TRIPS: A System for Translating Raw Indoor Positioning Data into Visual Mobility Semantics

†Huan Li, †Feichao Shi, ‡Hua Lu, †Gang Chen, †Ke Chen, and †Lidan Shou

†College of Computer Science and Technology, Zhejiang University, China
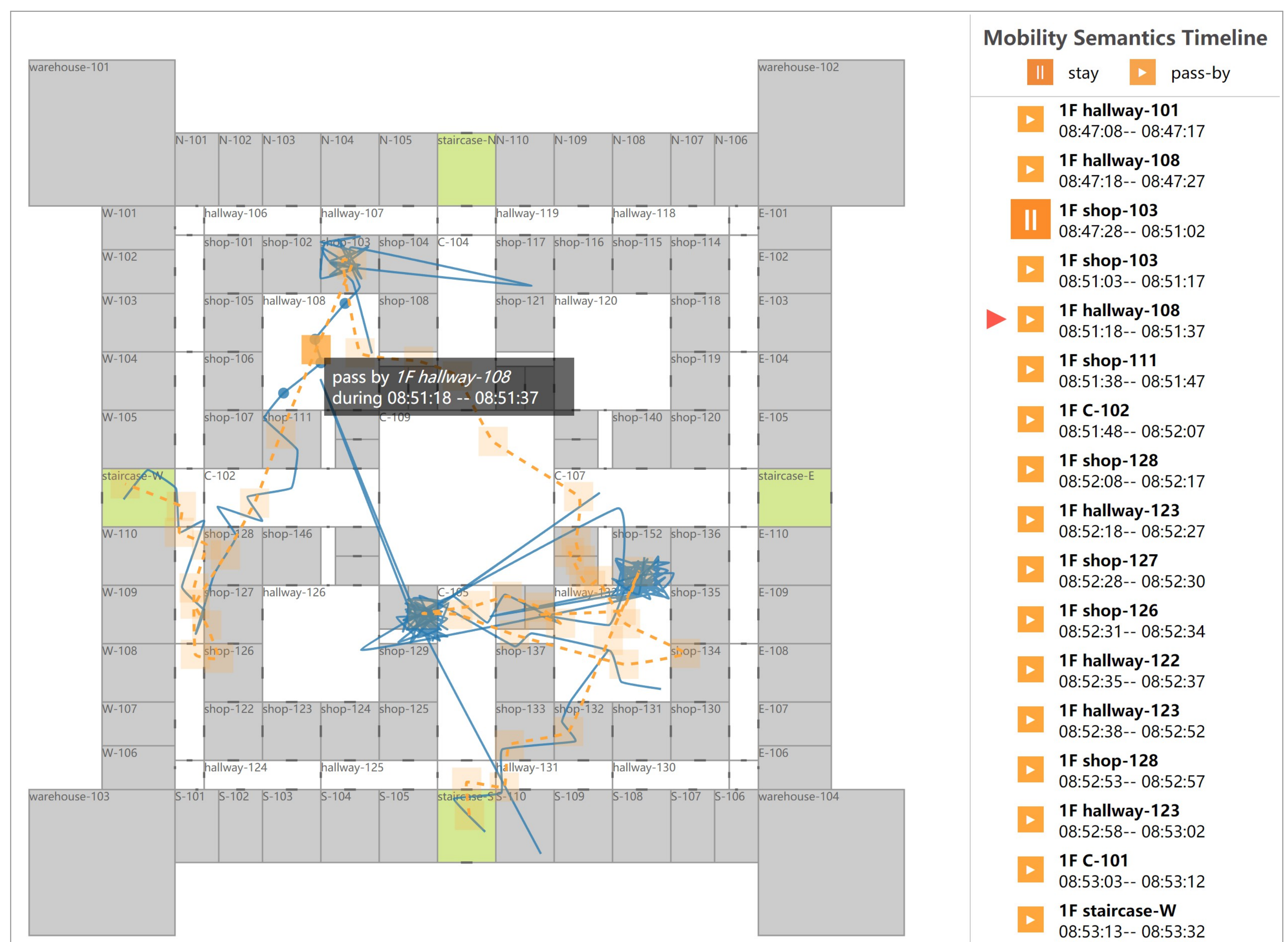‡Department of Computer Science, Aalborg University, Denmark

