Towards Understanding User Tolerance To Network Latency and Data Rate in Remote Viewing of Progressive Meshes

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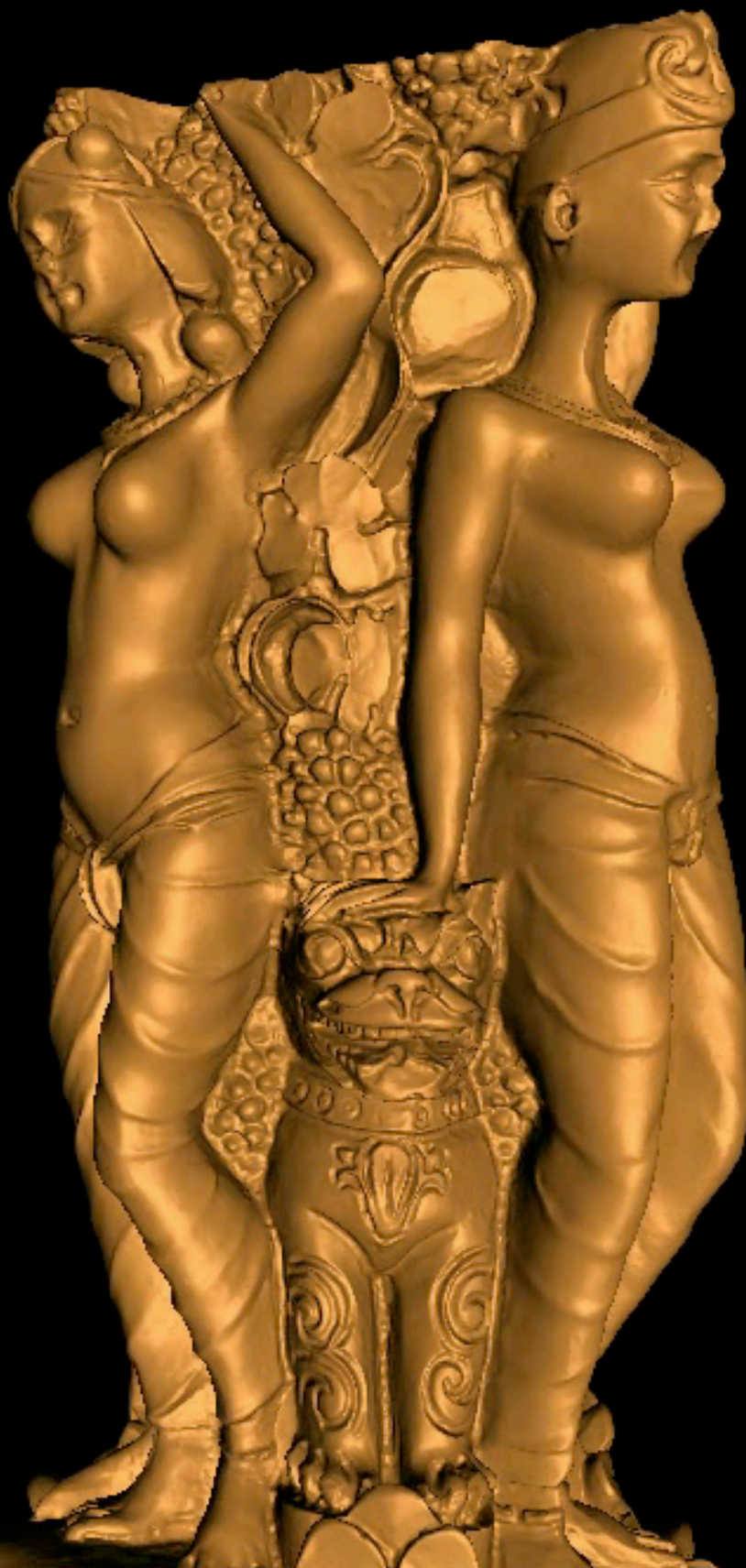

