33. Composition of Stream-Based Tools

Prof. Dr. U. Aßmann
Technische Universität Dresden
Institut für Software- und Multimediatechnik
http://st.inf.tu-dresden.de

Version 12-0.9, 07.12.12

Literatur

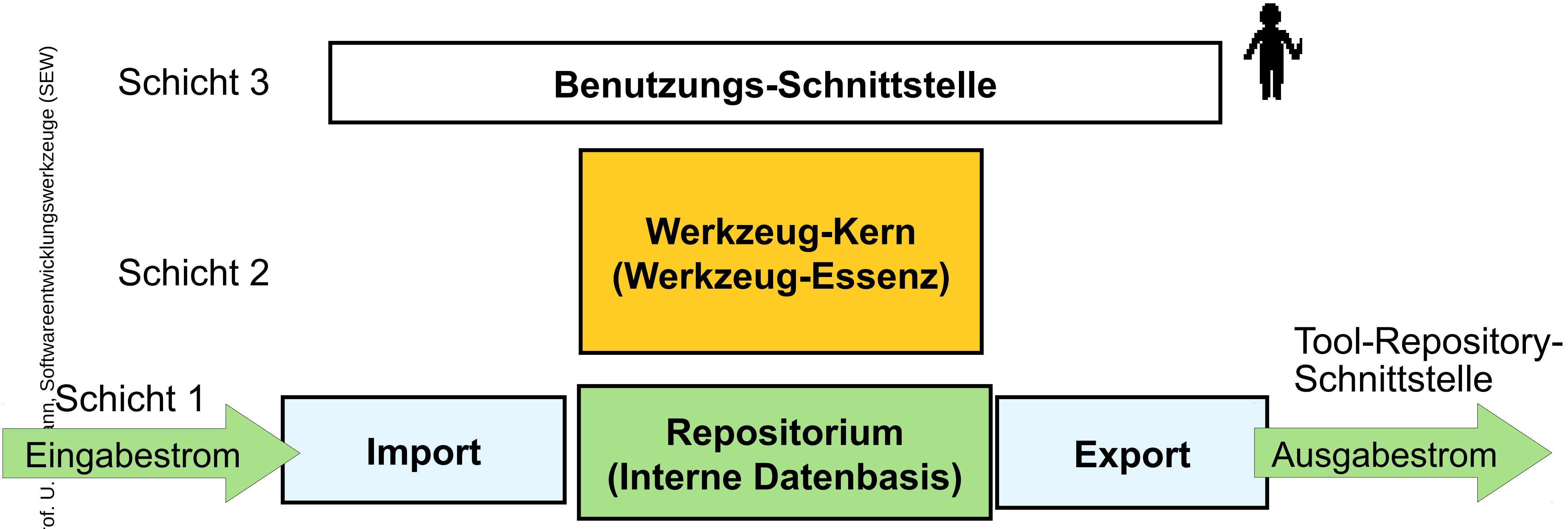
- Informatik Forum http://www.infforum.de/
- Structured Analysis Wiki http://yourdon.com/strucanalysis/wiki/index.php?title=Introduction
- De Marco, T.: Structured Analysis and System Specification; Yourdon Inc. 1978/1979. Siehe auch Vorlesung ST-2
- McMenamin, S., Palmer, J.: Strukturierte Systemanalyse; Hanser Verlag 1988
- Raasch, J.: Systementwicklung mit Strukturierten Methoden; Hanser Verlag (3.Aufl.) München 1993
- [Altinel07] Mehmet Altinel, Paul Brown, Susan Cline, Rajesh Kartha, Eric Louie, Volker Markl, Louis Mau, Yip-Hing Ng, David E. Simmen, and Ashutosh Singh. DAMIA - A data mashup fabric for intranet applications. In C. Koch, et.al., editors, VLDB, pages 1370-1373. ACM, 2007.

33.1 Extension of Stream-Based Tools by DFD

And composition of stream-based tools

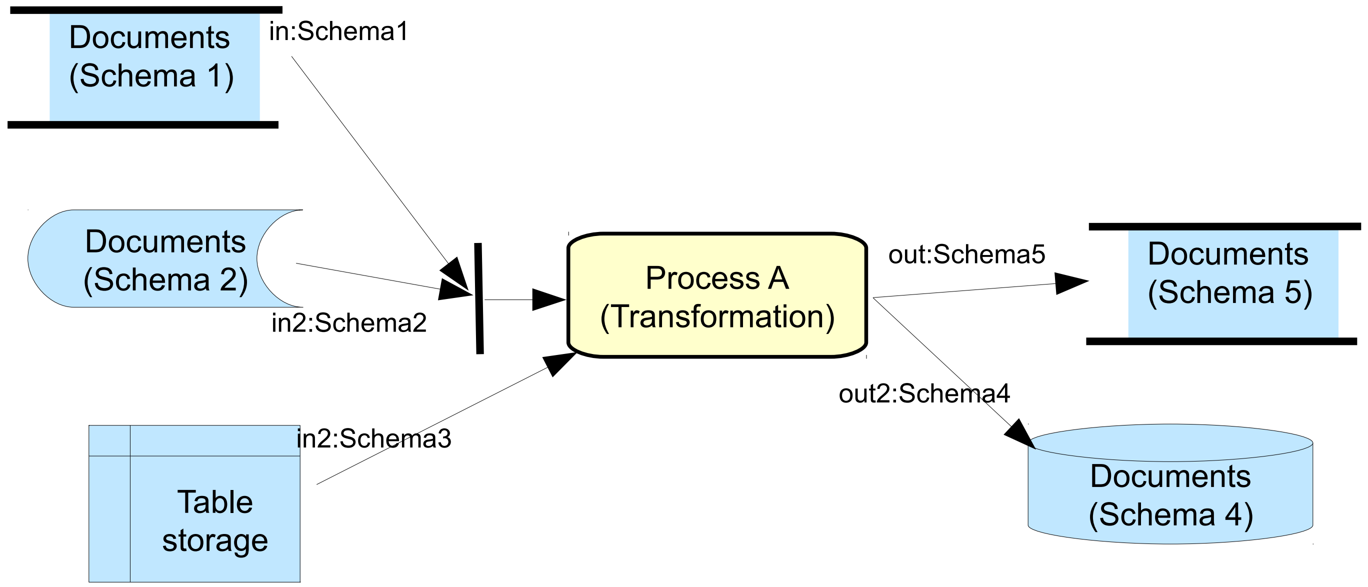
Rpt. Architektur eines datenflussgesteuerten, strom-basierten Werkzeugs

- Arbeit wird stückweise erledigt; meist pro gelesenem Datenpaket.
- Eine DFD- oder Workflow- Sprache verknüpft (komponiert) die Werkzeuge durch ein DFD oder Workflow (Mashup) zu komplexeren Werkzeugen


Schicht 3
Benutzungs-Schnittstelle
Schicht 2
Werkzeug-Kern (Werkzeug-Essenz)
Tool-Repository-Schnittstelle
Schicht 1
Eingabestrom
Import
Repositorium (Interne Datenbasis)
Export
Ausgabestrom

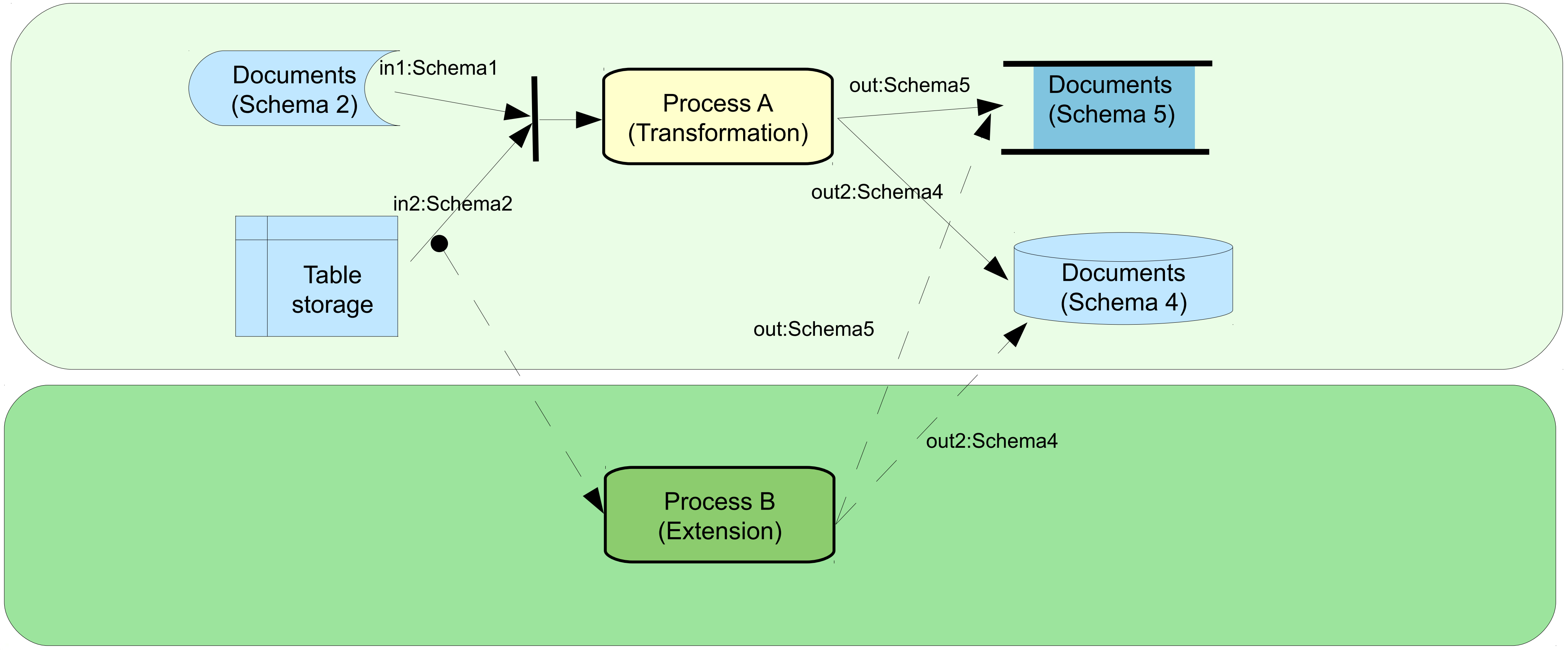
Stream Merging

- The architecture of stream-based tools can be described by DFD or (Web-)Mashups
- Three operations are important:
  - **Input stream synchronization:** does a process read from input channels synchronously or alternatingly?
  - **Input stream merge:** how does a process merge two input channels?
  - **Output stream replication:** does a process replicate output data in different streams or produce different output formats?