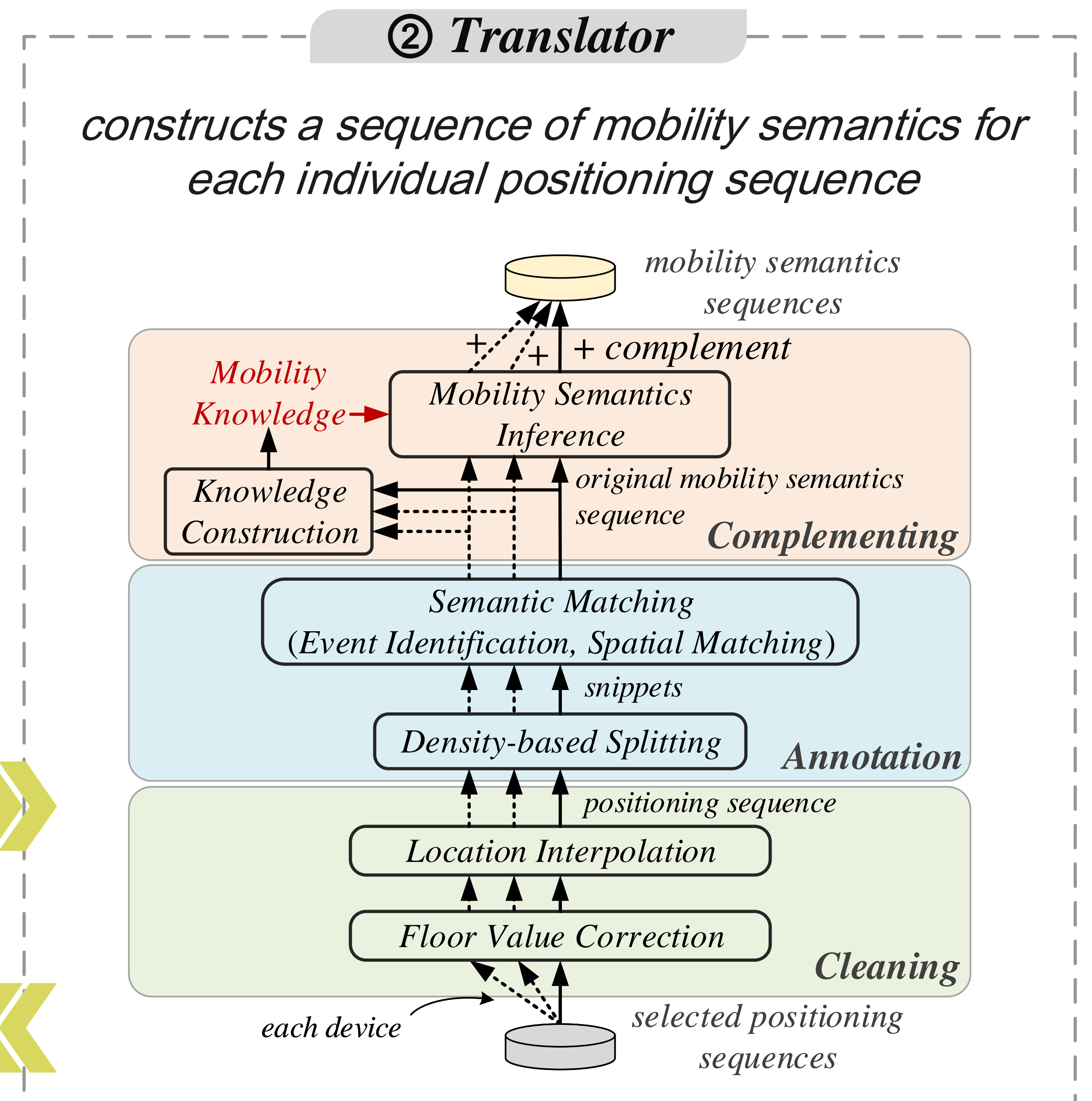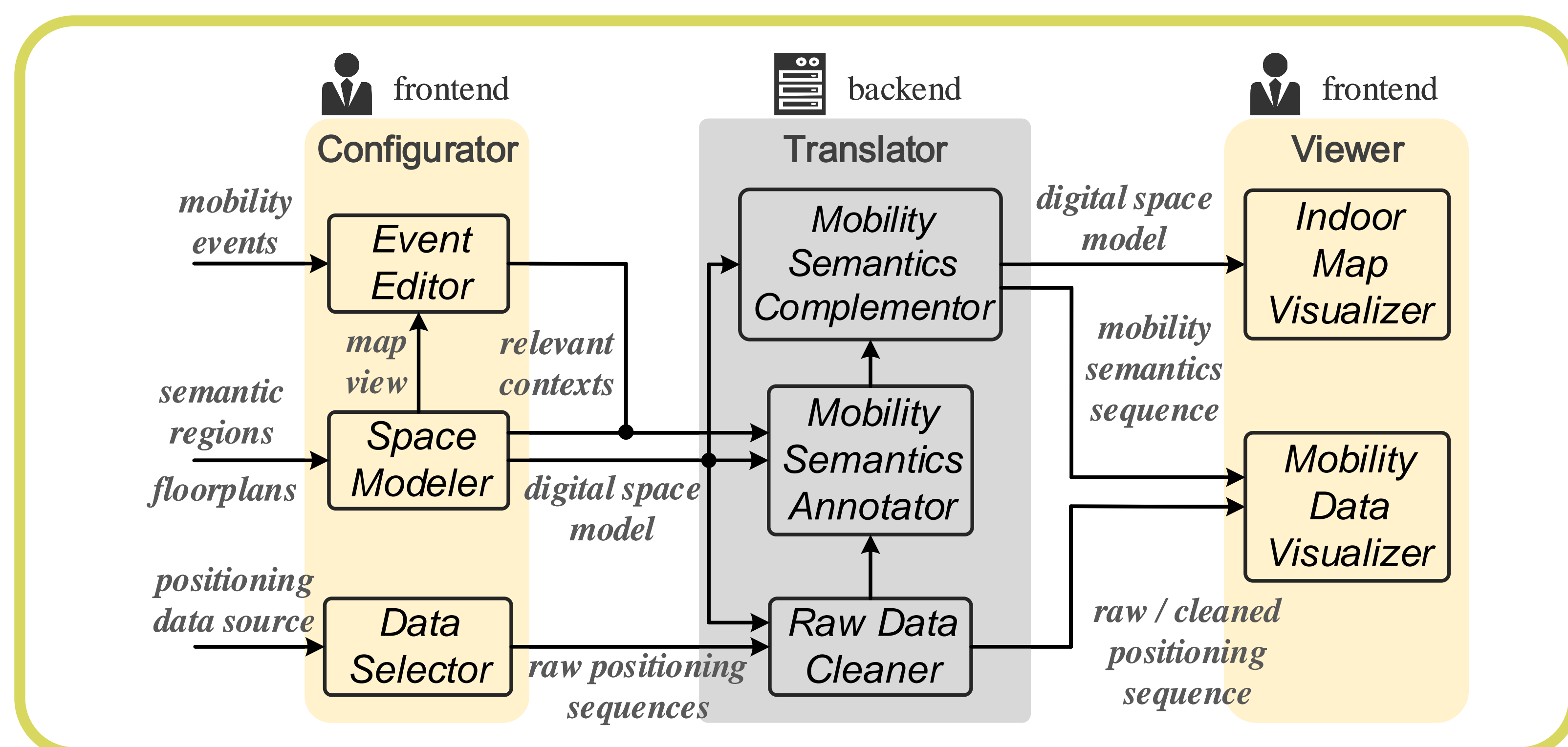## FROM *RAW INDOOR POSITIONING DATA* TO *VISUAL MOBILITY SEMANTICS*

