IMPACT OF 3D BOOKMARKS ON NAVIGATION AND STREAMING IN AN NVE

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NVE

NVE : A Networked Virtual Environment is a 3D virtual environment that is streamed through the network
Examples : Second life, Sketchfab.com, etc..

ARROW BOOKMARKS

Figure 1: Bookmarks as arrows
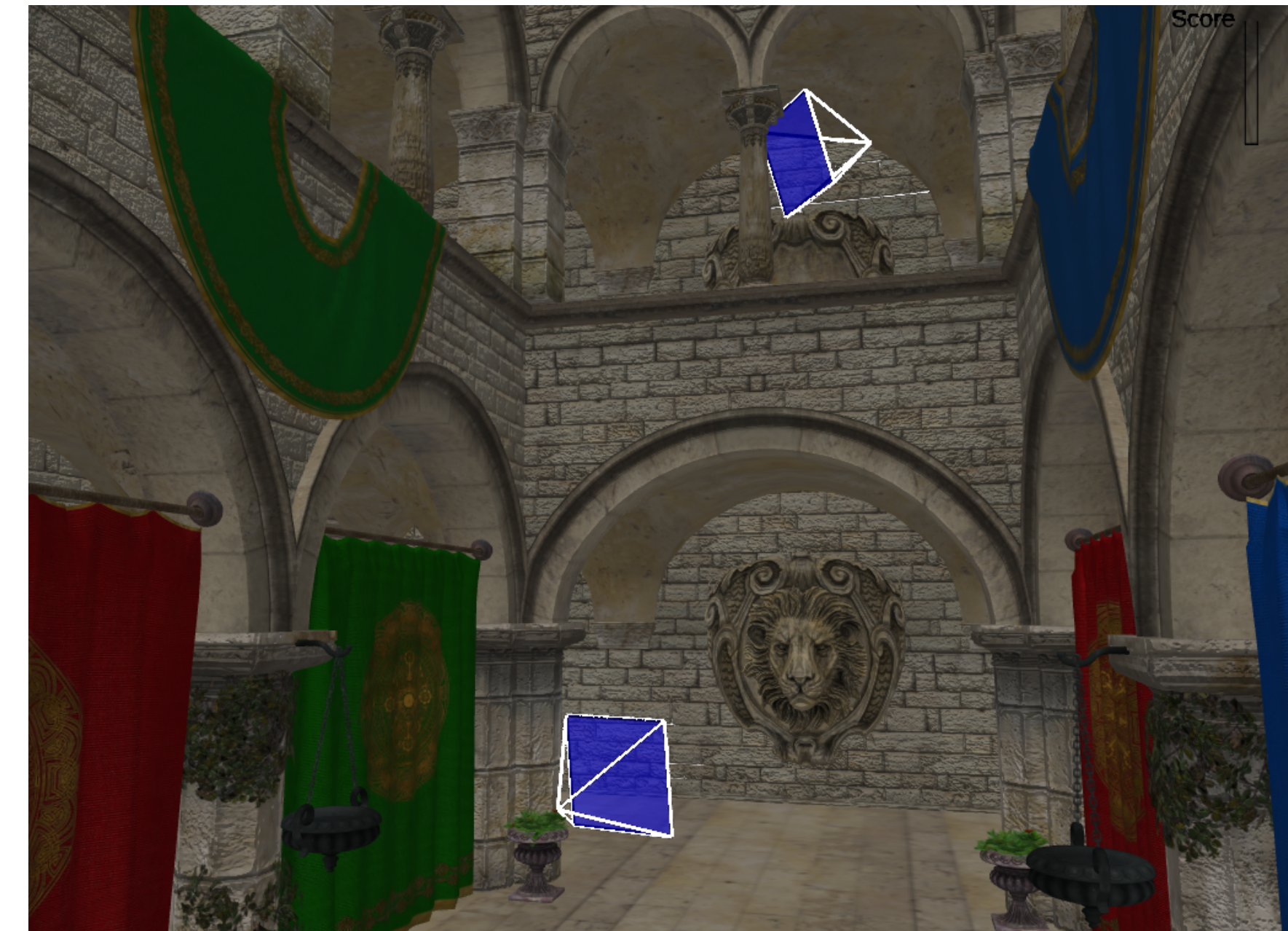
VIEWPORT BOOKMARKS