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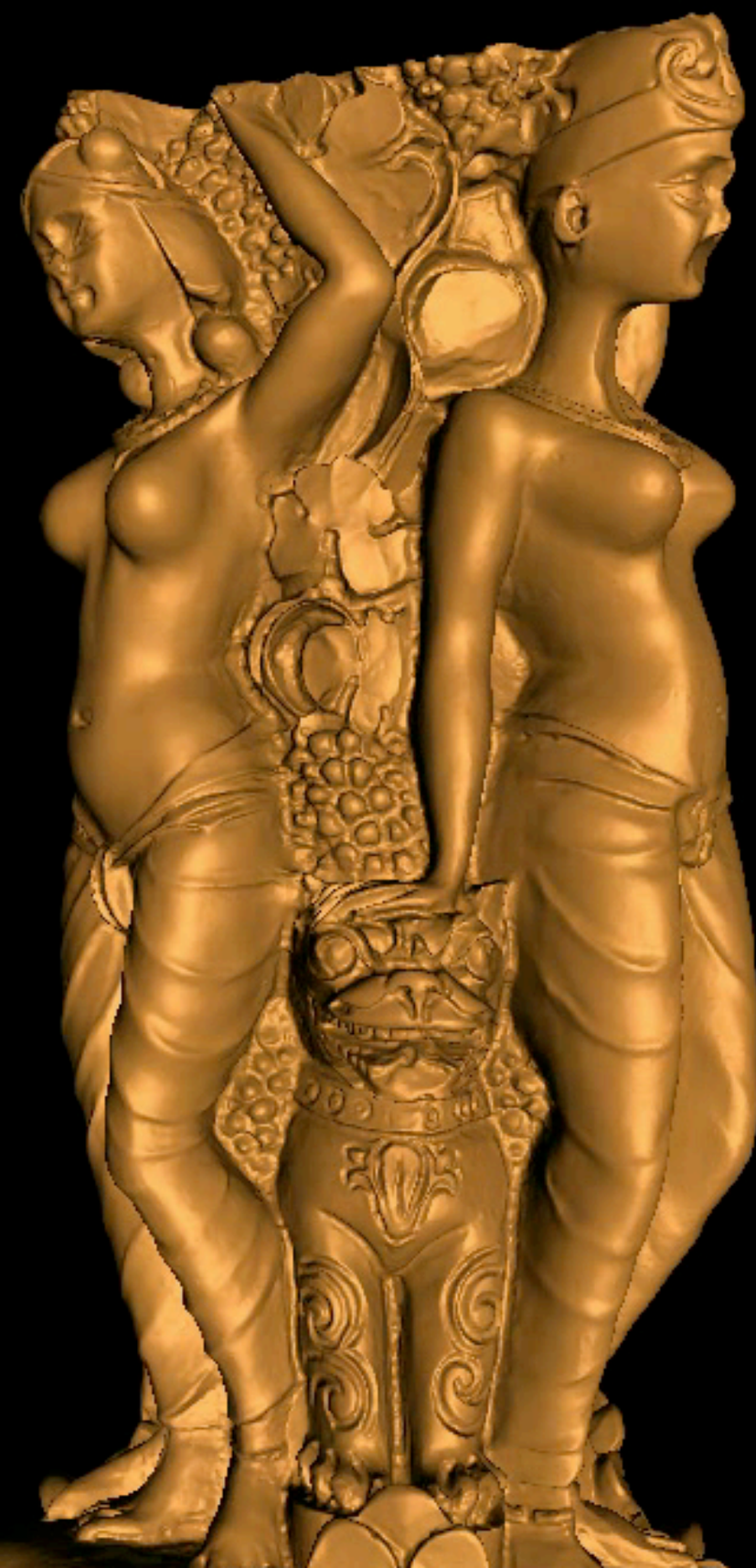
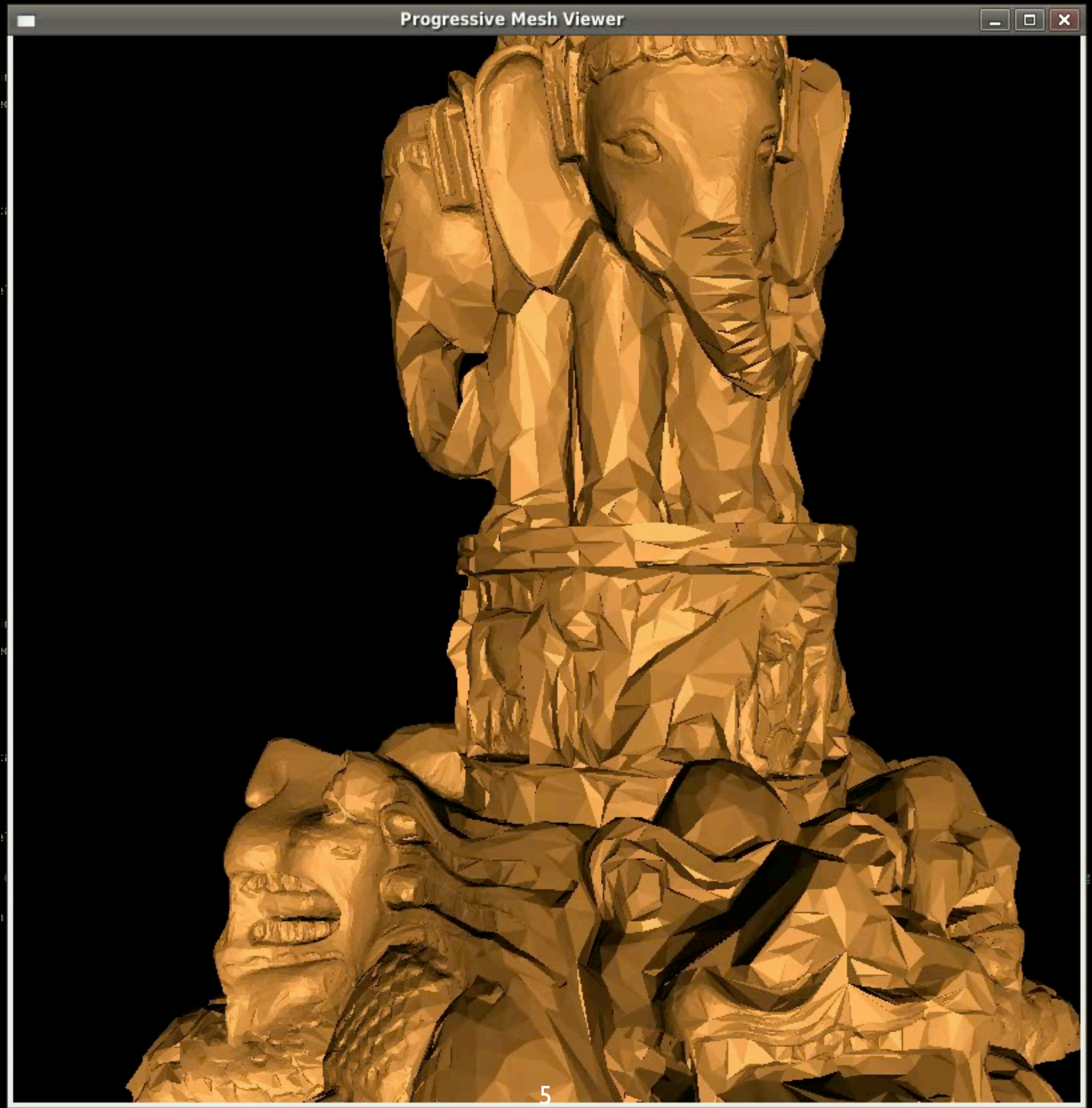