● **Indoor Mobility Analytics:** It is relevant to translate the raw indoor positioning data into the *mobility semantics* that describe **what, where and when** in a more concise and semantics-oriented way.

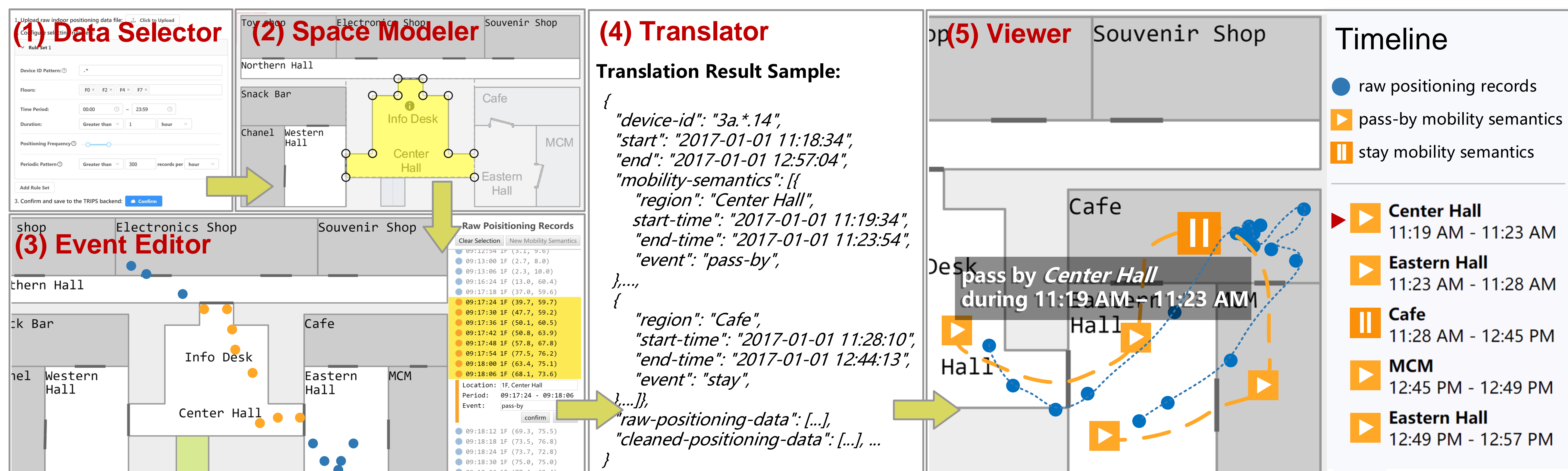| Raw Positioning Records	Mobility Semantics
$o_i, (5.1, 12.7, 3F), 1:02:05pm$	o_i:
$o_i, (6.5, 11.8, 3F), 1:02:12pm$	$(stay, Adidas, 1:02:05\text{-}1:18:15pm)$
$\ldots\ldots\ldots$	$(pass\text{-}by, Nike, 1:18:16\text{-}1:20:13pm)$
$o_i, (13.6, 4.2, 2F), 1:24:05pm$	$(stay, Cashier, 1:20:14\text{-}1:24:05pm)$