Figure 2: Bookmarks as viewports

USER STUDY

- One micro-job
  - Initial questionnaire, tutorial
  - 3 random tasks
  - Final questionnaire to evaluate QoE
- One random task
  - Select 1 3D scene out of 3
  - Select 1 UI out of 3 (no bookmarks, viewports, arrows)
  - Select 8 coins randomly out of 50 (positioned beforehand)
- Success
  - At least 6 coins found among the 8 hidden coins in the scene

Figure 3: A coin hidden behind a curtain

USER STUDY RESULTS – NAVIGATION

BM type	Mean # coins	Mean time
No bookmarks	7.08	4:16 min
Arrows	7.39	2:33 min
Viewports	7.51	2:16 min

Table 1: Analysis of the sessions length and users success by type of bookmarks

Questions	Answers
Difficulty without BM?	3.04 / 5 ±0.31 (99%)
Difficulty with BM?	2.15 / 5 ±0.30 (99%)
BM help to find the coins?	42 Yes, 5 No
BM help to browse?	49 Yes, 2 No
Can BM be helpful?	49 Yes, 2 No
Preferred BM?	32 AR, 7 VP

Table 2: Questionnaire and summary of answers
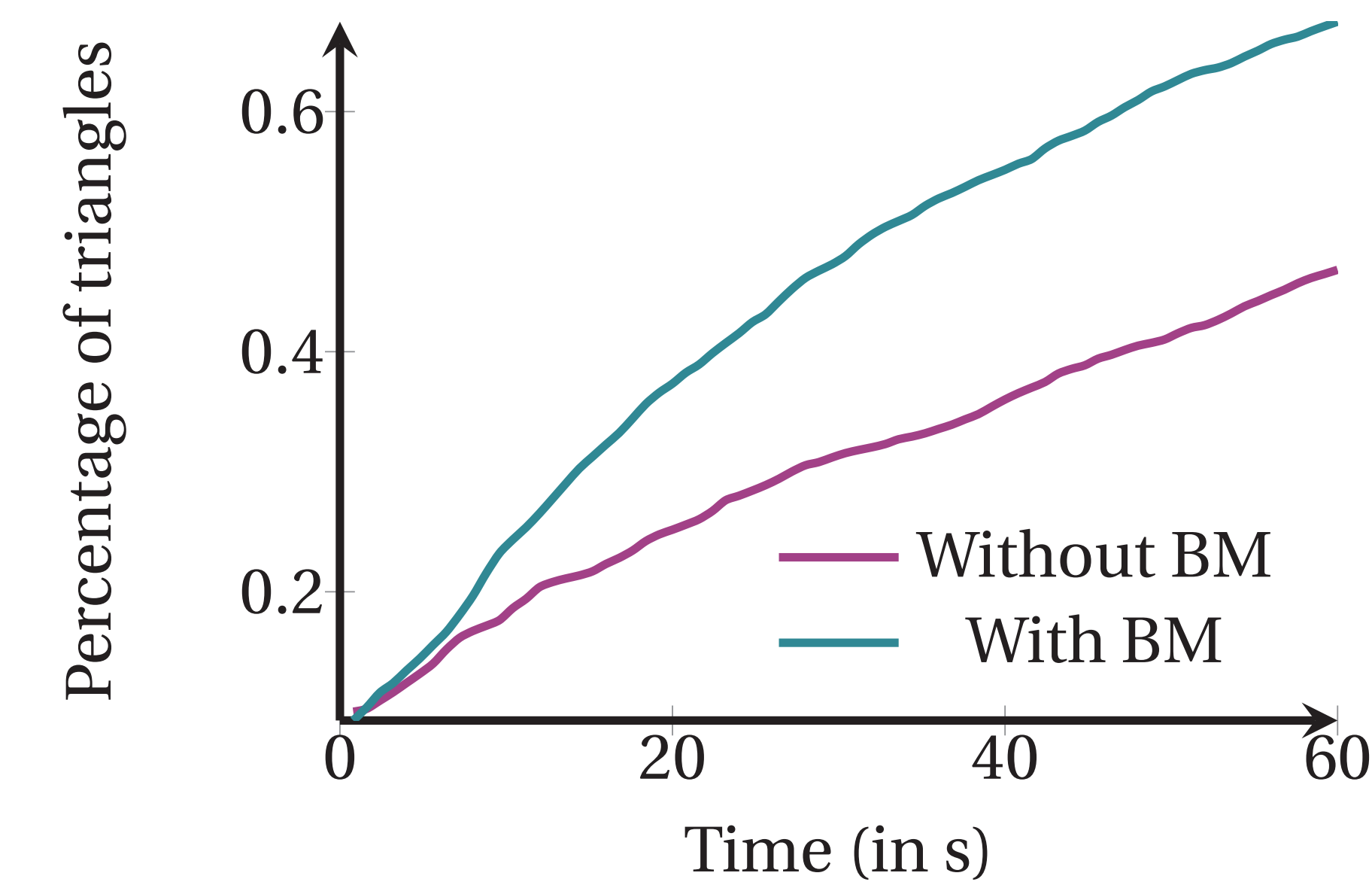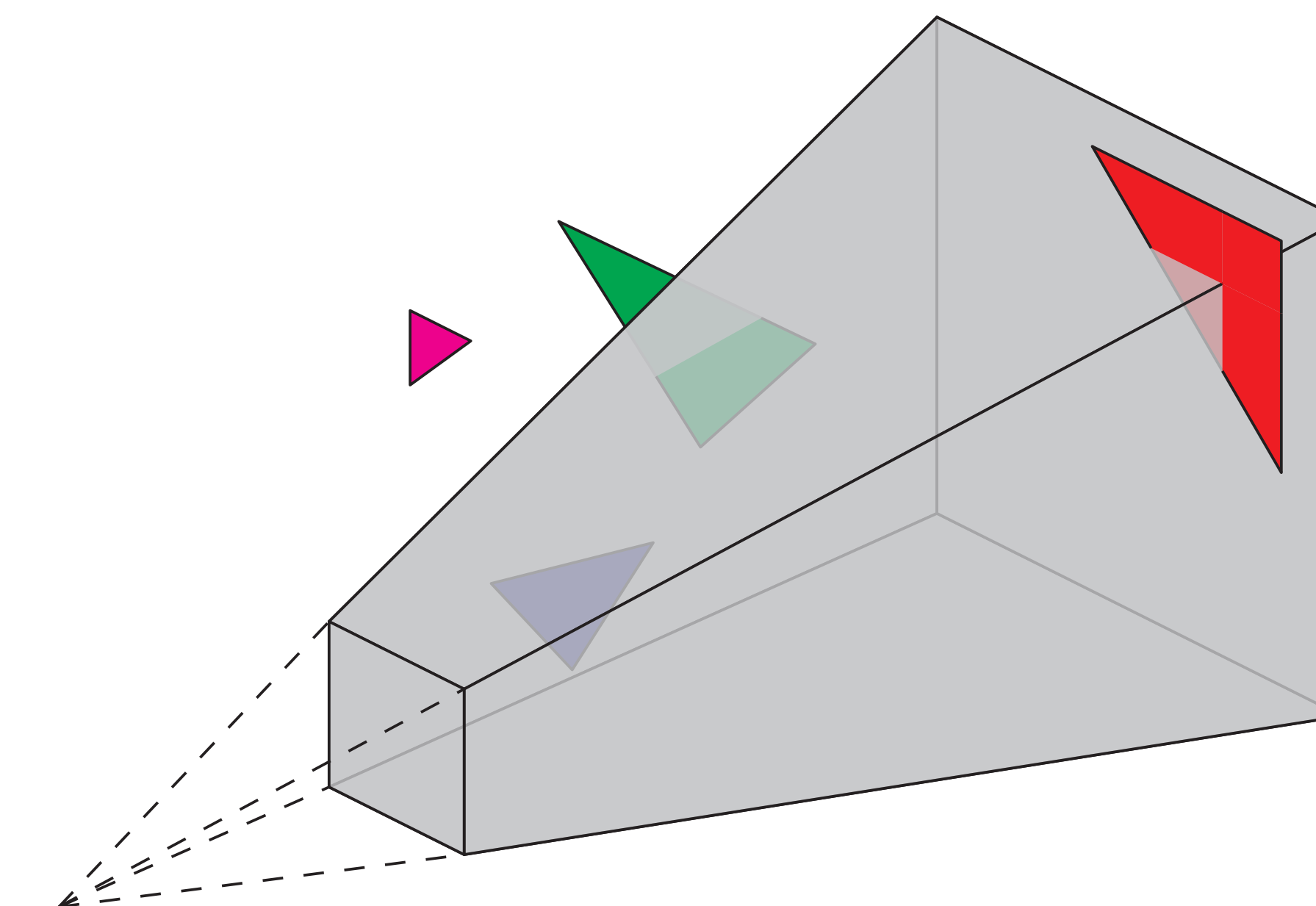
USER STUDY RESULTS – SYSTEM