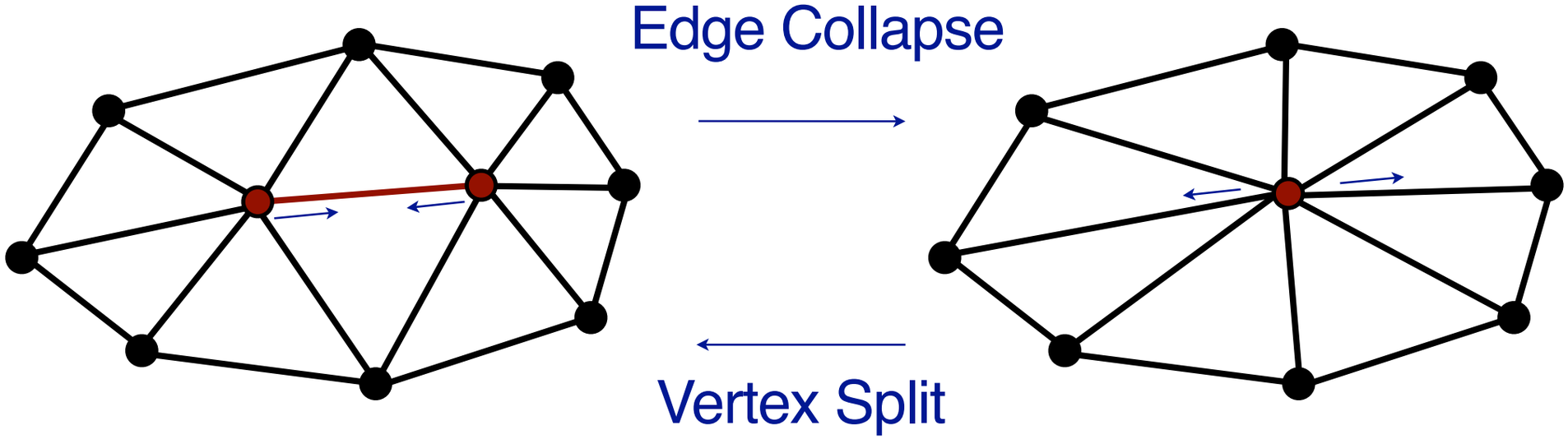

N
Gray Buildings © 2008 Sanborn
© 2010 Google
Image © 2010 DigitalGlobe
Image © 2010 Sanborn
©2009 Google
1, 2001 - May 4, 2009
40°41'34.43" N 74°02'41.77" W elev 0 m
Eye alt 54 m