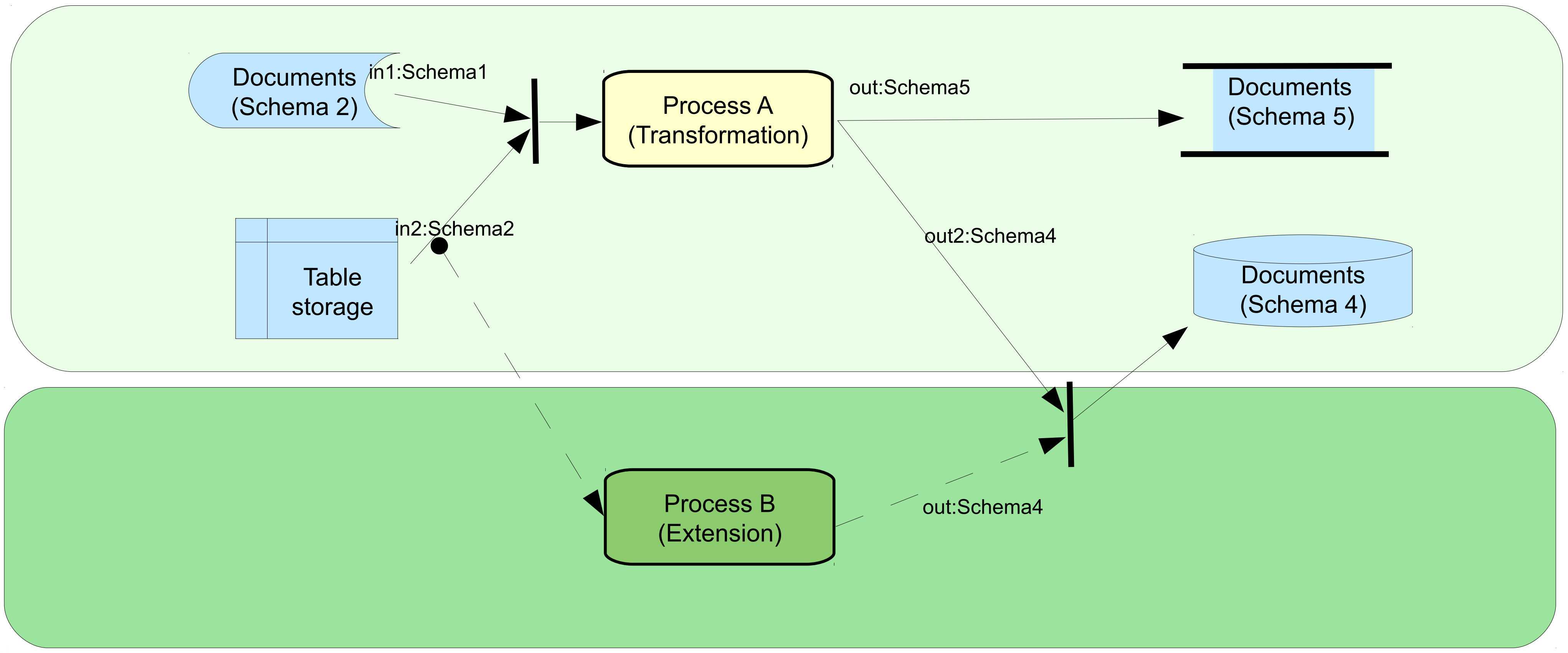
Tool Extension by Stream Duplication and Asynchronous Merge

- DFD are easily extensible, because input streams can be replicated to deliver their content into the processes of the extension (extension listening on stream of core)
- Output streams of extensions can write asynchronously into output storages



Synchronizing Extension of Core Tool

- Output streams of extensions can write synchronously into output storages by adding new synchronizing activities guarding output storages



33.2. Extensible Stream-Based Tools: DQL und DTL in DFD-Mashups

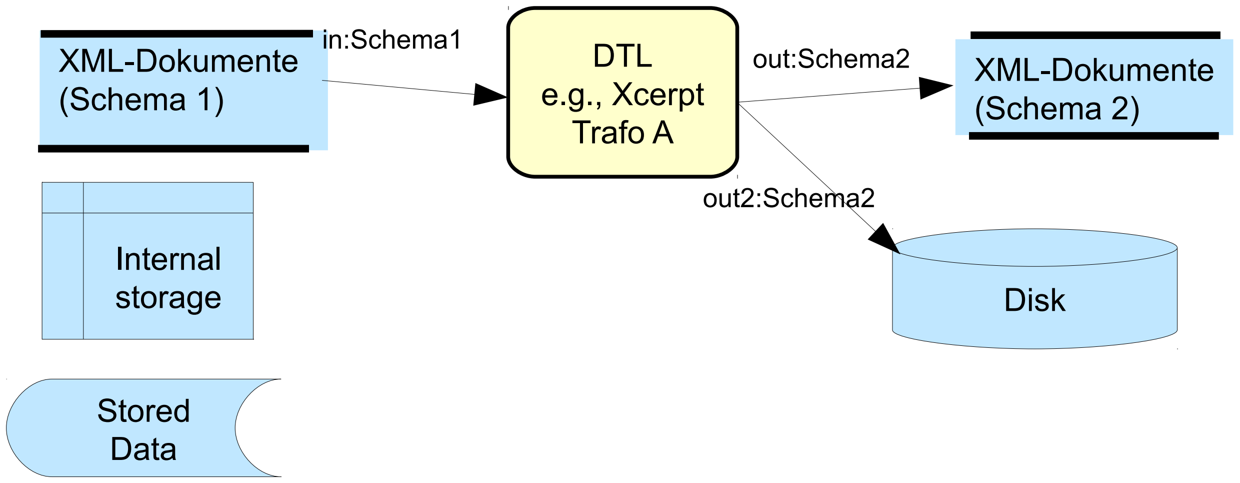
Ex.: Technical Space Treeware-XML

XML Mashups are special DFD

The example can be transferred to Graphware or Grammarware using other DQL and DTL

Use of DQL and DTL in DFD (e.g., Mashups)

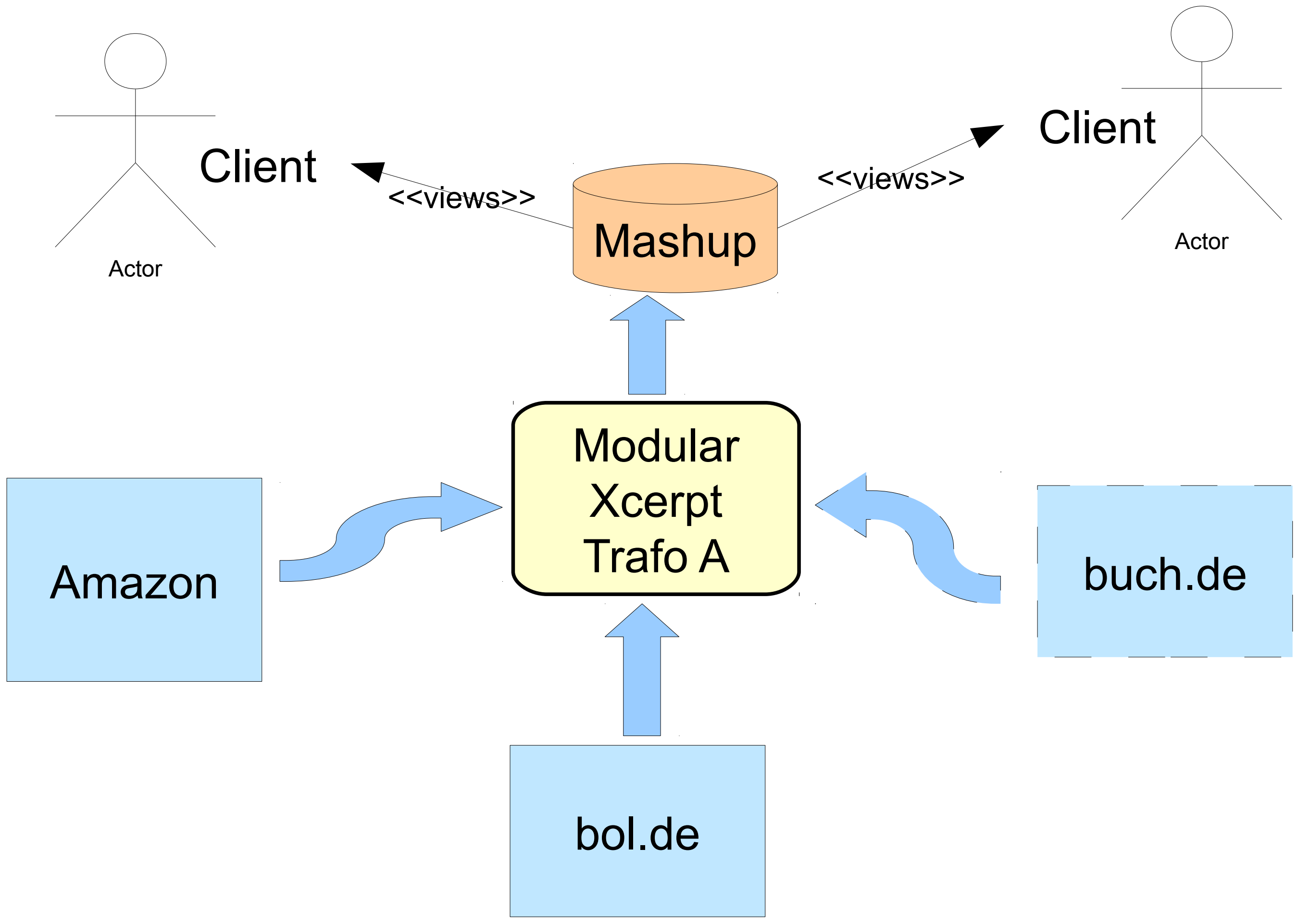
- DTL and DQL (Xquery, Xcerpt and others) can be employed as generators and transformers in DFD
  - A DDL describes the types of data on the streams (types, schemata)
  - String rewrite systems can be used to specify processes if streams transport texts
  - Term rewrite systems can be used to specify processes if streams transport trees
  - XML rewrite systems: With XML and XSD, Xcerpt can be used
  - Graph rewrite systems can be used if streams transport graphs
- Mashups are easily extensible, because channels can be replicated and extended
- Mashups are extremely important for extensible tools