Figure 4: Percentage of polygons queried after a certain period of time

FRUSTUM CULLING

- Ignore polygons outside the viewing volume
- Ignore polygons not facing the camera
- Sort polygons by distance to the camera
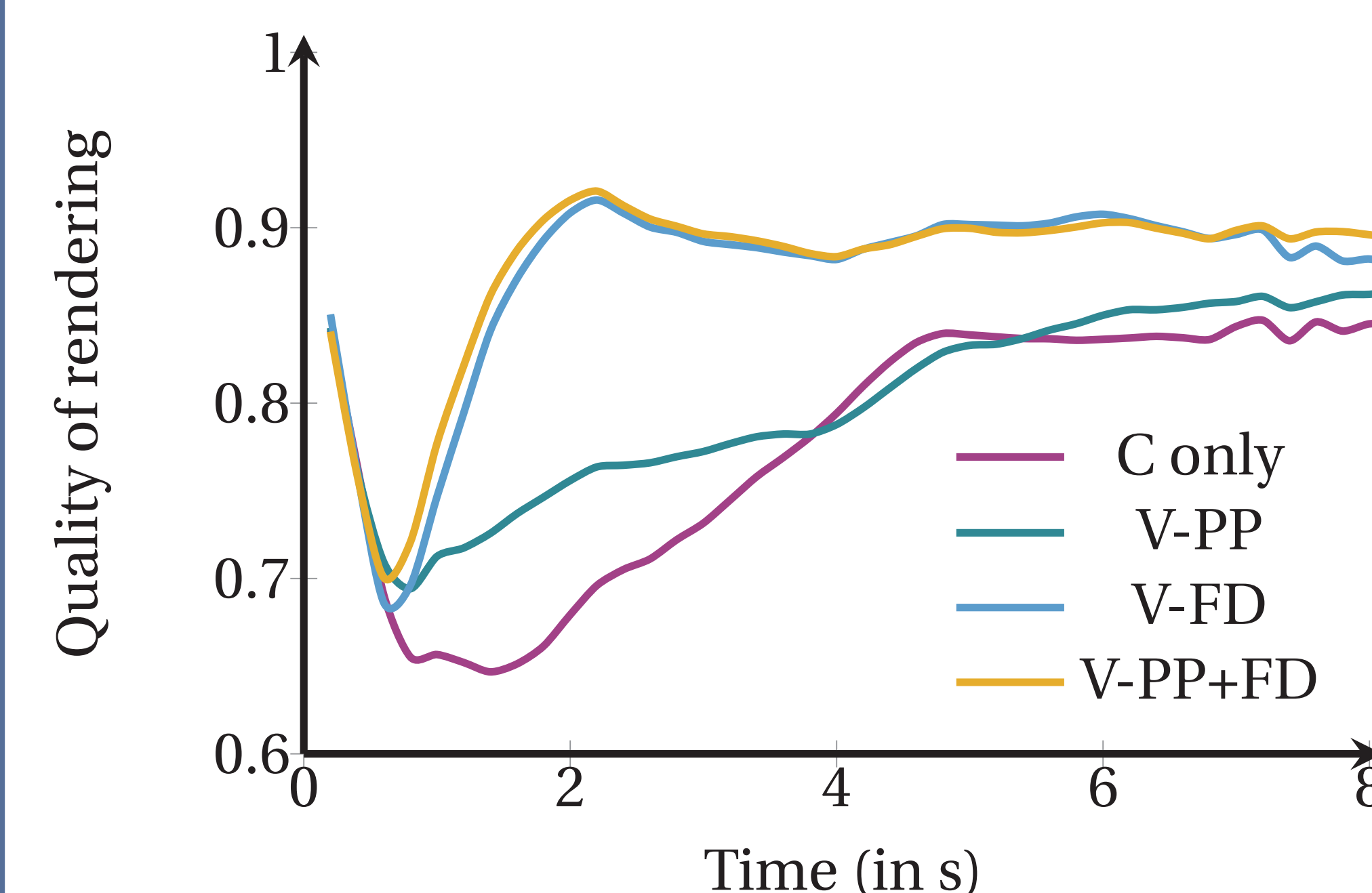
RESULTS – POLICIES COMPARISON