MILON DE CROTONE - after EDME DUMONT
scott eaton 2007 www.scott-eaton.com

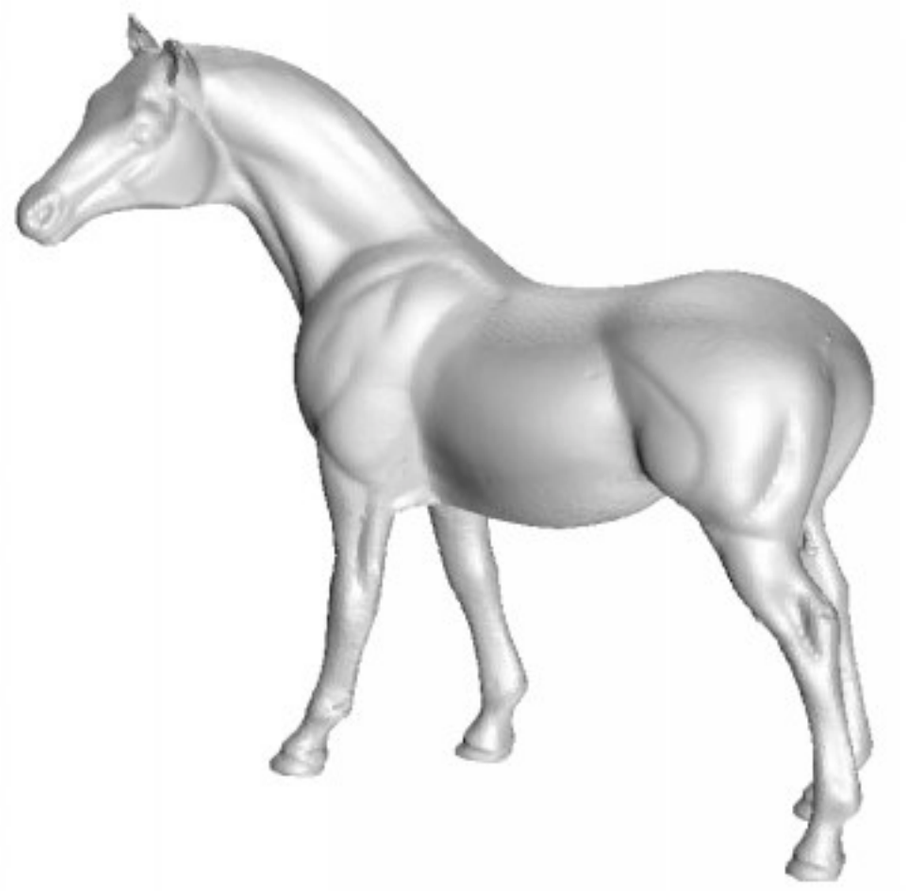
Death of the Centaur


Progressive Mesh Viewer

Hoppe's Progressive Mesh