XML-Mashups with Modular Xcerpt

Use Modular Xcerpt for creating a CD mashup of our favourite music LPs

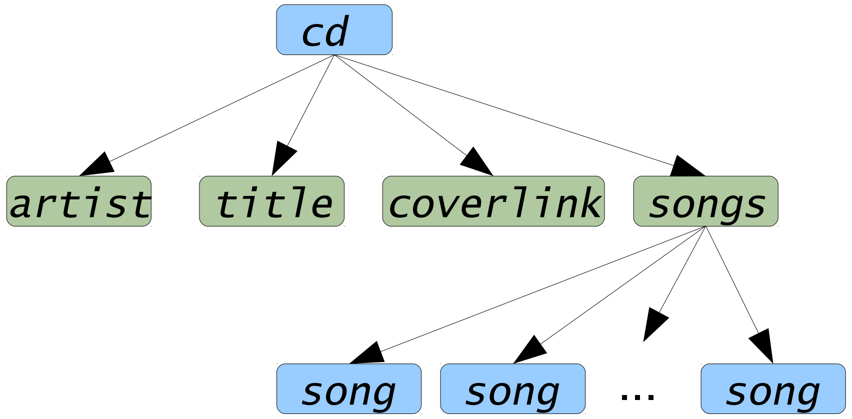
- “mashing-up” freely available data from online stores
- easily extensible with new sources or processing steps



Mashups with Modular Xcerpt

- First we need a data structure for CDs, so that we can use it for our virtual store of aggregated data
- Model with Xcerpt data terms (XML trees)

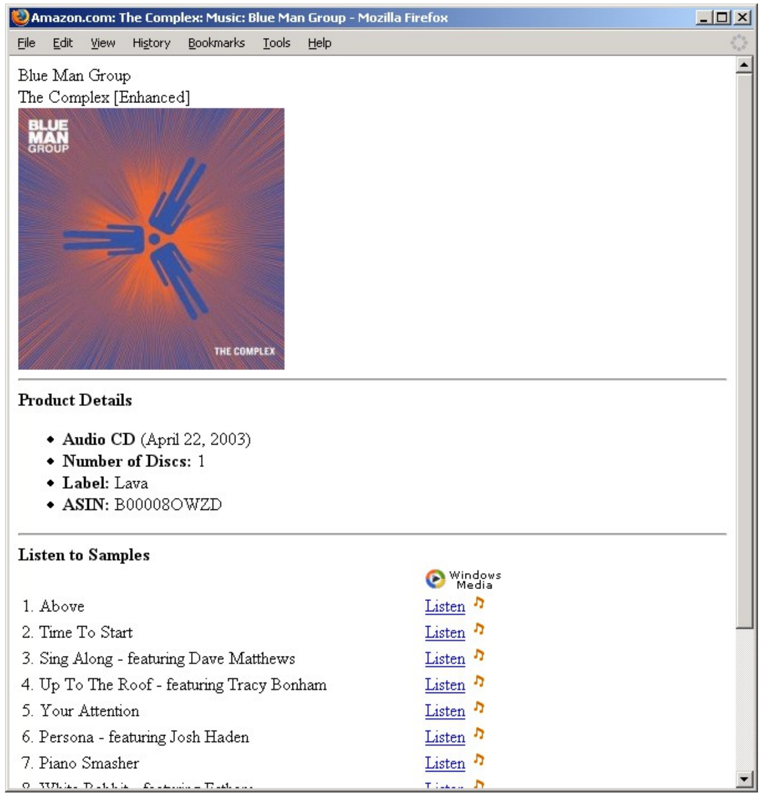
```
cd [
        artist,
        title,
        coverlink,
        songs [
                song, song … song
        ]
]
```



Mashups with Modular Xcerpt

- Next step: creating import modules to aggregate data from our sources

```
MODULE AmazonQuery
CONSTRUCT
public cd [
           artist [ var ARTIST ],
           title [ var TITLE ],
           coverlink [ var COVERLINK ],
           songs [
             all song [ var SONGTITLE ]
           ]
]
FROM
public html [
             head [[ ]],
               body [[
                      var ARTIST, br,
                      var TITLE, br,
                      img {
                        attributes {src { var COVERLINK }}
                      },
                      table [[
                          tr [
                            th [[ ]]
                          ],
                        tr[
                            td [ var SONGTITLE ],
                          td [[ ]]
                         ]
                  ]]
           ]]
      ]
END
```


Amazon.com: The Complex: Music: Blue Man Group - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Blue Man Group
The Complex [Enhanced]

Product Details

- **Audio CD** (April 22, 2003)
- **Number of Discs:** 1
- **Label:** Lava
- **ASIN:** B00008OWZD

Listen to Samples

	Windows Media
1. Above	Listen
2. Time To Start	Listen
3. Sing Along - featuring Dave Matthews	Listen
4. Up To The Roof - featuring Tracy Bonham	Listen
5. Your Attention	Listen
6. Persona - featuring Josh Haden	Listen
7. Piano Smasher	Listen

(Example HTML Source)

Mashups with Modular Xcerpt

- Import modules are independent from a concrete source
  - pass the resource locations to the modules
  - collect all data from modules by introducing a virtualroot node (dummy)

```
MODULE MainProgram

IMPORT /import/AmazonQuery.mxcerpt AS Amazon
IMPORT /import/BuchdeQuery.mxcerpt AS BuchDE

CONSTRUCT to Amazon (
     var DATA
)
FROM
  in {
     resource { “file:data/amazon-blue_man_group-
                      the_complex.html", "xml" },
     var DATA
   }
END

CONSTRUCT to BuchDE

   …
END
```

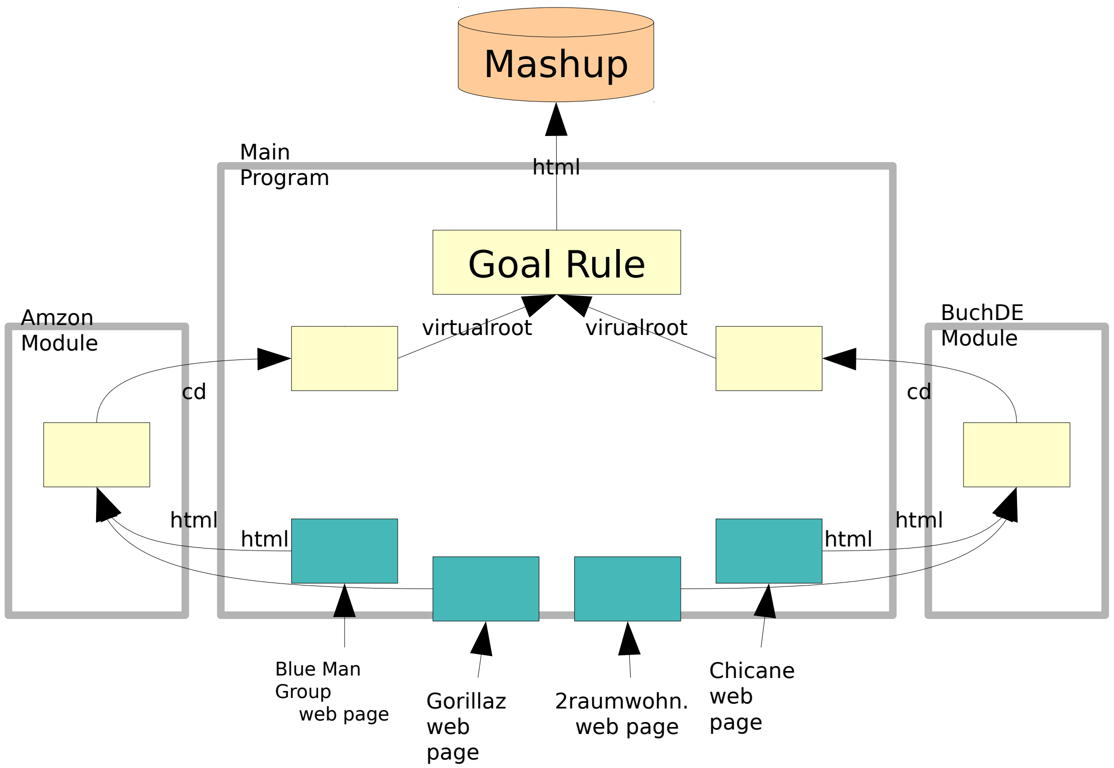
```
// Filling variable CDINFO with
// dummy virtual root node
CONSTRUCT
           virtualroot [ all var CDINFO ]
FROM in Amazon (
           var CDINFO -> cd [[ ]]
)
END

CONSTRUCT
           virtualroot [ all var CDINFO ]
FROM in BuchDE (
           var CDINFO -> cd [[ ]]
)
END
```

Mashups with Modular Xcerpt

- Construct rules “mash up” the data – create a new webpage
  - in Xcerpt a goal rule must be specified (program entry point)

