important, and has almost no legacy in the JDK except `java.util.Currency`, that it should be supported by **all possible** platforms, except maybe JavaCard for now.
- With back-port to previous versions still supported and in relevant use
- EDR: Beginning of April 2013

DRAFT

Overview



Overview of JSR 354

- **Core** API: **`javax.money`**

  `CurrencyUnit, MonetaryAmount and exceptions`
- **Conversion** API: **`javax.money.conversion`**

  `ExchangeRate, CurrencyConverter`
- **Formatting**: **`javax.money.format`**

  `LocalizationStyle, ItemFormatter, ItemParser`
- **Provider** singleton: **`javax.money.provider`**

  `Monetary`
- **Extensions**: **`javax.money.ext`**

  `Region support, Calculations`

Currencies and Amounts

javax.money

Currencies

ISO 4217

Special Codes

- Precious Metals (XAU, XAG)
- Testing (XTS)
- No Currency (XXX)
- Supranational currencies, e.g. East Caribbean dollar, the CFP franc, the CFA franc.

Ambiguities

- **CFA** franc: **West African CFA** franc und **Central African CFA** franc = denotes 2 effectively interchangeable (!).
- Switzerland: CHF, CHE (WIR-EURO), CHW (WIR)
- USA: USD, USN (next day), USS (same day)

Legal acceptance, e.g. Indian Rupees are legally accepted in Buthan/Nepal, but not vice versa!

Typically 1/100, rarely 1/1000, but also 1/5 (Mauritania, Madagaskar), 0.00000001 (BitCoin)

Virtual Currencies

- **Video Game Currencies** (Gold, Gil, Rupees, Credits, Gold Rings, Hearts, Zenny, Potch, Munny, Nuyen…)
- **Facebook Credits** are a virtual currency you can use virtual goods in any games or apps of the Facebook platform that accept payments. You can purchase Facebook Credits directly from within an app using you credit card, PayPal, mobile phone and many other local payment methods.

- **Bitcoin** (sign: **BTC**) is a decentralized digital currency based on an open-source, peer-to-peer internet proto It was introduced by a pseudonymous developer name Satoshi Nakamoto in 2009.

Limitations of `java.util.Currency`

- No support for historical Currencies
- No support for non standard Currencies (e.g. cows or camels)
- No support for virtual Currencies (Lindon Dollars, BitCoin, Social Currencies)
- No support for custom schemes (e.g. legacy codes)
- Only access by currency code, or `Locale`
- No support for special use cases/extensions

Implementation:
`MoneyCurrency`

```
public interface CurrencyUnit{
  public String getCurrencyCode();
  public int getNumericCode();
  public int getDefaultFractionDigits();
  // new methods
  public String getNamespace();
  public boolean isLegalTender();
  public boolean isVirtual();
  public Long getValidFrom();
  public Long getValidUntil();
  public <T> T getAttribute(
        String key, Class<T> type);
}
```

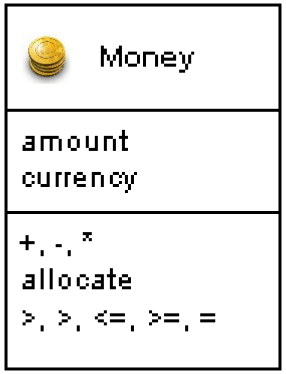
Access/Create Currencies
Usage

```
/**
 * Shows simple creation of a CurrencyUnit for ISO, backed up by JDK
 * Currency implementation.
 */
public void forISOCurrencies() {
  CurrencyUnit currency = MoneyCurrency.of("USD");
  currency = MoneyCurrency.of("myNamespace", "myCode"); // null!
}

public void buildACurrencyUnit() {
  MoneyCurrency.Builder builder = new MoneyCurrency.Builder();
  builder.setNamespace("myNamespace");
  builder.setCurrencyCode("myCode");
  builder.setDefaultFractionDigits(4);
  builder.setLegalTender(false);
  builder.setValidFrom(System.currentTimeMillis());
  builder.setVirtual(true);
  builder.setAttribute("test-only", true);
  CurrencyUnit unit = builder.build();
    // nevertheless MoneyCurrency.of("myNamespace", "myCode"); still returns
    // null!
  builder.build(true);
    // no it is registered
  unit = MoneyCurrency.of("myNamespace", "myCode");
}
```

Monetary Amount

Amount = Number + Currency + Operations



How to represent the numeric amount?
Contradictory requirements:

- Performant (e.g. for trading)
- Precise (e.g. for calculations)
- Must model small numbers (e.g. webshop)
- Must support huge Numbers (e.g. risk calculations, statistics)

lution: support several numeric representations!