Figure 6: Quality of rendering after a click on a BM

STREAMING SIMULATION

Client info :
- Camera position
- Frustum of the camera
- Bookmark clicked if any

Compute faces to send according to a streaming policy

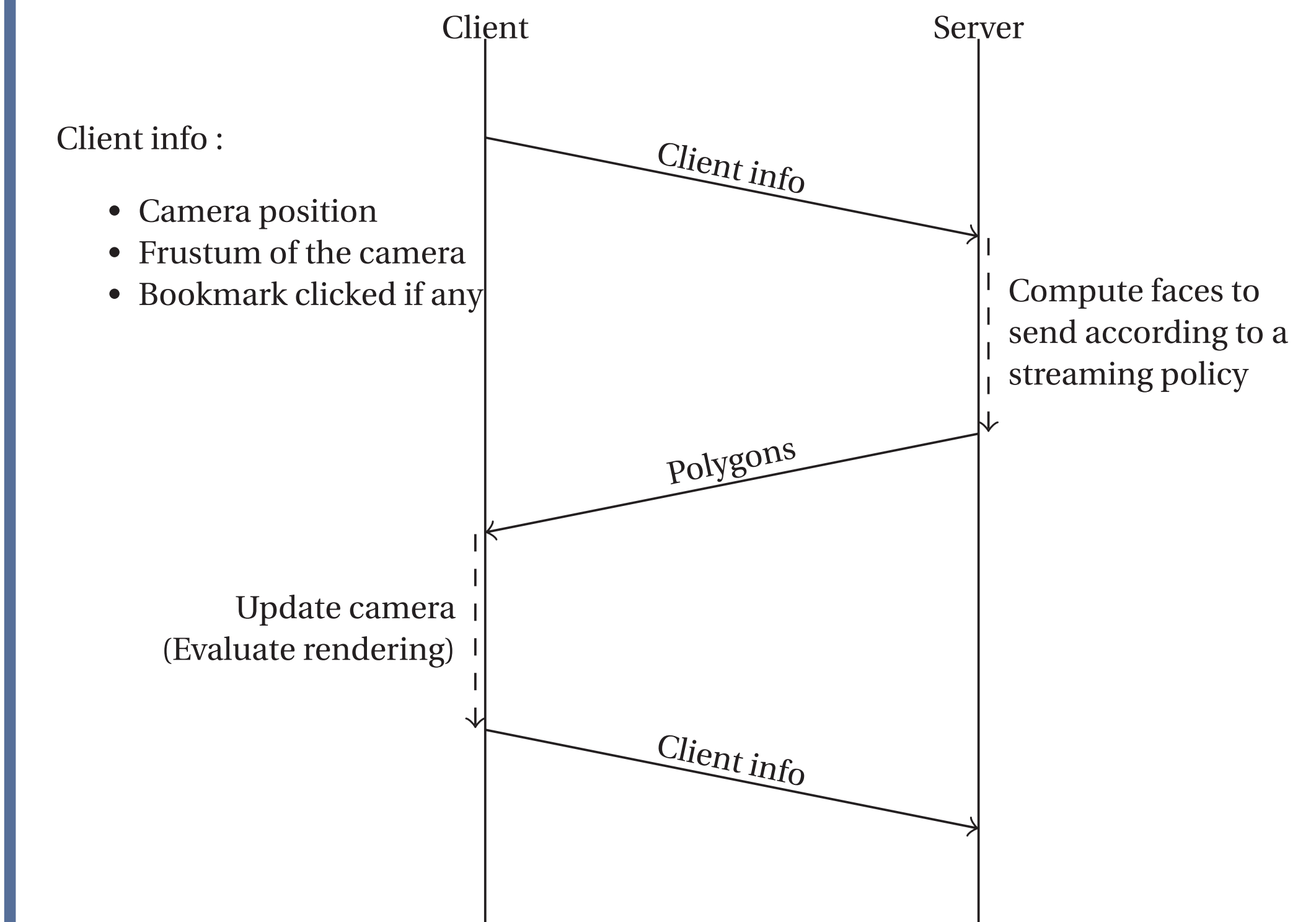Update camera (Evaluate rendering)