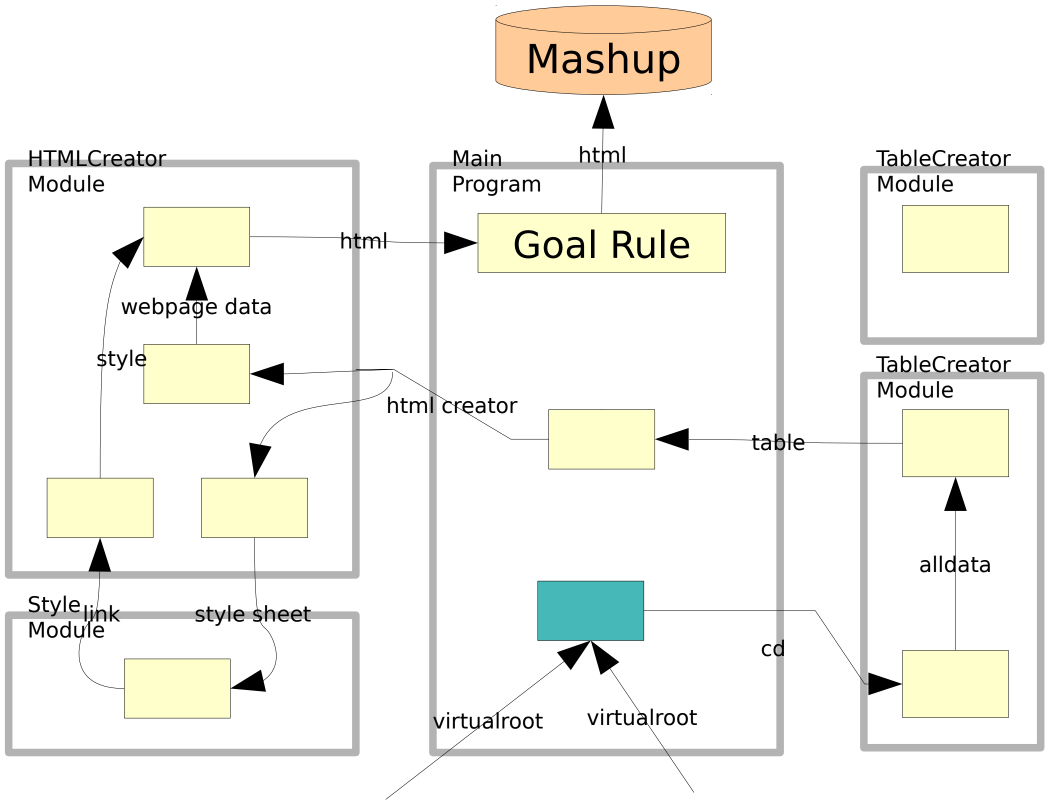
```
GOAL
out {
   resource {"file:mashup.html", "xml"},
   html [
      head [
         title ["Mashup"]
      ],
      body [
         table [
                      all tr [
                  td [ var ARTIST ],
                  td [ var TITLE ]
            ]
         ]
      ]
   ]
}
FROM
virtualroot [[
   cd [[
         artist [ var ARTIST ],
         title [ var TITLE ]
      ]]
   ]]
END
```



(Structure of the Modular Xcerpt program)

Mashups with Modular Xcerpt

- Further decomposition of program possible
  - HTML creator can be an extra module
  - Table layout and style sheet linking can be made configurable



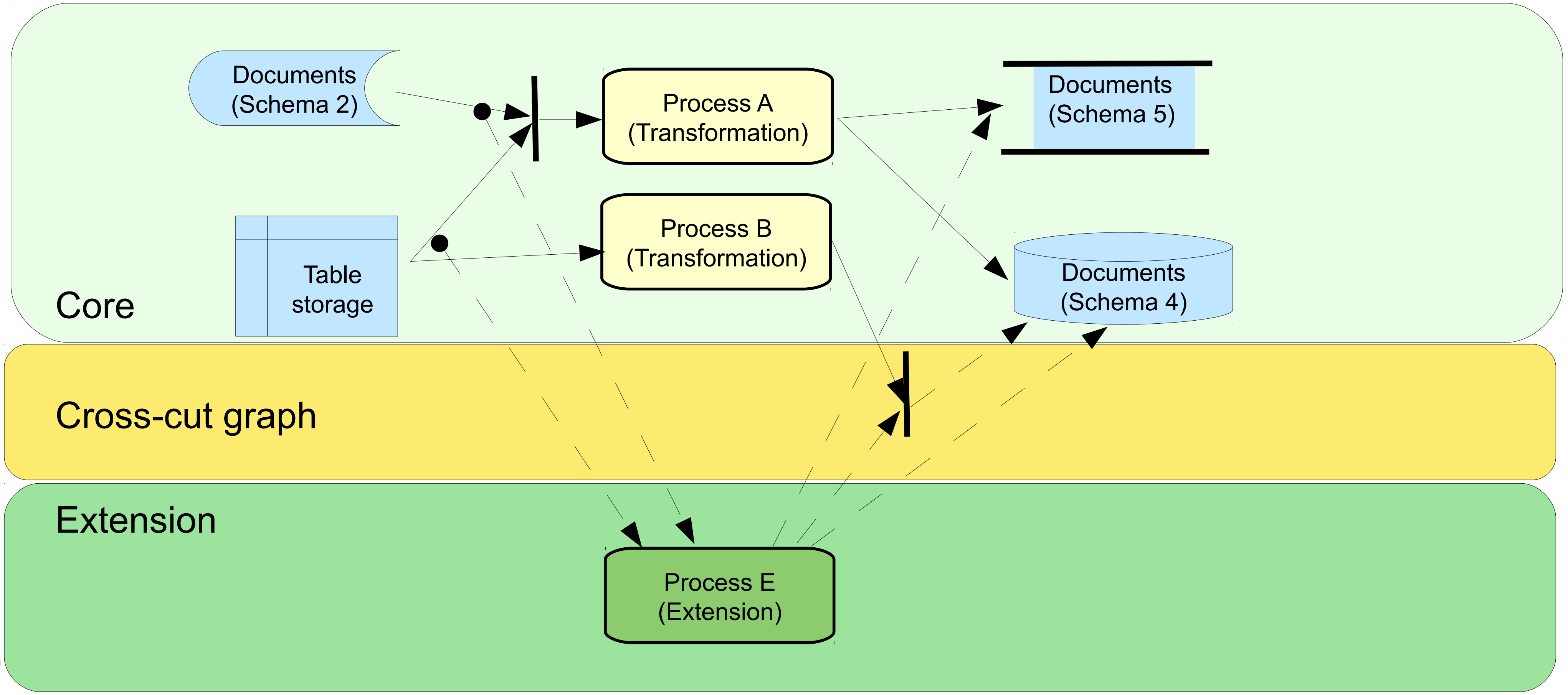
(advanced Modular Xcerpt program)

33.3. Aspect-Oriented XML-Weaving with XML Transformations

- For aspect-orientied extensions of DFD und Mashups

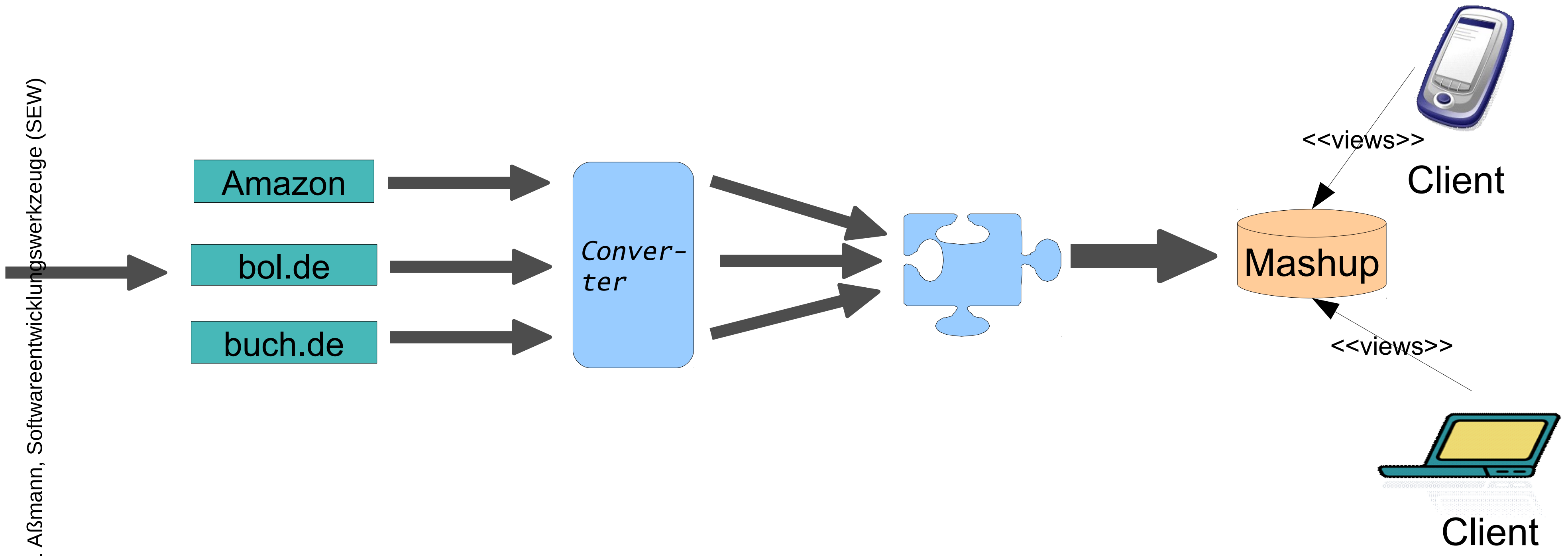
Aspect-Oriented Tool Extension by Crosscut-Graph between Core and Extension

- If an extension extends many places in a core (scattering), a ***crosscut-graph*** describes the