Rounding, Precision, Scale

Monetary Amount (continued)

```
public interface MonetaryAmount{
  public CurrencyUnit getCurrency();
  public Class<?> getNumberType();
  public <T> T asType(Class<T>);
  public int intValue(); public int intValueExact();
  public long longValue(); public long longValueExact();
  […]
  public MonetaryAmount abs();
  public MonetaryAmount min(…);
  public MonetaryAmount max(…);
  public MonetaryAmount add(…);
  public MonetaryAmount substract(…);
  public MonetaryAmount divide(…);
  public MonetaryAmount[] divideAndRemainder(…);
  public MonetaryAmount divideToIntegralValue(…);
  public MonetaryAmount remainder(…);
  public MonetaryAmount multiply(…);
  public MonetaryAmount withAmount(Number amount);
  […]
  public int getScale(); public int getPrecision();
  […]
  public boolean isPositive(); public boolean isPositiveOrZero();
  public boolean isNegative(); public boolean isNegativeOrZero();
  public boolean isLessThan(…);
  public boolean isLessThanOrEqualTo(…);
  […]
}
```

Data Access.

Implementation:
Money

Algorithmic Operations…

Data Representation and Comparison.

Creating Amounts
Usage

```
/**
 * Simplest case create an amount with an ISO currency.
 */
public void forISOCurrencies() {
  MonetaryAmount amount = Money.of("USD", 1234566.15);
}




/**
 * Create an amount using a custom currency.
 */
public void forCustomCurrencies() {
  CurrencyUnit currency = MoneyCurrency.of(
                              "myNamespace", "myCode");
  MonetaryAmount amount = Money.of(currency, 1234566.15);
}
```

Precision and Rounding

javax.money

Numeric Precision

- **Internal** Precision (implied by internal number type)
- **External** Precision (Rounding applied, when the numeric part is accessed/passed outside)
- **Formatting** Precision (Rounding for display and output)
- **Interoperability**
  - Different precision/scale
  - Distinct numeric representations
  - Serialization

By default only internal rounding is applied automatically.

Mixing Numeric Representations

```
Money amt1 = Money.of(“CHF”, 10.23d);
IntegralMoney amt2 = IntegralMoney.of(“CHF”, 123456789);
Money result = amt1.add(amt2);
```

- **Money** as representation type, since its the class on which `add()` was called.
- Precision = 9
- Scale = 2

- Mechanism applies similarly for operation chaining

```
Money amt1 = …;
IntegralMoney amt2 = …;
CurrencyConversion conversion = …;
Money result = amt1
                .add(amt2)
                .multiply(2)
                .with(conversion)
                .round(MoneyRounding.of());
```

Rounding

External Rounding and Formatting Rounding can be implemented in many ways,

```
public interface Rounding{
  public MonetaryAmount round(MonetaryAmount );
}
```

Implementation:
MoneyRounding

```
Rounding rounding =
MoneyRounding.getRounding(
      MoneyCurrency.of("USD"));
MontaryAmount myAmount = …;
MonetaryAmount rounded =
          rounding.round(myAmount);
```

Original	Rounde d	Remark
123.452	123.45	3. digit <3 -> round down
123.456	123.455	3<= 3. digit <=7 -> change to 5
123.459	123.46	3. digit >=8 -> round up

Example for non standard-rounding Argentina:

- If the third digit is 2 or less, change it to 0 or drop it.
- If the third digit is between 3 and 7, change it to 5.