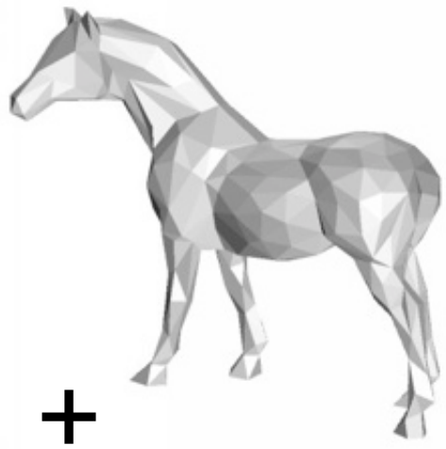


At the sender



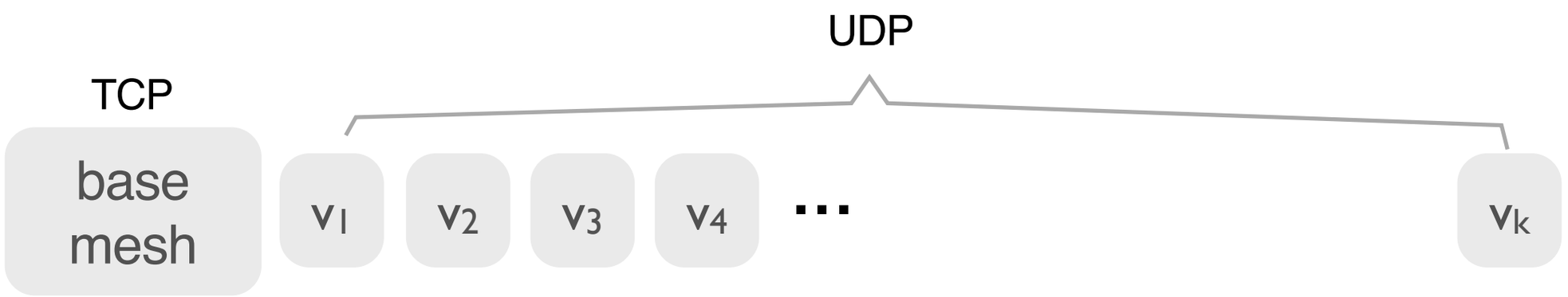
=

v_k ... v_4 v_3 v_2 v_1 +



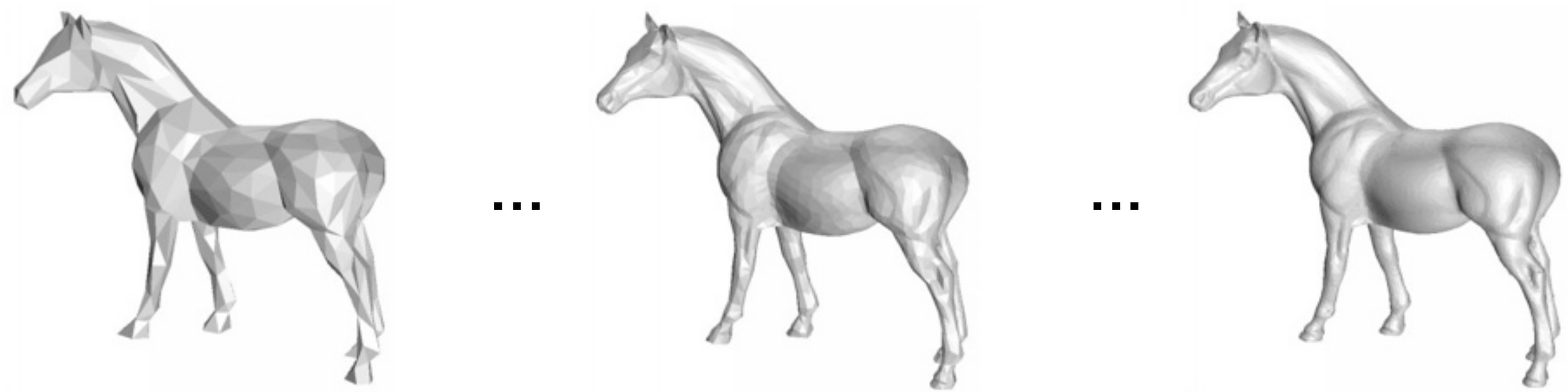