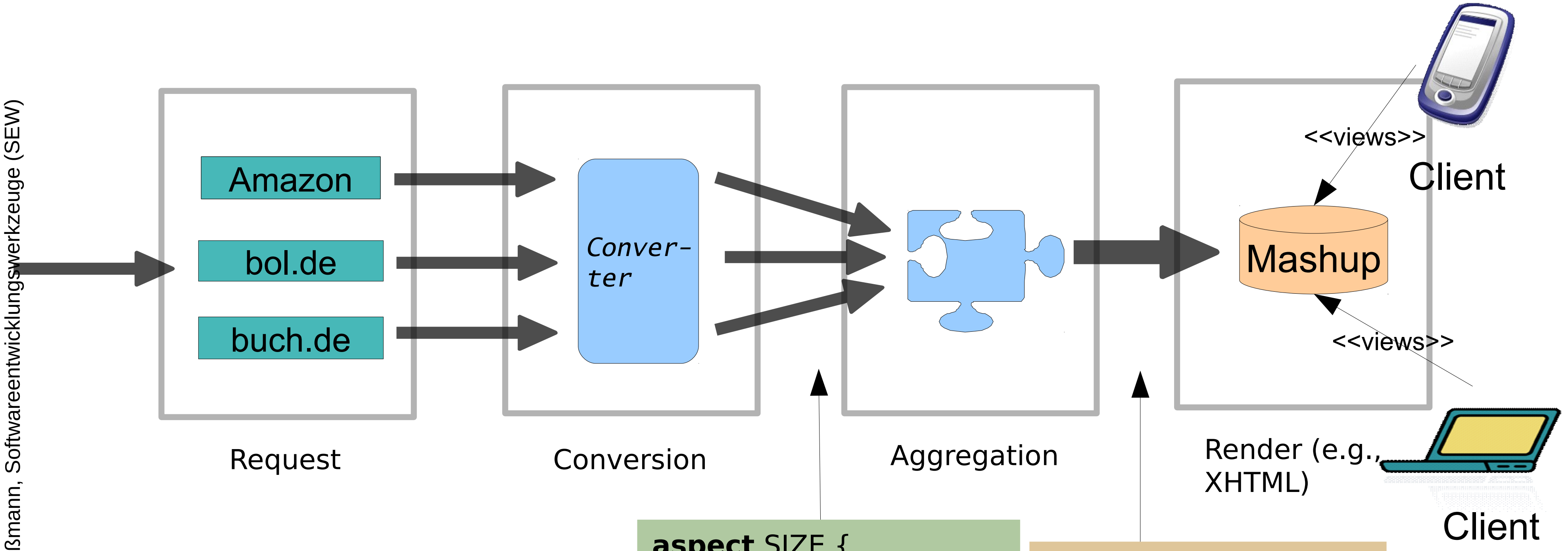
XML Adaptation Aspects (HyperAdapt Weaver)

- Xcerpt mashups induce data-flow architecture
- Mashups should be rendered for different target devices, e.g., mobiles, tablets → *Adaptation Aspects*



XML Adaptation Aspects (HyperAdapt Weaver)

- The tool "HyperAdapt Weaver" modifies the streams by transformation: "aspect actions" are "woven" into the stream



aspect SIZE {
Before „Aggregation"
If (device="mobile")→
Action Choose SMALL CD Cover Variant
}

aspect LAYOUT {
Before „Render"
If (screen_w<"5cm")→
Action Convert Layout
}

XML Adaptation Aspects (HyperAdapt Weaver)

- Example: Virtual Storage Music Database before aggregation phase as plain XML

aspect SIZE {
Before „Aggregation“
If (device=“mobile“)→
Action Choose SMALL
CD Cover Variant
}

```
<music-database xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://music music.xsd" xmlns="http://music">
    <album inStock="Yes">
        <title>How to Be a Megastar-Live!</title>
        <artist>
            <pseudonym>Blue Man Group</pseudonym>
        </artist>
        <id>B00166GLVO</id>
           dition>First</edition>
           ublisher>Rhino (Warner)</publisher>
           mage size="SMALL" url="..."/>
           ma        GE" url="...SS500_.jpg"/>
           mage size="TINY" url="...SS500_tiny.jpg"/>
           edia>
            <medium kind="CD">
                <tracks>
                   <song name="Above" length="3.30" />
                   <song name="Drumbone" length="3.25" />
                   <song name="Time To Start" length="4.22" />
                   <song name="Up To The Roof" length="4.16" />
                   <song name="Altering Appearances" length="2.23" />
                   <song name="Persona" length="4.12" />
                   <song name="Your Attention" length="4.04" />
                   <song name="Piano Smasher " length="6.01" />
                   <song name="Shirts And Hats" length="4.40" />
                   <song name="Sing Along" length="3.10" />
                </tracks>
            </medium>
          </media>
     </album>
</music-database>
```

XML Adaptation Aspects (HyperAdapt Weaver)

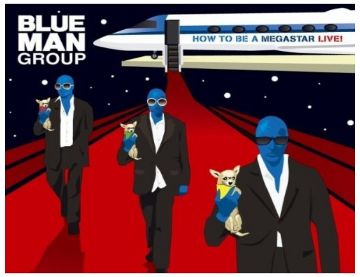
- Example: Document adaptation specified as HyperAdapt Adaptation Aspect, written in the XML-based HyperAdapt Aspect Language
  - Interpreting these aspects, the weaver weaves aspect slice into streams

```
<?xml version="1.0" encoding="UTF-8" ?>
<aspect name="choose-image">
    <interface>
         <core id="core" type="http://music" />
    </interface>
    <adviceGroup>
        <scope>
            <xpath>/music:music-database</xpath>
            <before>Aggregation</before>
        </scope>
        <advices>
          <chooseVariant>
               <pointcut>/music:album/music:image[1]</pointcut>
          </chooseVariant>
        </advices>
    </adviceGroup>
</aspect>
```

document namespace

process stage (joinpoint)

adaptation rule (advice)


SMALL

LARGE

TINY

(Pictures from amazon.de)

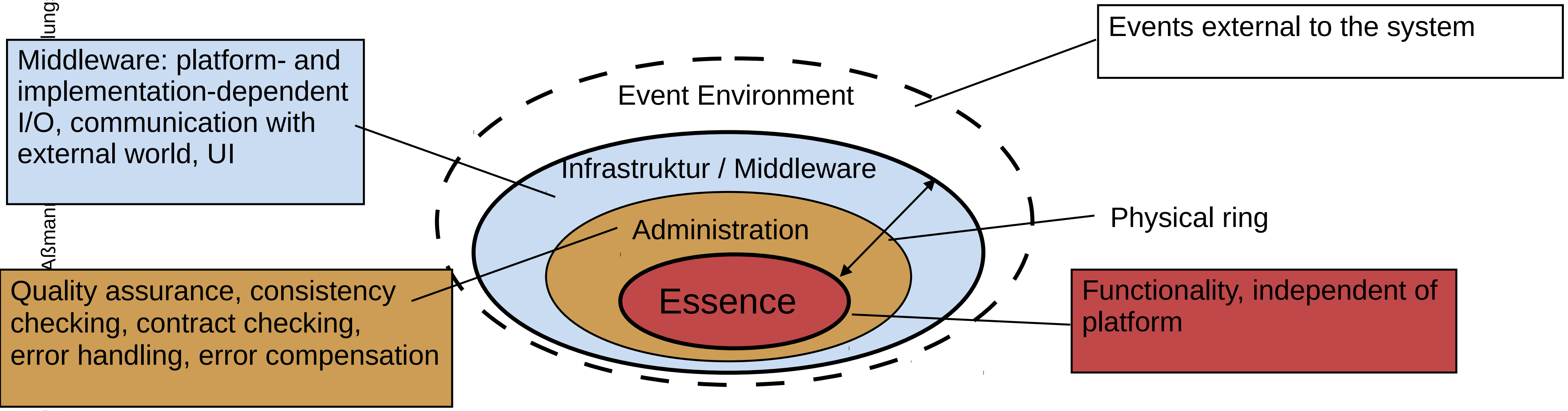
33.4 Essential Decomposition of Tools

Development with DFD

- **Prozess-oriented Refinement/Decomposition** refines processes/activities step by step into smaller processes (divide-and-conquer)
  - One dimension of decomposition
- **Essential Decomposition** uses aspect-oriented decomposition and distinguishes three aspects: [McMenamen/Palmer]
  - Essence (E): essential processes, activities, storage. Functionality that cannot be stripped
  - Administration (A): administrative activities (for consistency checking of data in internal storages;for contract checking of processes on input and output streams)
  - Infrastructure (I): activities for communication and adaptation to platform (platform-specific details)

EAI-Decomposition

- **Essential decomposition (EAI decomposition)** separates the **essence** of a system from implementation-specific parts (**infrastructure**) and quality assurance (**administration**).
  - Essence assumes perfect technology [McMenamen/Palmer]
    - Processes do not need time, storage with unlimited capacity