Arithmetics & Rounding
Usage

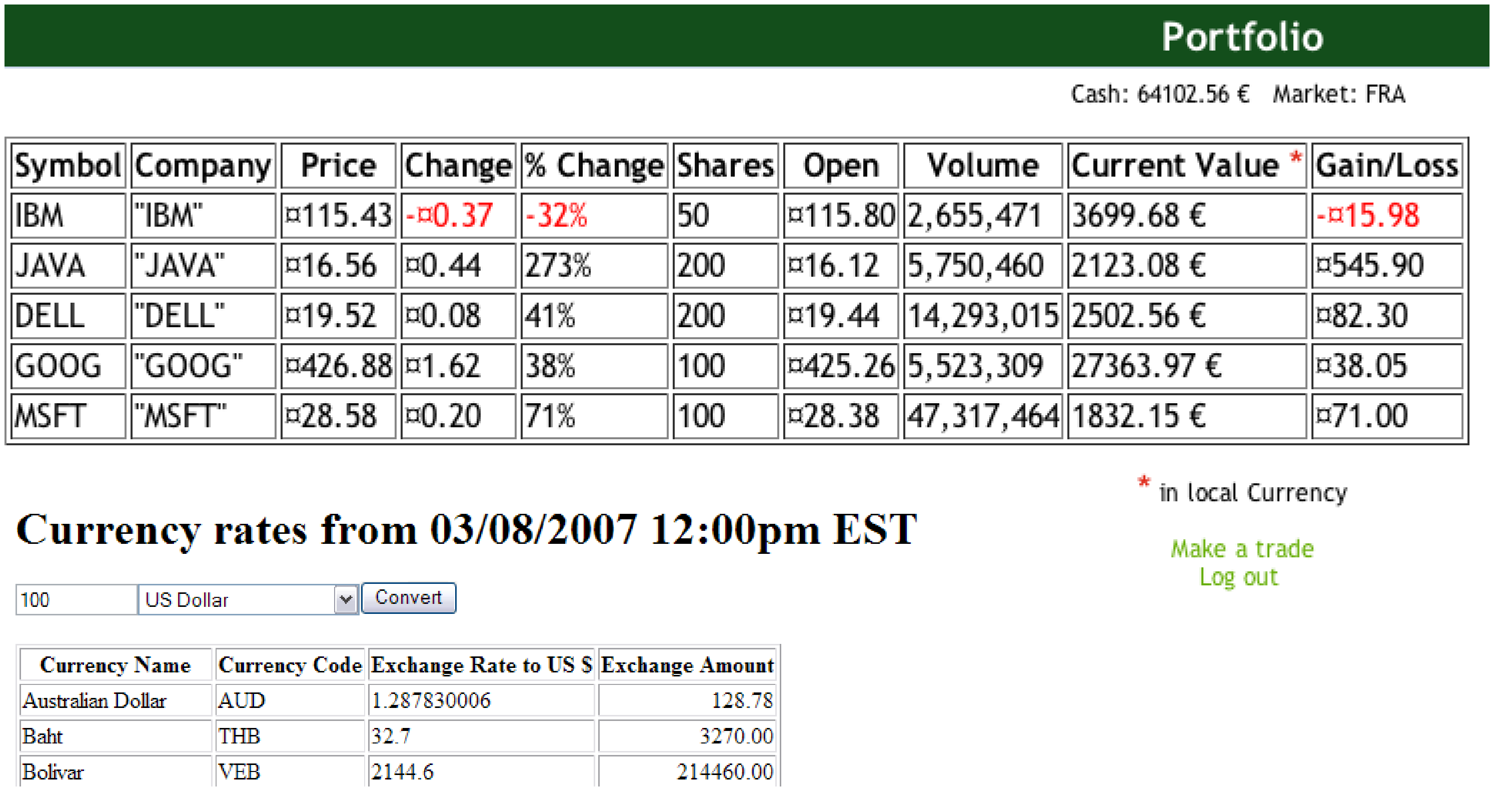
```java
/**
 * Mixed representations.
 */
public void mixedImplementations() {
  MonetaryAmount m1 = IntegralMoney.of("USD", 789);
  MonetaryAmount m2 = Money.of("USD", 1234566.15);

  MonetaryAmount sum = m1.add(m2);
  MonetaryAmount diff = m2.substract(m1).negate();
}

/**
 * Round amount based on ist currency (defaultFractionUnits).
 */
public MonetaryAmount roundDefault(MonetaryAmount amount){
  Rounding rounding =
                MoneyRounding.of(amount.getCurrency());
  return rounding.round(amount);
}
```

Formatting and Parsing

javax.money.format



Portfolio

Cash: 64102.56 €   Market: FRA

Symbol	Company	Price	Change	% Change	Shares	Open	Volume	Current Value *	Gain/Loss
IBM	"IBM"	¤115.43	-¤0.37	-32%	50	¤115.80	2,655,471	3699.68 €	-¤15.98
JAVA	"JAVA"	¤16.56	¤0.44	273%	200	¤16.12	5,750,460	2123.08 €	¤545.90
DELL	"DELL"	¤19.52	¤0.08	41%	200	¤19.44	14,293,015	2502.56 €	¤82.30
GOOG	"GOOG"	¤426.88	¤1.62	38%	100	¤425.26	5,523,309	27363.97 €	¤38.05
MSFT	"MSFT"	¤28.58	¤0.20	71%	100	¤28.38	47,317,464	1832.15 €	¤71.00

* in local Currency

Make a trade
Log out

Currency rates from 03/08/2007 12:00pm EST

100 | US Dollar | Convert

Currency Name	Currency Code	Exchange Rate to US $	Exchange Amount
Australian Dollar	AUD	1.287830006	128.78
Baht	THB	32.7	3270.00
Bolivar	VEB	2144.6	214460.00