Figure 5: Streaming model

BOOKMARK AWARE POLICIES

Use server side rendering to know exactly which faces are important in front of bookmarks
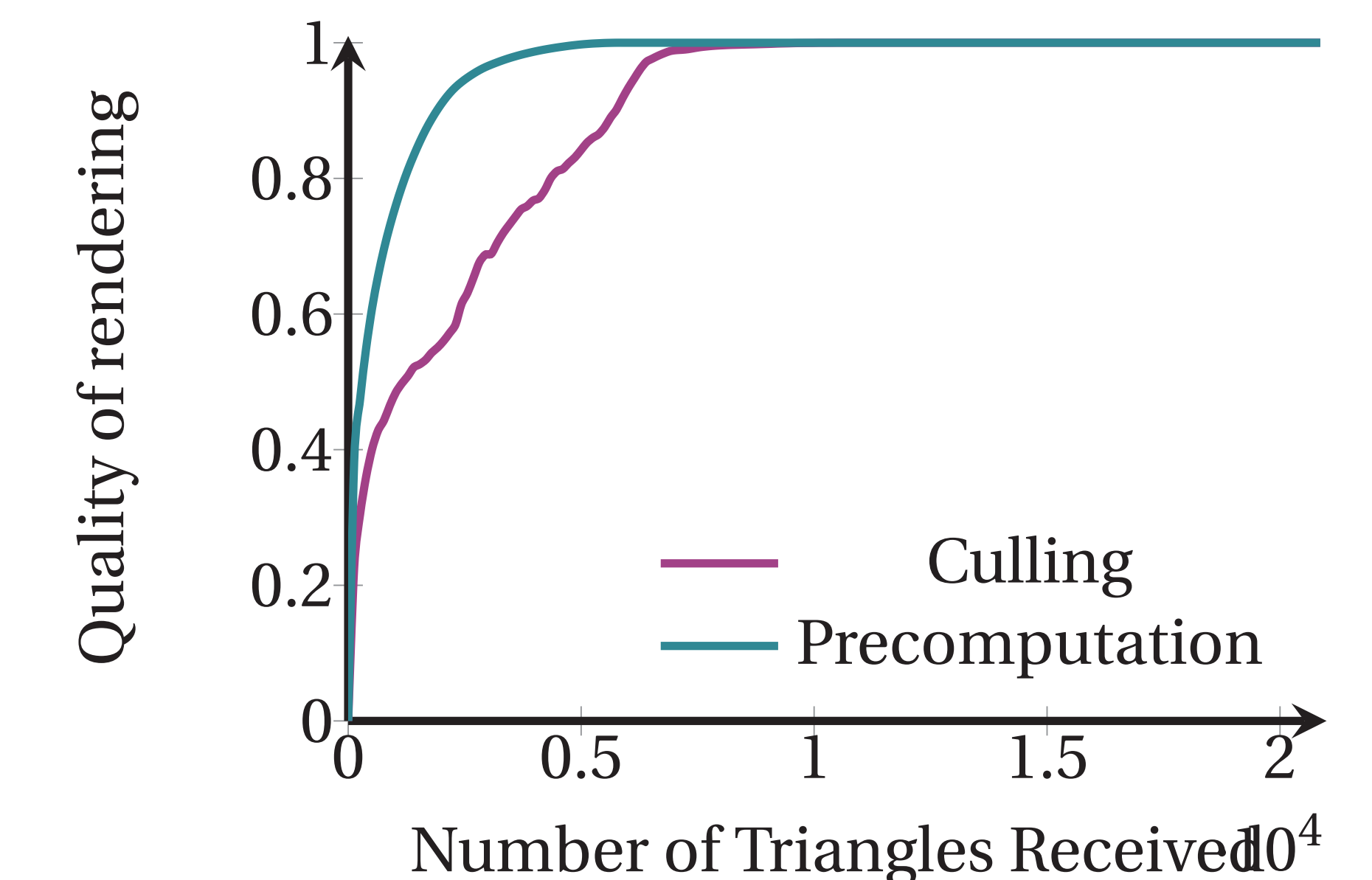

Figure 7: Impact of server side rendering

- **V-PP** : predict the next bookmark clicked and prefetch it

- **V-FD** : prefetch the bookmark clicked during the transition

CONCLUSION AND FUTURE WORK

- V-PP is not really efficient
- V-FD has a great impact on QoS
- Future work :
  - Adapt the *fly-to* speed to the bandwidth
  - Study the impact of bookmark positioning on predictability
  - Improve the prefetching policy