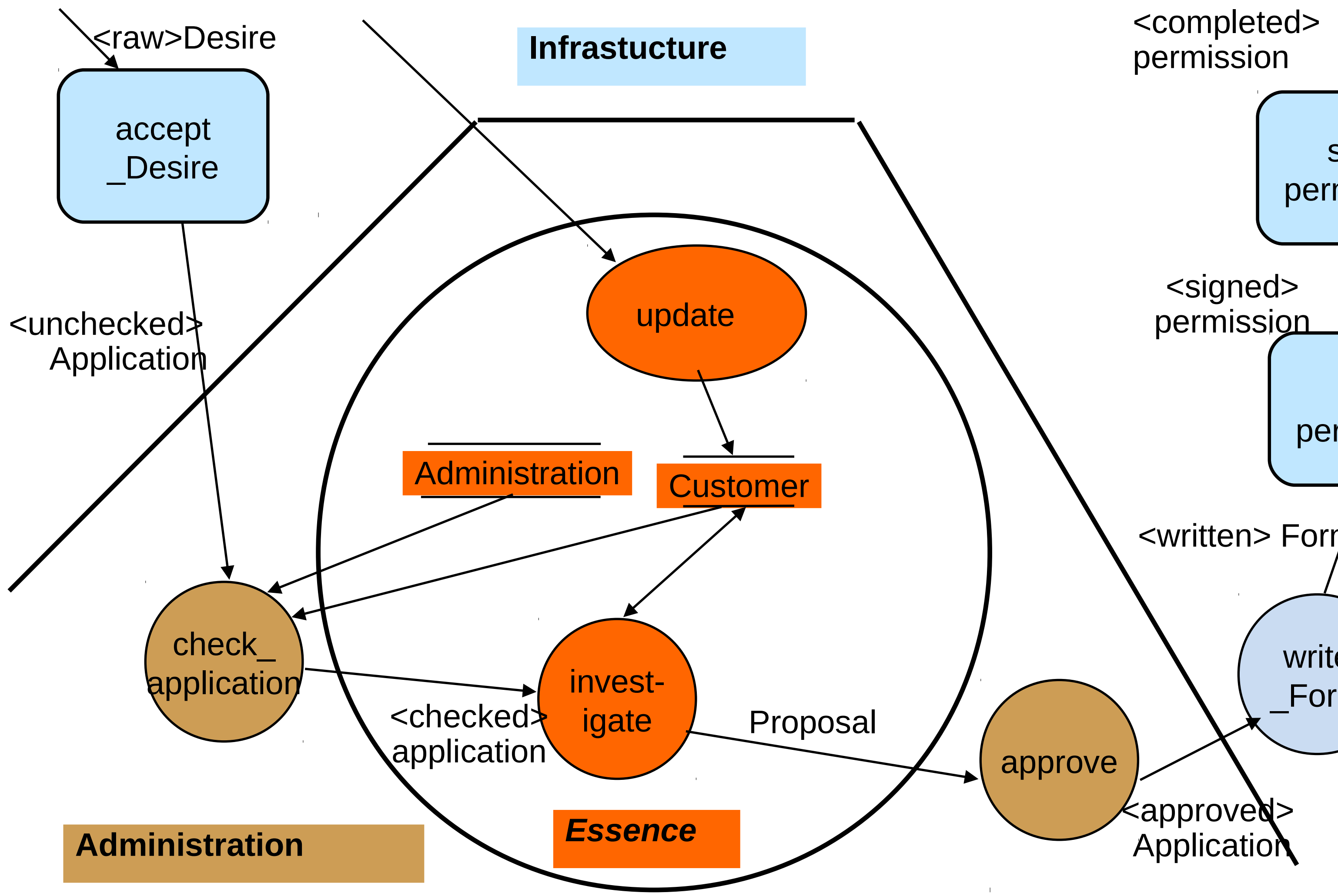

Middleware: platform- and implementation-dependent I/O, communication with external world, UI
Quality assurance, consistency checking, contract checking, error handling, error compensation
Event Environment
Infrastruktur / Middleware
Administration
Essence
Events external to the system
Physical ring
Functionality, independent of platform

EAI-Decomposition of DFD-Based Tools

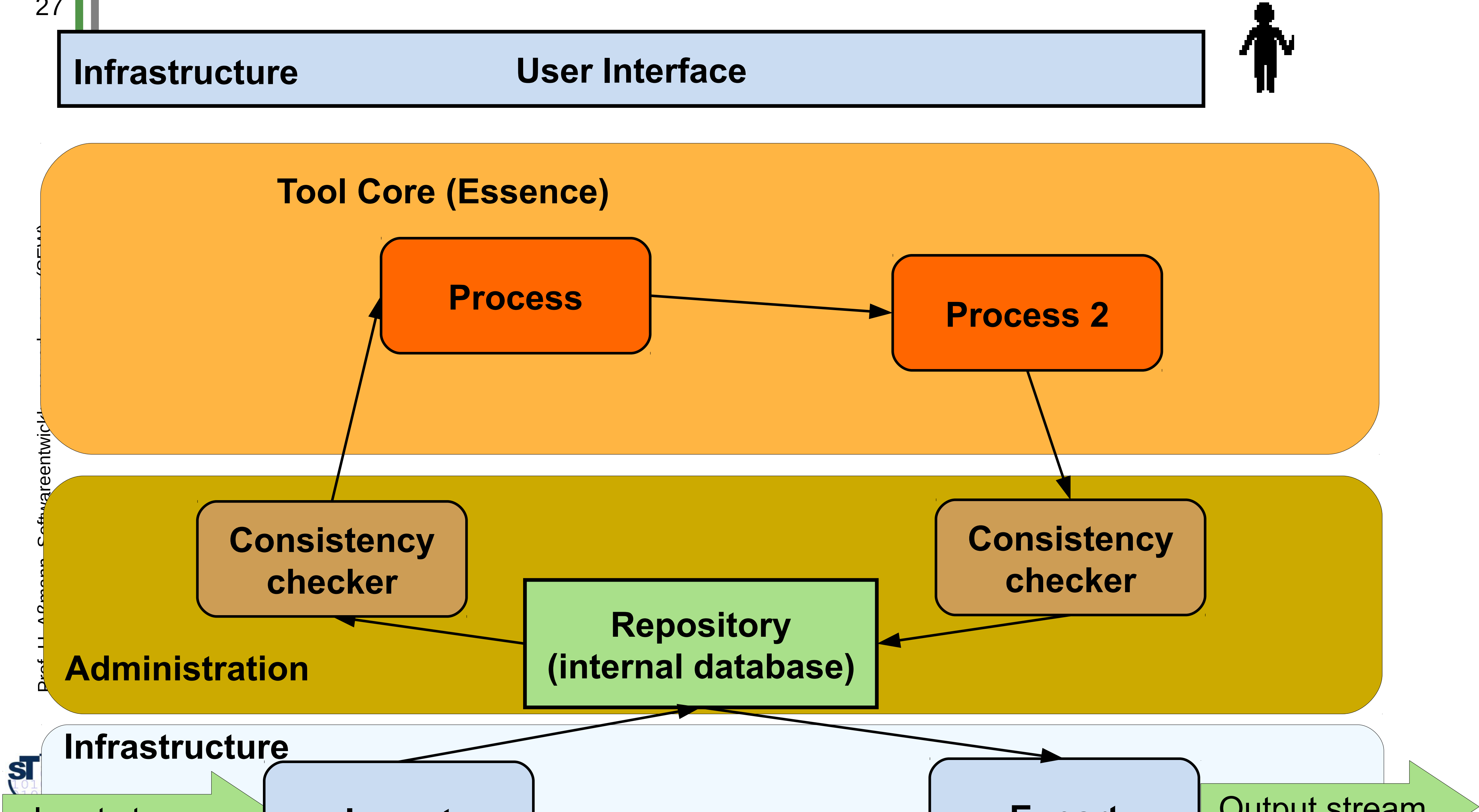
- With DFD, the decomposition into EAI-aspects (Essence, Administration, Infrastructure) is simple: by graph slicing
- EAI-aspects of a tool:
- Essence of a tool:
  - Functionality assuming perfect technology
- Administration of a tool:
  - Constraint checker, wellformedness checker on internal repository, contract checkers on streams
- Infrastructure of a tool:
  - Parser, tree constructor (import)
  - Pretty printer, code generator (export)

Ex. EAI-Decomposition of a Process of a Tool “Task Management Sytem”

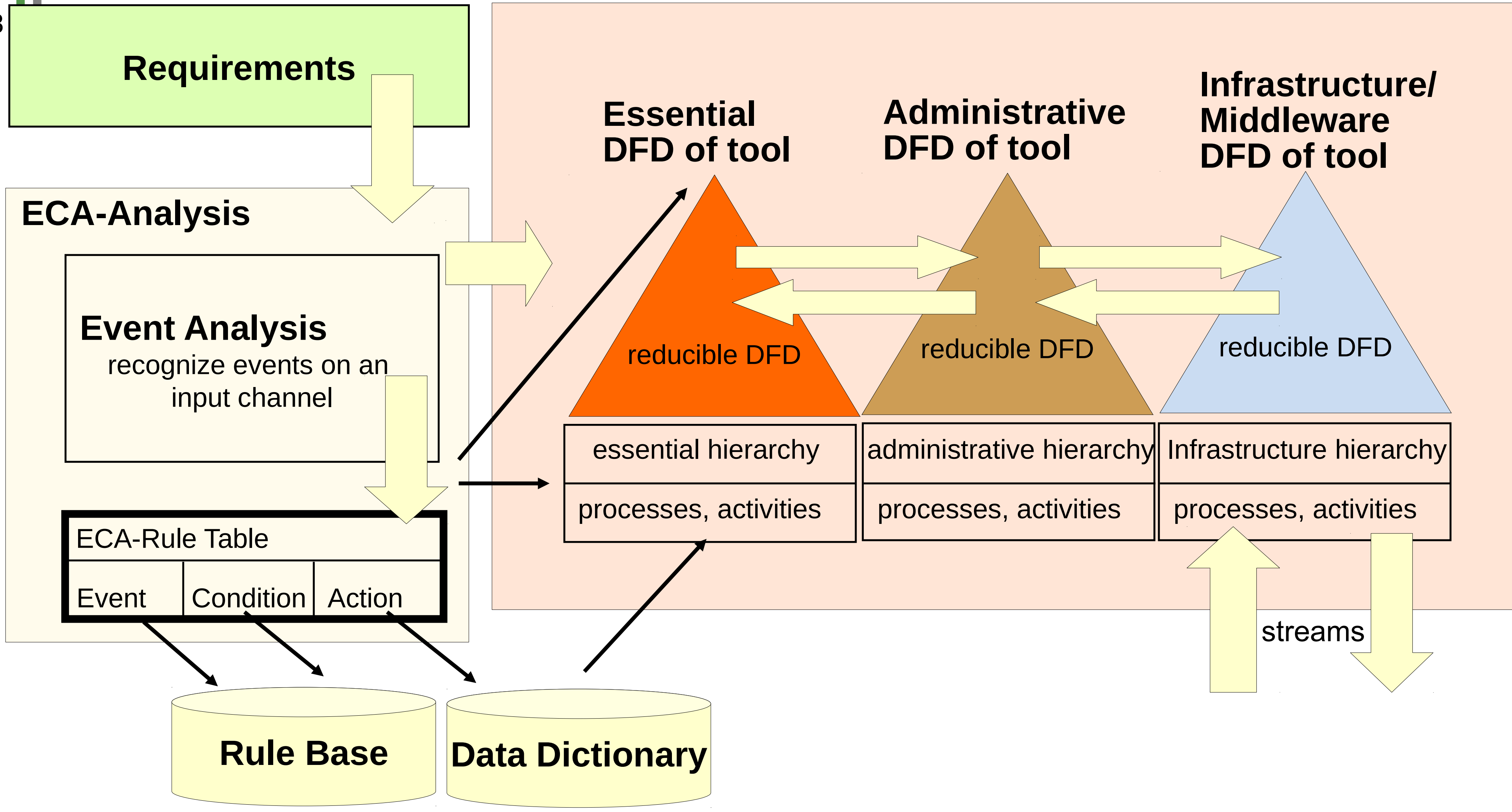
- EAI was invented for the Structured Analysis of applications, but can be used for tools