base mesh

Transmission

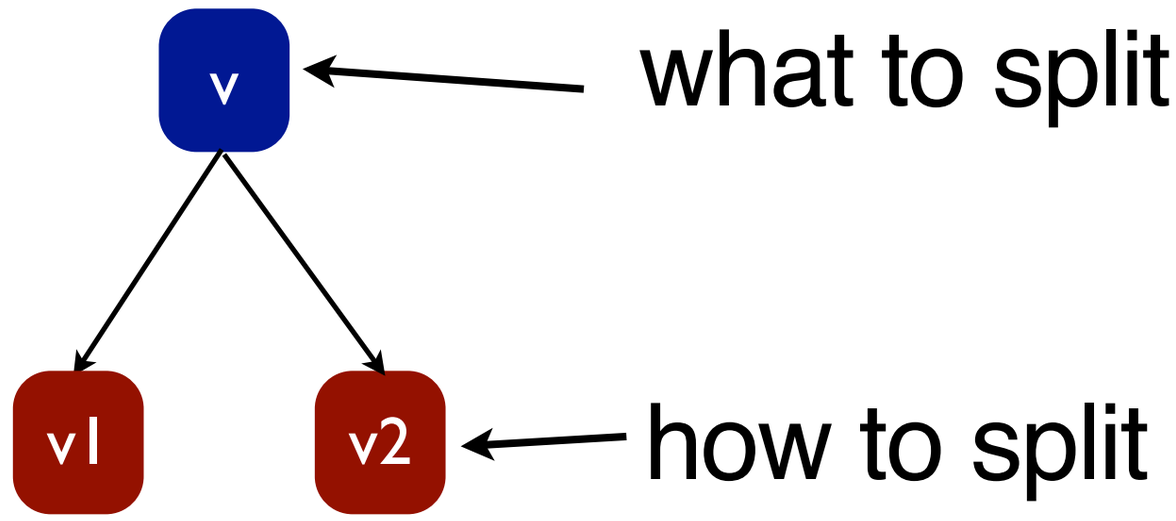


At the receiver

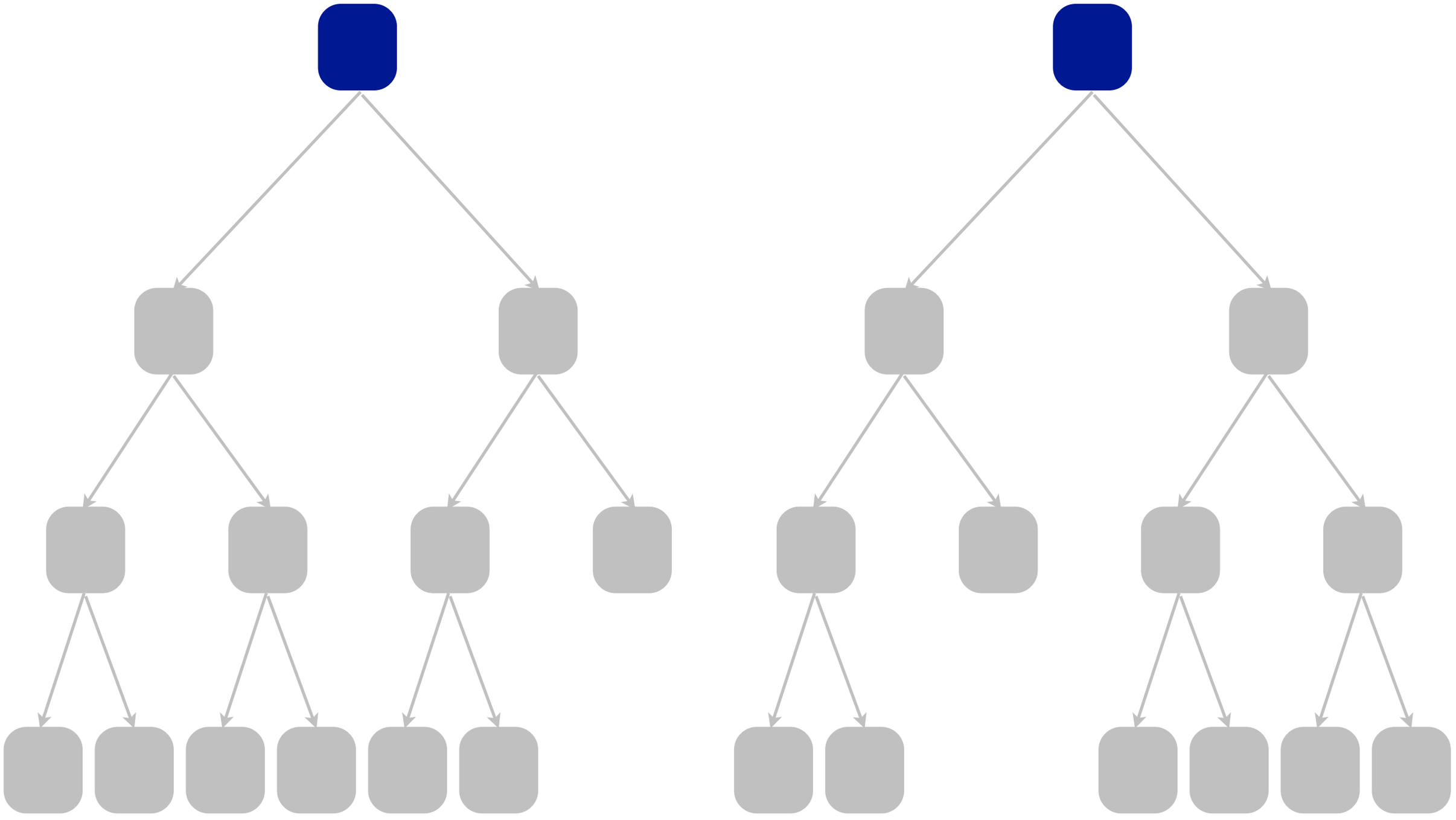
base mesh | v_1 | v_2 | v_3 | v_4 | ... | v_k