● **Translation is Challenging:** (1) *multiple data sources* are involved; (2) raw indoor positioning data is *of low quality*; (3) translation results are *hard to assess*.

● **TRIPS Makes Translation Easy:** It obtains the desired mobility semantics in a visual and convenient way. TRIPS streamlines the entire translation process, featuring the following highlights:

● *The Configurator* provides a standard but concise means to configure multiple input sources.

● *The Translator* cleans the indoor positioning data and exports reliable mobility semantics without manual interventions.

● *The Viewer* offers a suite of flexible operations to trace the input, output and intermediate data involved in the translation.

Mobility Semantics Timeline

⏸ stay ▶ pass-by

▶	1F hallway-101 08:47:08-- 08:47:17
▶	1F hallway-108 08:47:18-- 08:47:27
⏸	1F shop-103 08:47:28-- 08:51:02
▶	1F shop-103 08:51:03-- 08:51:17
▶	1F hallway-108 08:51:18-- 08:51:37
▶	1F shop-111 08:51:38-- 08:51:47
▶	1F C-102 08:51:48-- 08:52:07
▶	1F shop-128 08:52:08-- 08:52:17
▶	1F hallway-123 08:52:18-- 08:52:27
▶	1F shop-127 08:52:28-- 08:52:30
▶	1F shop-126 08:52:31-- 08:52:34
▶	1F hallway-122 08:52:35-- 08:52:37
▶	1F hallway-123 08:52:38-- 08:52:52
▶	1F shop-128 08:52:53-- 08:52:57
▶	1F hallway-123 08:52:58-- 08:53:02
▶	1F C-101 08:53:03-- 08:53:12
▶	1F staircase-W 08:53:13-- 08:53:32

SYSTEM DESIGN & THREE FUNCTIONAL COMPONENTS

① Configurator

takes charge of the configuration of raw indoor positioning data, indoor space information and relevant contexts

③ Viewer

provides an interface for browsing and comparing different mobility data sequences involved in the translation

② Translator

constructs a sequence of mobility semantics for each individual positioning sequence

A SYSTEM WALK-THROUGH

(1) Data Selector
(2) Space Modeler
(3) Event Editor

(4) Translator

Translation Result Sample:

```
{
  "device-id": "3a.*.14",
  "start": "2017-01-01 11:18:34",
  "end": "2017-01-01 12:57:04",
  "mobility-semantics": [{
      "region": "Center Hall",
      "start-time": "2017-01-01 11:19:34",
      "end-time": "2017-01-01 11:23:54",
      "event": "pass-by",
    },....,
    {
      "region": "Cafe",
      "start-time": "2017-01-01 11:28:10",
      "end-time": "2017-01-01 12:44:13",
      "event": "stay",
    },...]},
  "raw-positioning-data": [...],
  "cleaned-positioning-data": [...], ...
}
```

(5) Viewer

Timeline

● raw positioning records
▶ pass-by mobility semantics
⏸ stay mobility semantics

▶	**Center Hall** 11:19 AM - 11:23 AM
▶	**Eastern Hall** 11:23 AM - 11:28 AM
⏸	**Cafe** 11:28 AM - 12:45 PM
▶	**MCM** 12:45 PM - 12:49 PM
▶	**Eastern Hall** 12:49 PM - 12:57 PM

Example of TRIPS's Workflow in a Shopping Mall Scenario.

Project Website.

A Demo Video.