Profile-Directed Optimization of Event-Based Programs

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2010.05.17
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概要

- イベントベースの抽象化
  - GUI, ネットワークプロトコル
- イベントを起こすのとハンドラ間のオーバヘッド大
- プロファイリングベースの最適化
  - exploits the underlying predictability

Components

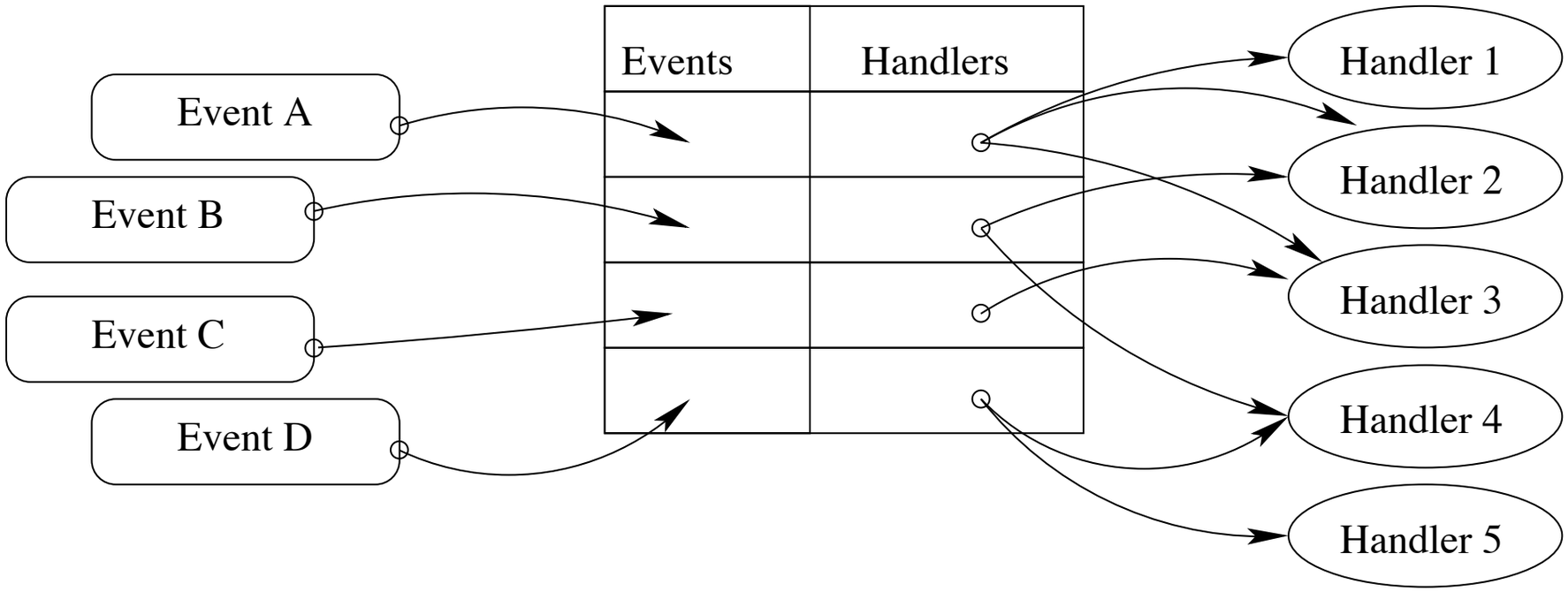

Figure 1: Event bindings

Examples

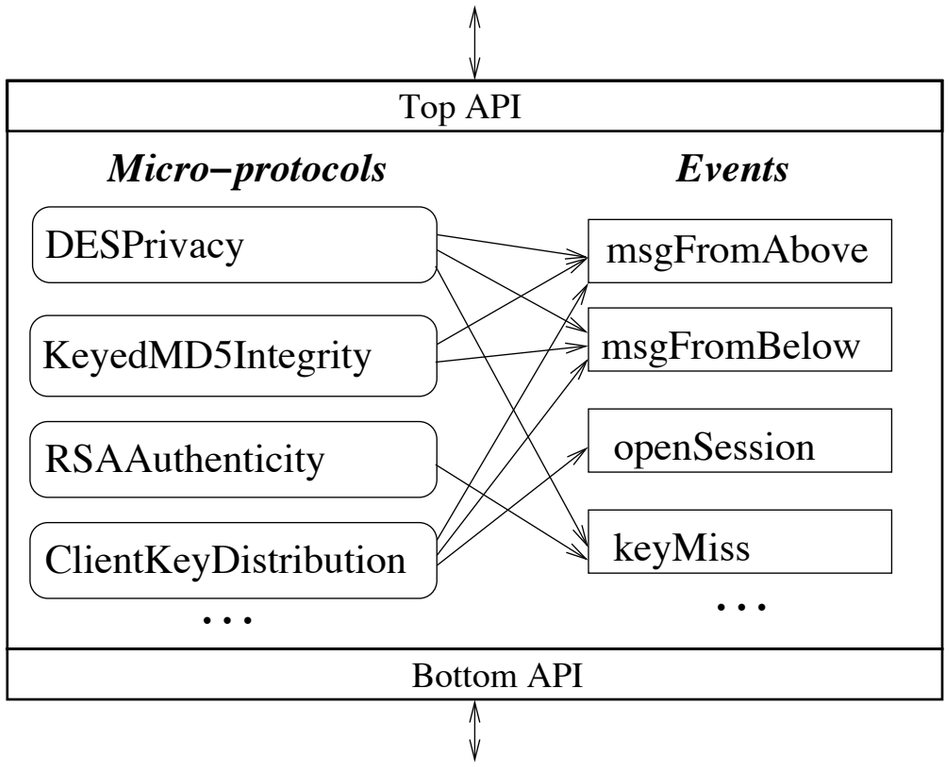

Figure 2: Cactus composite protocol

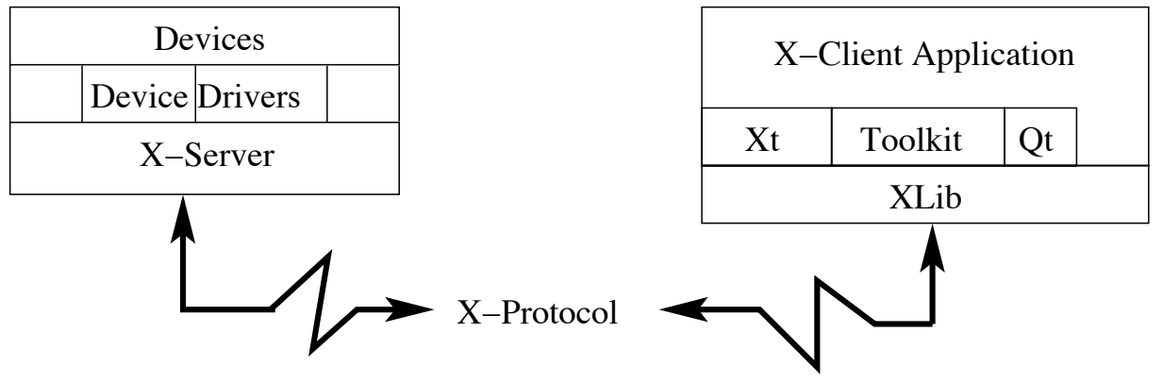

Figure 3: Architecture of X Window systems

Approach

- Event Profiling
- Optimization Techniques
  - Graph Optimizations
  - Compiler Optimizations
- Dealing with the Unexpected

Event Profiling

```
EventGraph = ∅;
prev_event = eventTrace→firstEvent;
while not (end of eventTrace) {
        event = eventTrace→nextEvent;
        if (prev_event,event) not in EventGraph {
                EventGraph += (prev_event,event);
                EventGraph(prev_event,event)→weight = 1;
        } else
                eventGraph(prev_event,event)→weight++;
        prev_event = event;
}
```