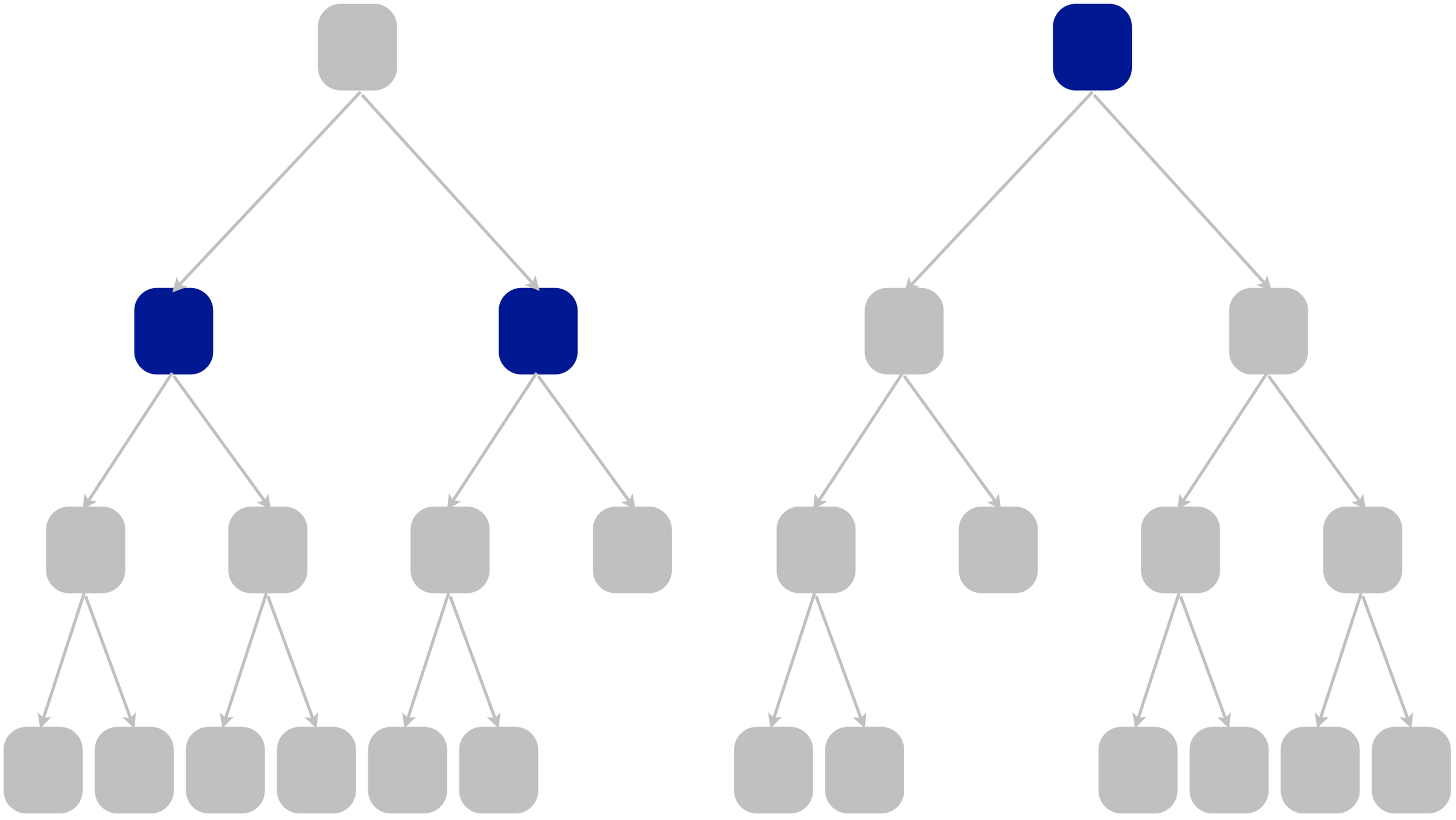