EAI-Decomposition of a Stream-Based Tool



Essential Structured Analysis for Tools

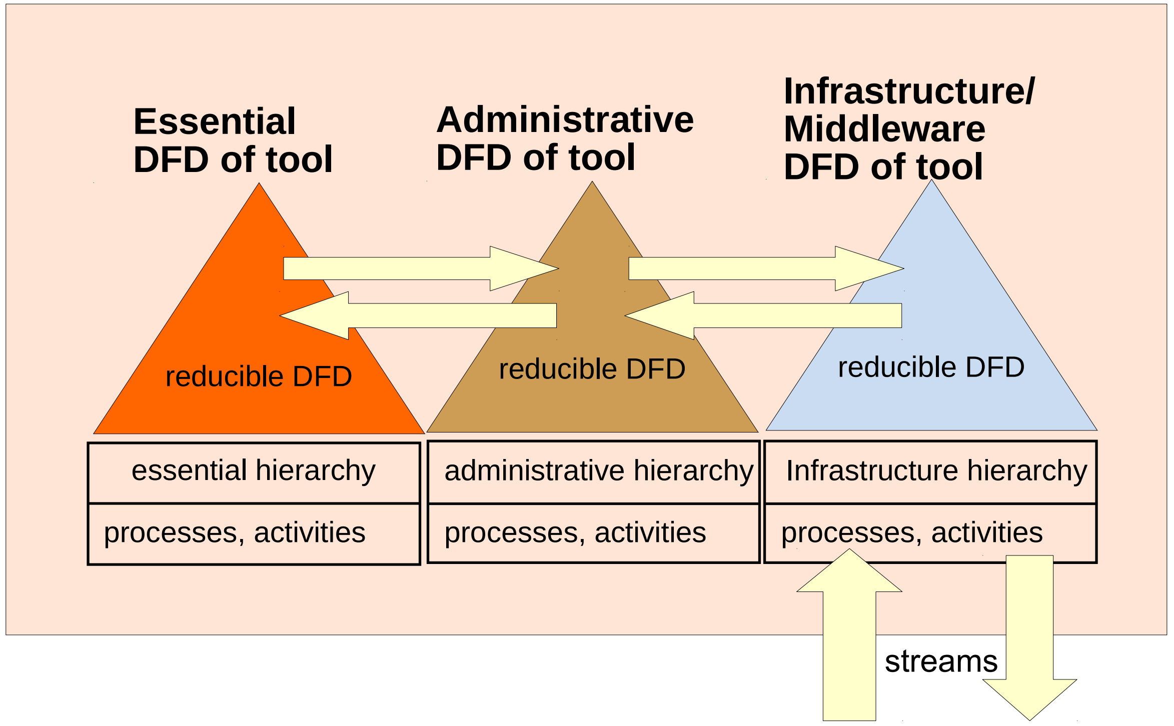


Quelle: Raasch, J.: Systementwicklung mit Strukturierten Methoden; Hanser Verlag (3.Auf .) München 1993