Figure 4: *GraphBuilder* **algorithm.**

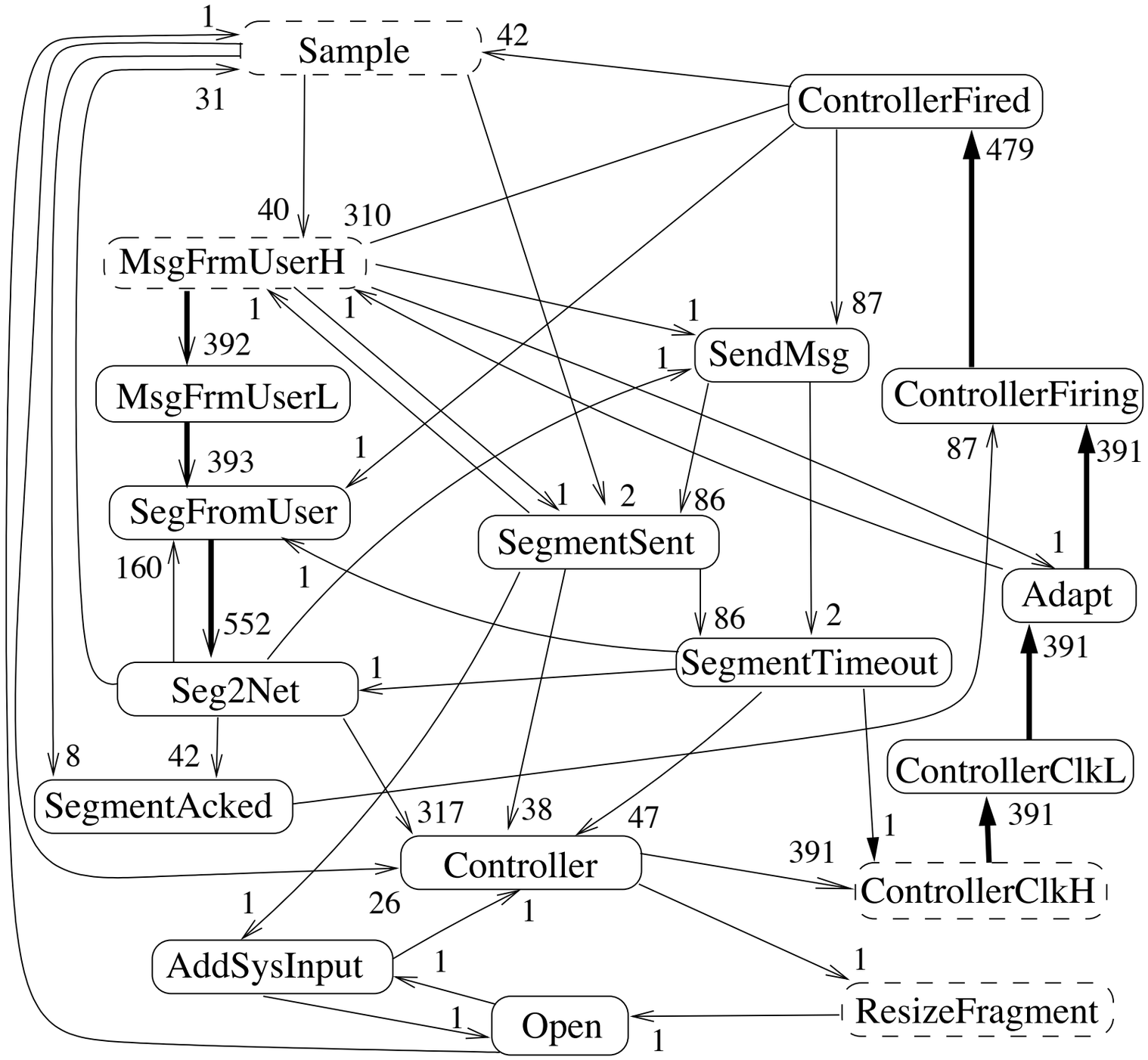

Figure 5: Event graph generated from video player

Graph Optimizations(1)