Formatting and Parsing
Challenges

- Multiple Locale instances for Translation, Dates, Time, Numbers, Currencies
- Additional parameters
  - Currency Placement
  - Rounding, Lenient Fractions, Min, Max etc.
- Natural language support for non
  example
  - Lakhs, Crores (1 Lakh = 100,00
  - INR 12,34,56,000.21 is written
    12 Crore, 34 Lakh, 56 Thousan
    Rupees and 21 Paise
- Unsupported by NumberFormat,
  INR 12,34,225.21

```
public class LocalizationStyle
implements Serializable {
   […]
  public String getId();
  public Locale getTranslationLocale();
  public Locale getNumberLocale();
  public Locale getDateLocale();
  public Locale getTimeLocale();
  public Map<String, Object> getAttributes() ;
  public <T> T getAttribute(
              String key, Class<T> type);
  public static LocalizationStyle of(
              Locale locale);
  public boolean isDefaultStyle() ;
   […]
}
```

LocalizationStyle, ItemFormatter/-Parser

Formatting and Parsing

ItemFormat

```
public interface ItemFormat<T> {
public Class<T> getTargetClass();
public LocalizationStyle getStyle();
public String format(T item);
public void print(Appendable appendable,
                  T item)
throws IOException;
public T parse(CharSequence input)
throws ParseException;
}
```

```
public final class MonetaryFormat{
   public Collection<String>
        getSupportedStyleIds(Class<?> targetType);
   public boolean isSupportedStyle(
             Class<?> targetType, String styleId);
   public <T> ItemFormat<T>
            getItemFormat(Class<T> targetType,
                          LocalizationStyle style)

   throws ItemFormatException;
   public <T> ItemFormat<T>
            getItemFormat(Class<T> targetType,
                          Locale locale)
   throws ItemFormatException;
}
```

Currency Conversion

javax.money.conversion

Currency Conversion

- ExchangeRateType
- ExchangeRate:
  - ExchangeRateType
  - Base, Term currency
  - Conversion factor
  - Validity (from/until)
  - Provider (optional)
  - Direct/Derived Rates
- ExchangeRateProvider
- CurrencyConverter

```
public interface ExchangeRate {
  public ExchangeRateType getExchangeRateType();
  public CurrencyUnit getBase();
  public CurrencyUnit getTerm();
  public Number getFactor();
  public Long getValidFrom();
  public Long getValidUntil();
  public boolean isValid();
  public String getProvider();
  public ExchangeRate[] getExchangeRateChain();
  public boolean isDerived();
}
```

Currency Conversion
Usage

```
/**
 * Shows simple conversion of an amount.
 */
public Money convertAmountToCHF(Money amount){
  CurrencyUnit currency = MoneyCurrency.of(curr);
  ExchangeRateType rateType = ExchangeRateType.of("EZB");

  ConversionProvider convProvider =

MonetaryConversion.getConversionProvider(rateType);

  CurrencyConversion chfConversion =
               convProvider.getConverter()

.getCurrencyConversion(MoneyCurrency.of("CHF");
  return amount.with(chfConversion);
}
```

Note: this module has changed in the meantime

Provider & Extensions

javax.money, javax.money.ext

Note: this module has changed in the meantime

Provider

Monetary Singleton

- `javax.money.Monetary` singleton provides access to all components
- By default components loaded using JDK's `java.util.ServiceLoader`.
- Alternate Loader implementations possible, e.g.
  - Using CDI standalone
  - Within a J2EE co
  - Spring
  - ...

```
public final class Monetary{
 public static CurrencyUnitProvider getCurrencyUnitProvider();
 public static ConversionProvider getConversionProvider();
 public static ItemFormatterFactory getItemFormatterFactory();
 public static ItemParserFactory getItemParserFactory();
 public static RoundingProvider getRoundingProvider();
}
```

Note: this module has changed in the meantime

Extensions

Allow registration of additional functionalities into Monetary:

- Calculation Utilities
- Compound Values
- Statistical Modules
- Financial Modules
- Regions/Regional Providers, e.g. for mapping accepting currencies, legal tenders etc.
- ...

```
@ExposedType(CalculationUtils.class)
public class CalculationUtilsImpl implements
CalculationUtils, MonetaryExtension{
  …
}
```

```
CalculationUtils utils =
    Monetary.getExtension(CalculationUtils.class);
utils.total(…);
```

To be discussed:

- if and what extensions are part of the JSR
- Extensions are provided within RI

Note: this module has changed in the meantime

Extensions
Usage

```
/**
 * Shows simple usage of an extension, e.g. calculating
 * the total of all amounts, that have a certain currency.
 */
public MonetaryAmount total(MonetaryAmount… amount,
             String curr){
  AmountUtils utils = MoneyCurrency.getExtensions(
                                     AmountUtils.class);
  return utils.total(utils.filter(amount, curr));
}
```

Demo

wüstenrot
UNI AG statt
BILDUNGSIDEAL
NICHT MIT UNS!!!
Zeit für's Bett!

Stay Tuned!

- JSR 354: http://jcp.org
- Java.net Project: http://java.net/projects/javamoney
- GitHub Project: https://github.com/JavaMoney/javamoney
- Twitter: @jsr354

Q & A

???