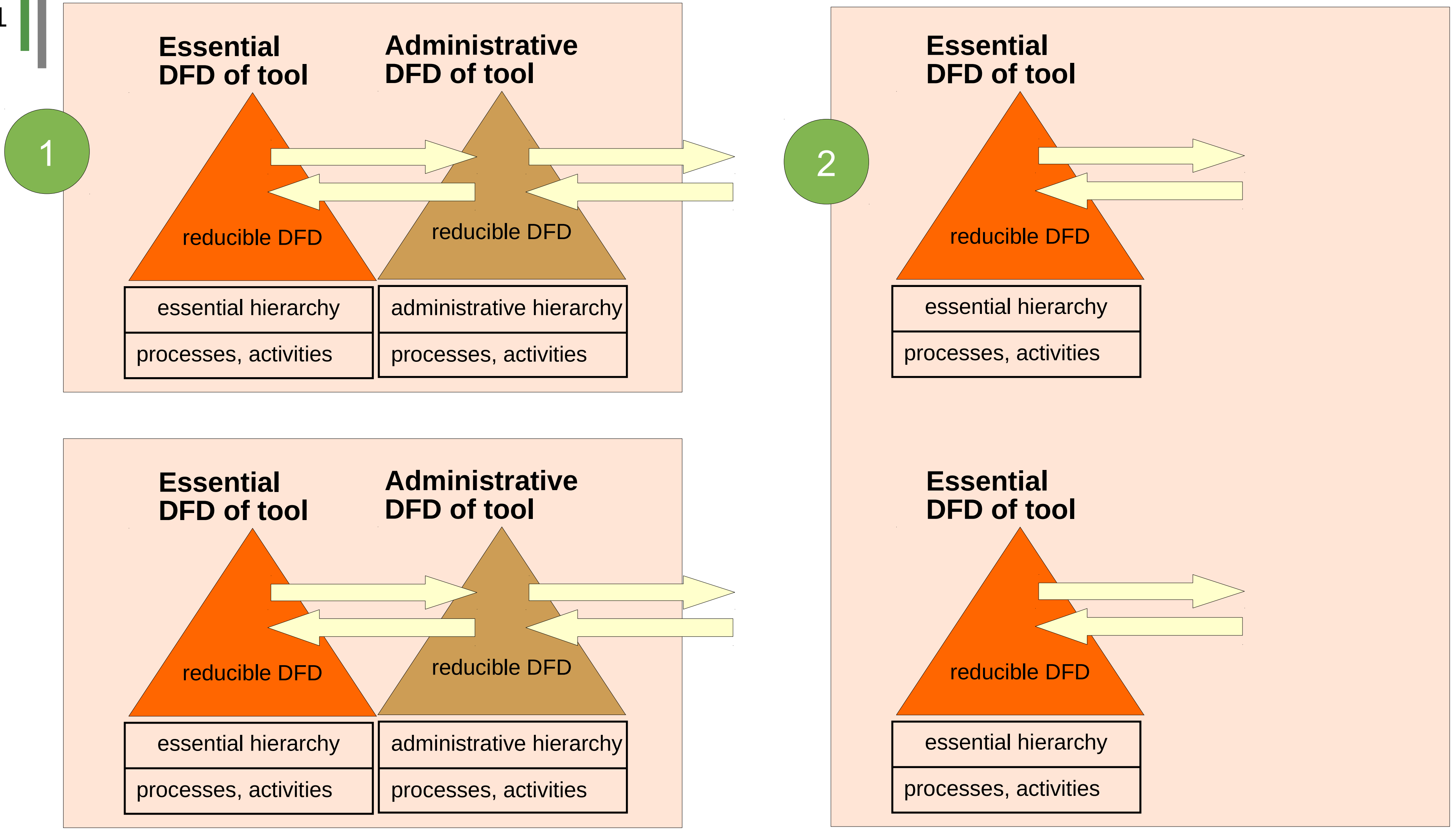
33.5 Composition of Stream-Based Tools

Process for Composition of Stream-Based Tools

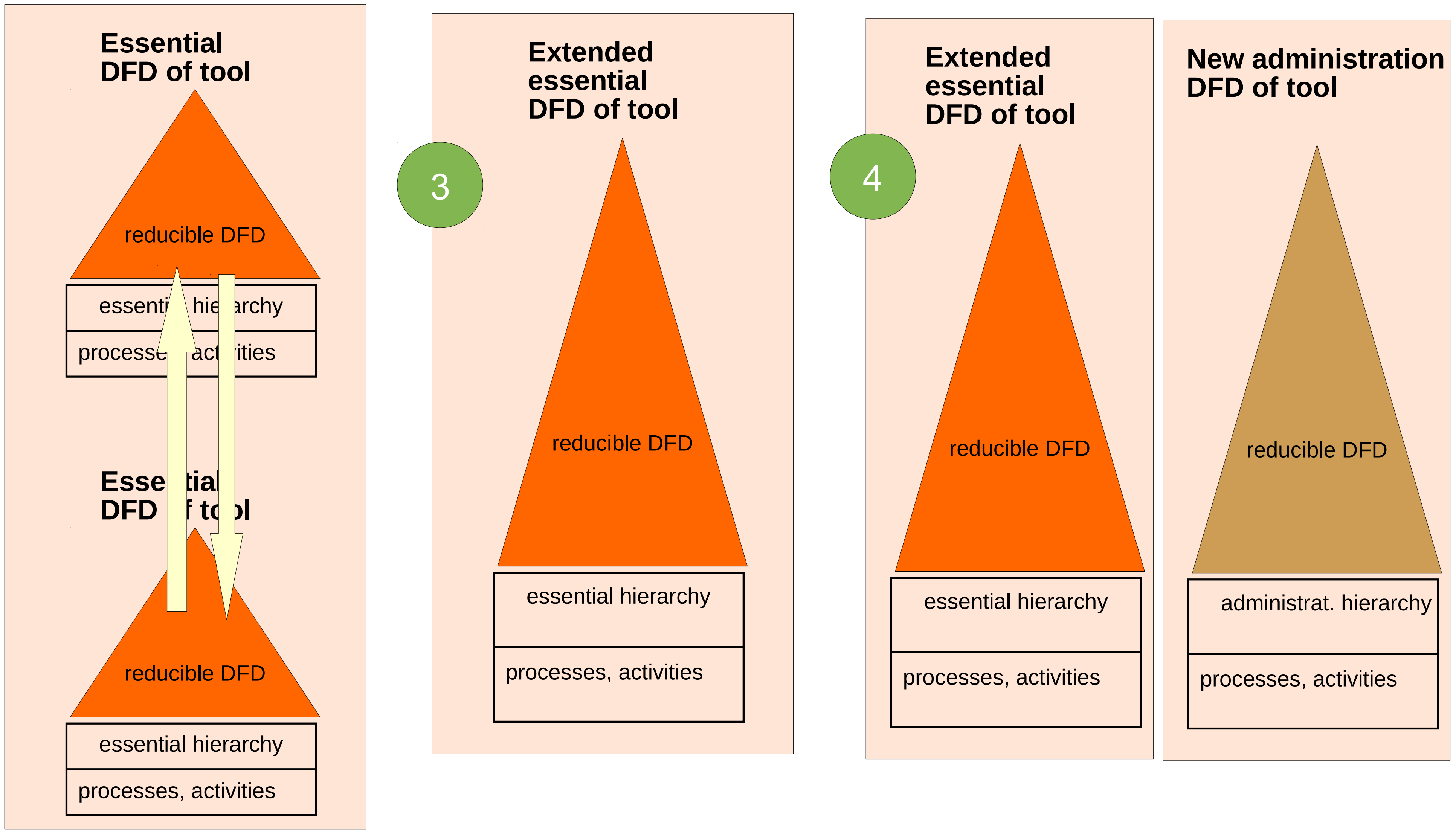
1) Strip the DFD Strip Essence of Administration and Infrastructure:
    1) remove parser, printer, GUI, etc.
2) Compose the essential DFD of the tools
    - Extend and merge streams with the same schema (respect typing)
    - Extend core tools by asynchronous merge of output streams
    - Extend core tools by synchronous merge of output streams
    - Use aspect-oriented extension with cross-cut-graphs
3) Add Administration
4) Add Infrastructure to the composed DFD



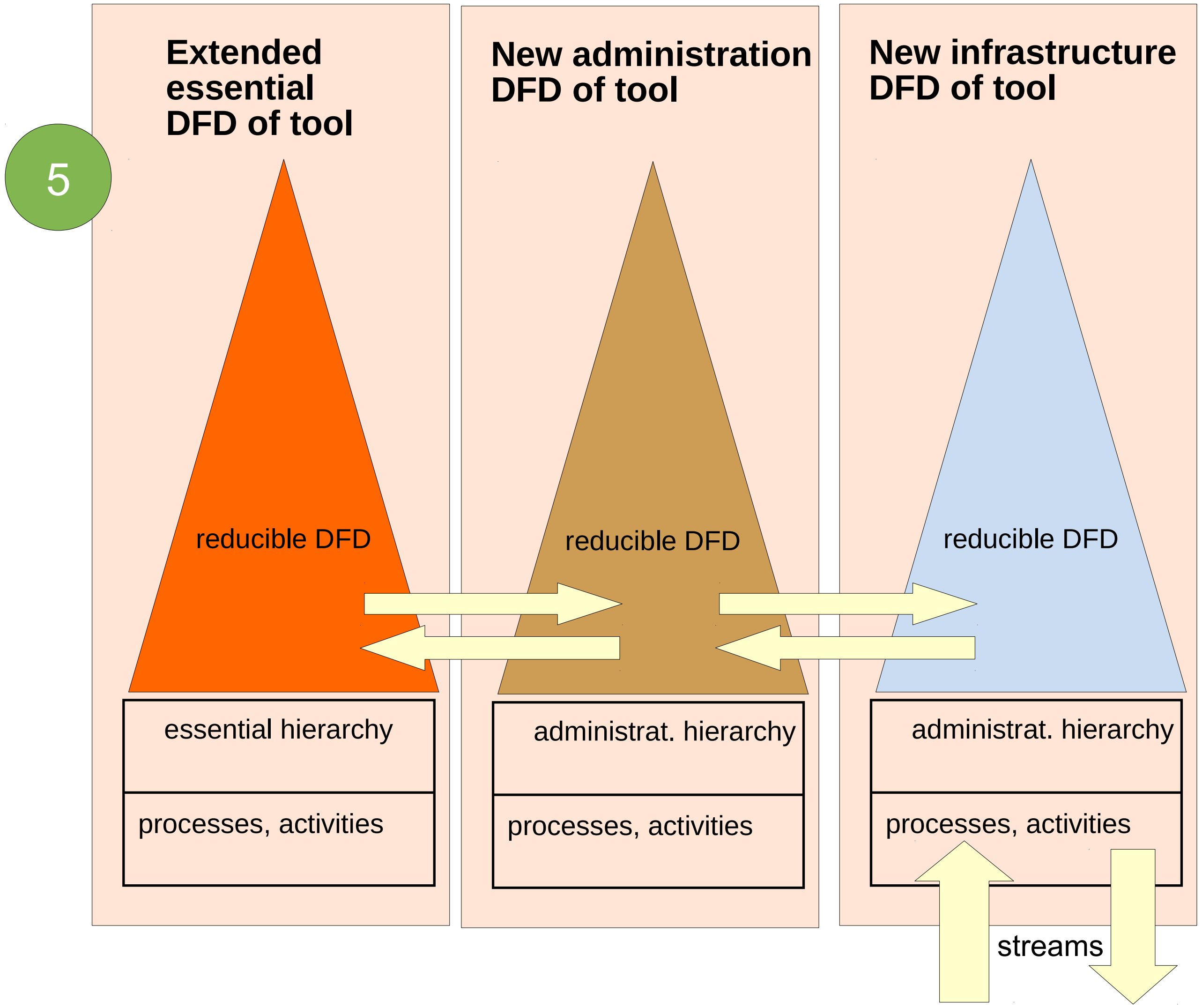
1) Strip Infrastructure 2) Strip Administration



3) Extend Essence 4) Add Administration

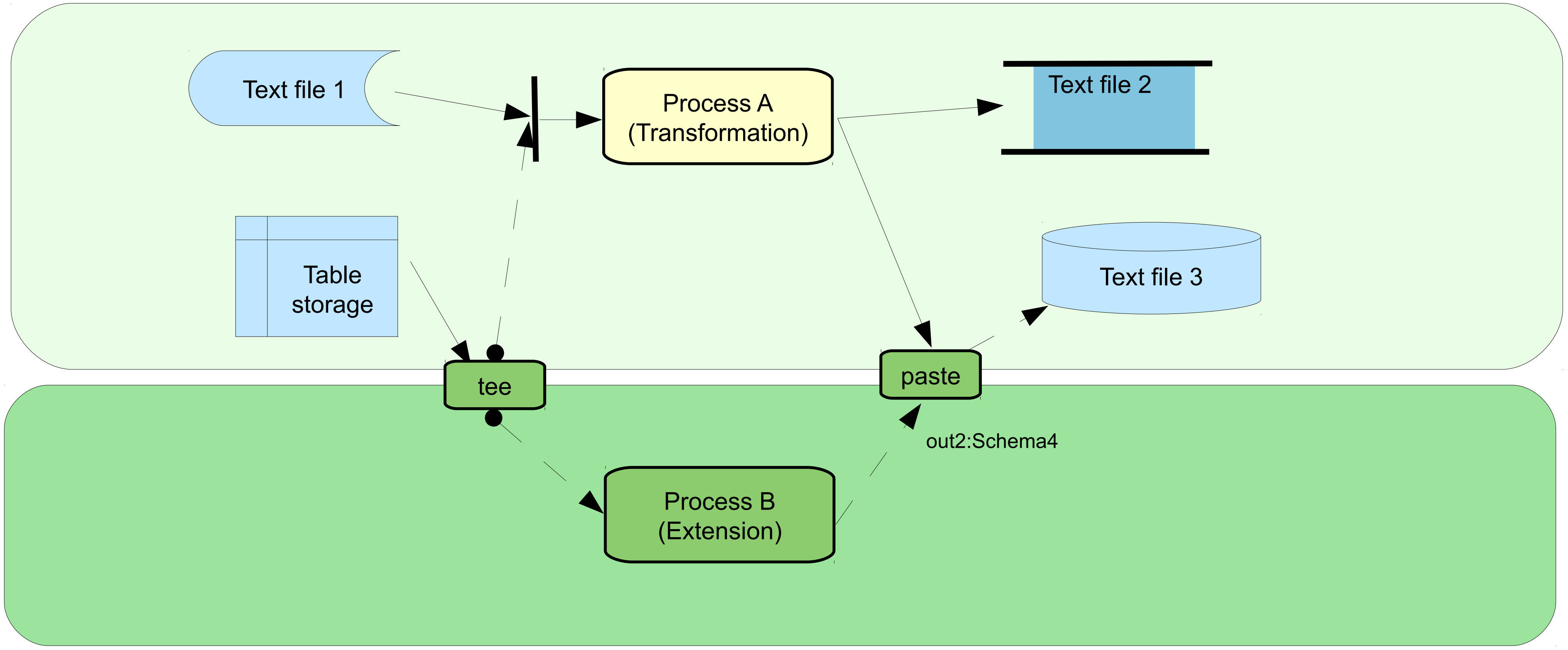


5) Add New Infrastructure



Example: Shell Script Extension in Linux

- Streams are text streams (untyped)
- `tee` is a little filter replicating a text stream
- `paste` or `lam` are little filters merging two streams



The End – What did we learn?

- Stream-based tools can easily be extended and composed
  - with input stream replication
  - with asynchronous or synchronous output stream merge
  - with aspect-oriented extension
- Tools should be composed only with regard to their Essence, disregarding Administration and Infrastructure aspects