Handler Merging

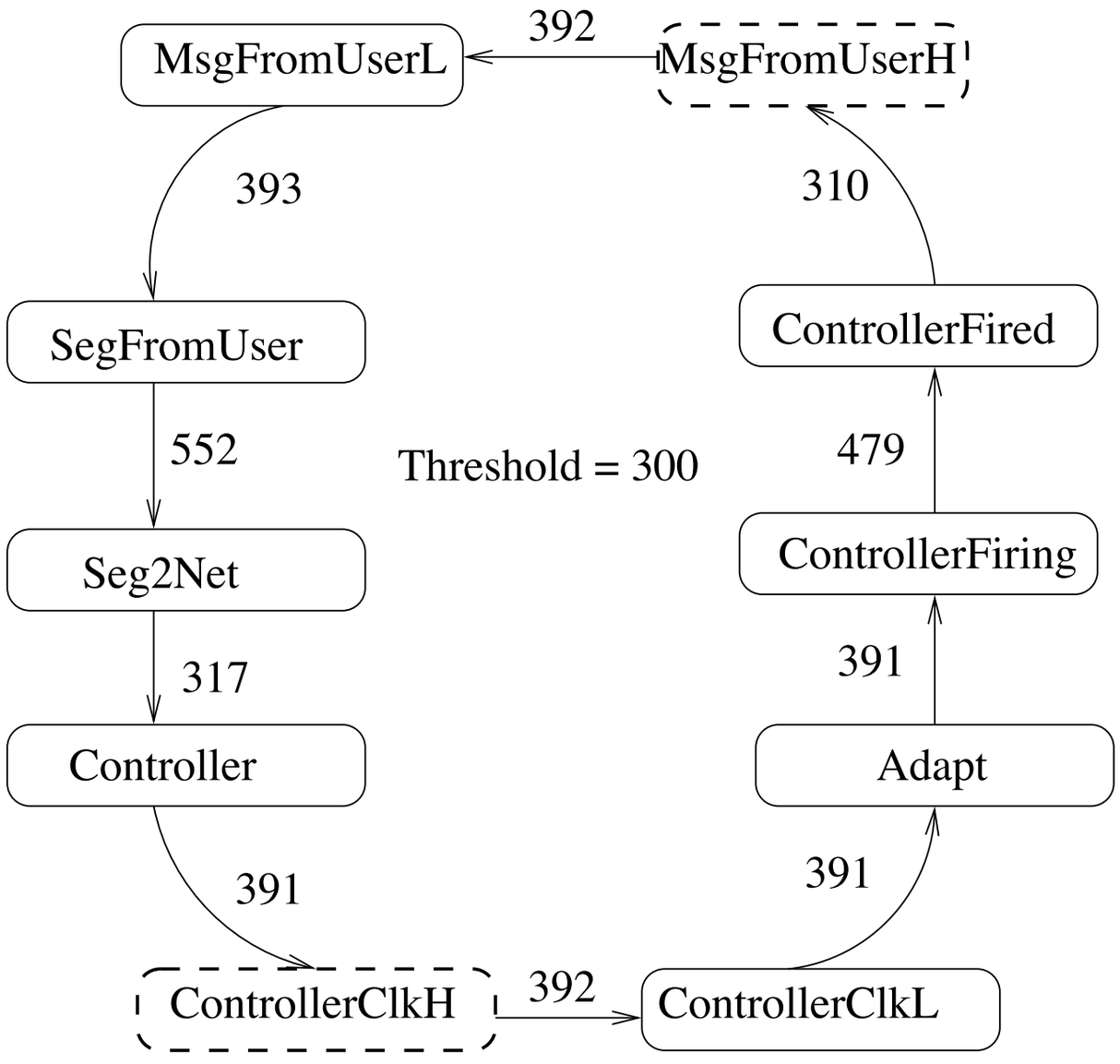

Figure 6: Reduced event graph

Graph Optimizations(2)

Event Chains and Subsumption

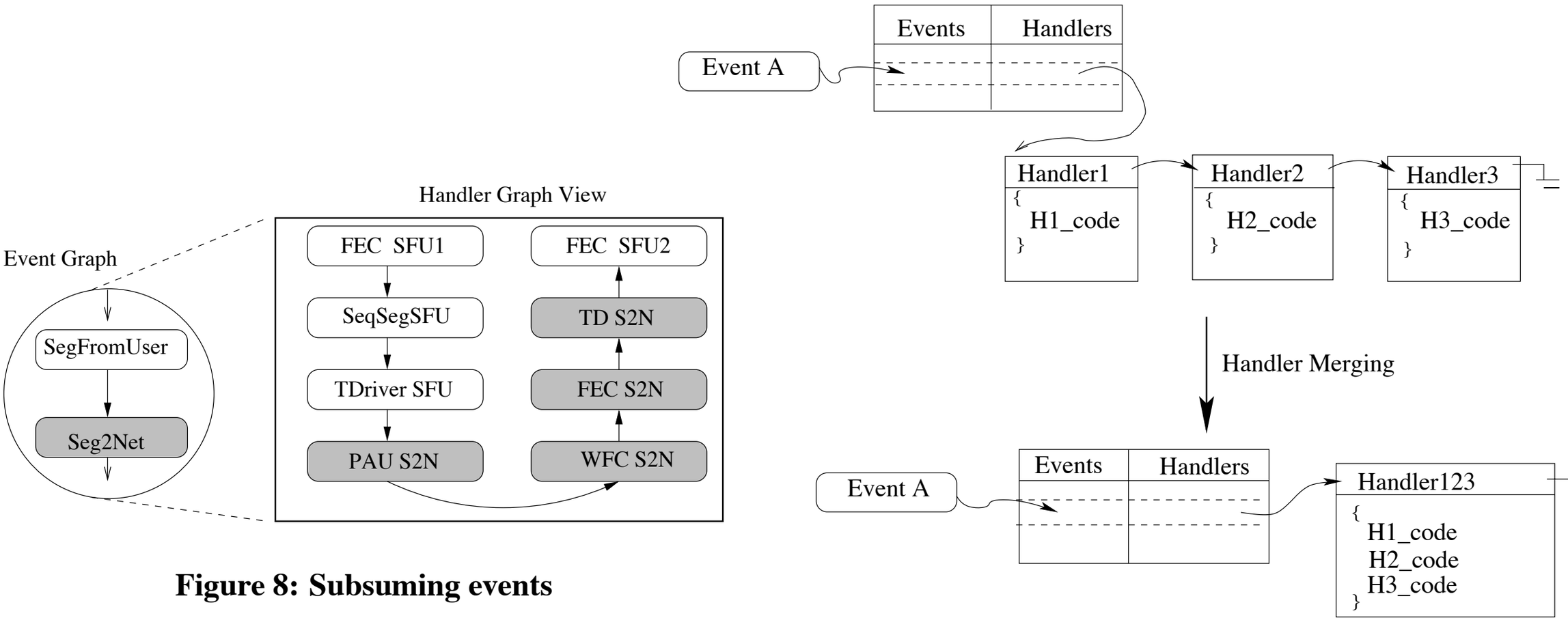

Figure 8: Subsuming events

Figure 7: Handler merging

Compiler Optimizations

- Function Inlining
- 定数伝播と不要命令の除去
- Redundant Code Elimination

Experiment Results

Frame rate	Total Execution Time (sec)			Event Handler Time (sec)		
	Orig. (T_0)	Opt. (T_1)	T_1/T_0 (%)	Orig. (T_0)	Opt. (T_1)	T_1/T_0 (%)
10	43.1	41.9	97.2	2.3	0.9	39.1
15	30.9	30.3	98.0	1.6	0.6	37.5
20	24.5	22.1	90.2	1.5	0.5	33.3
25	23.9	21.3	89.1	1.5	0.5	33.3

Key: Orig: Original program; Opt: Optimized program

Figure 10: Video player optimization results.

Size	Push time (μsec)			Pop time (μsec)		
	Orig. (T_0)	Opt. (T_1)	T_1/T_0 (%)	Orig. (T_0)	Opt. (T_1)	T_1/T_0 (%)
64	274	241	88.0	397	378	95.2
128	287	263	91.6	460	448	97.4
256	304	273	89.8	484	457	94.4
512	336	299	89.0	494	470	95.1
1024	430	373	86.7	608	570	93.8
2048	572	552	96.5	1016	893	87.9

Figure 12: Impact of optimization in SecComm

Event	Processing Time (μsec)		Speedup (%)
	Original	Optimized	
Adapt	55	11	80.0
SegFromUser	346	41	88.2
Seg2Net	137	37	73.0

Figure 11: Event processing times in the video player.

Event Type	Execution Time (μsec)		T_1/T_0 (%)
	Orig. (T_0)	Opt. (T_1)	
Scroll	158	148	93.7
Popup	37	31	83.8

Figure 13: Optimization of X events