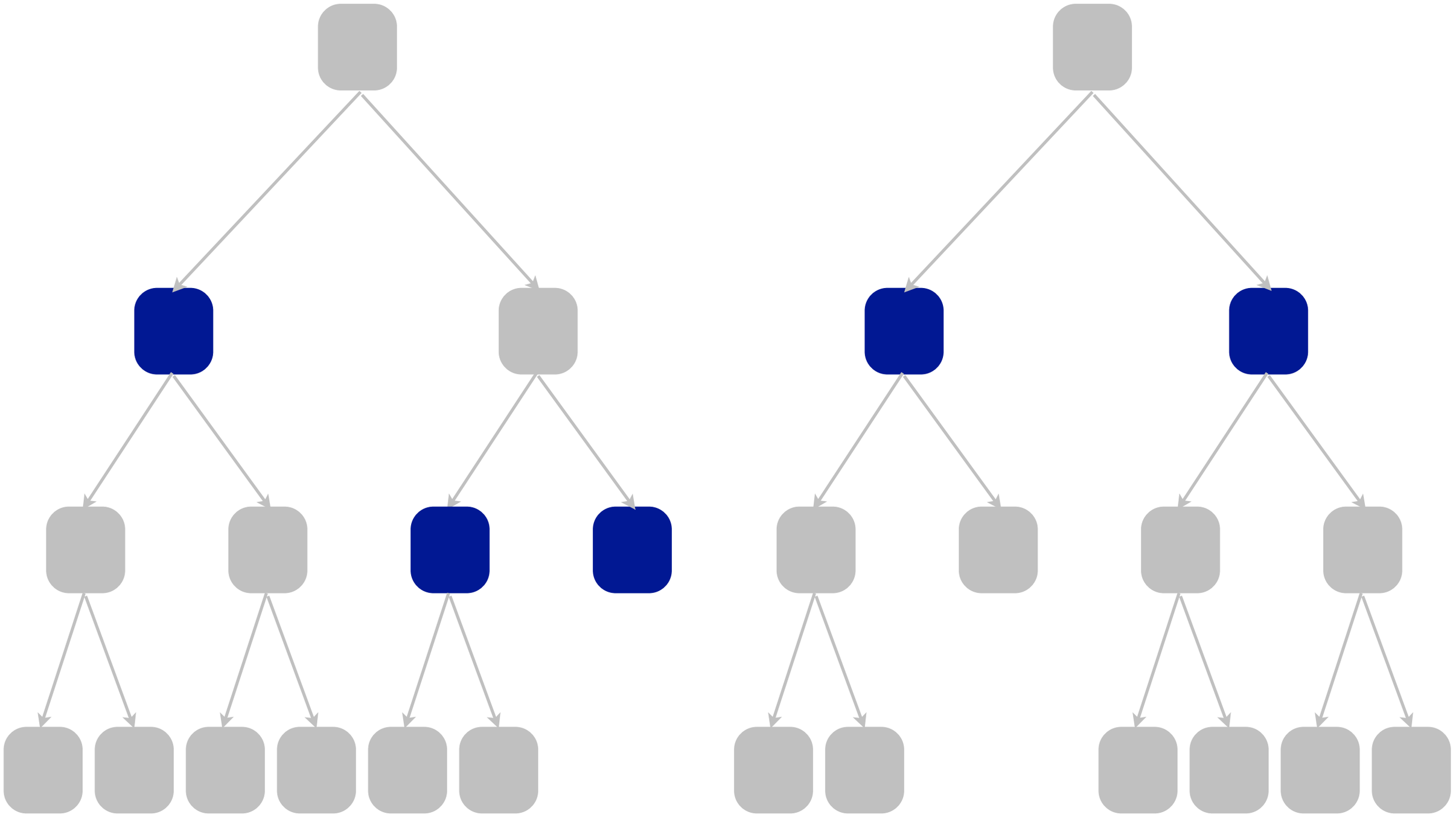

Vertex Split

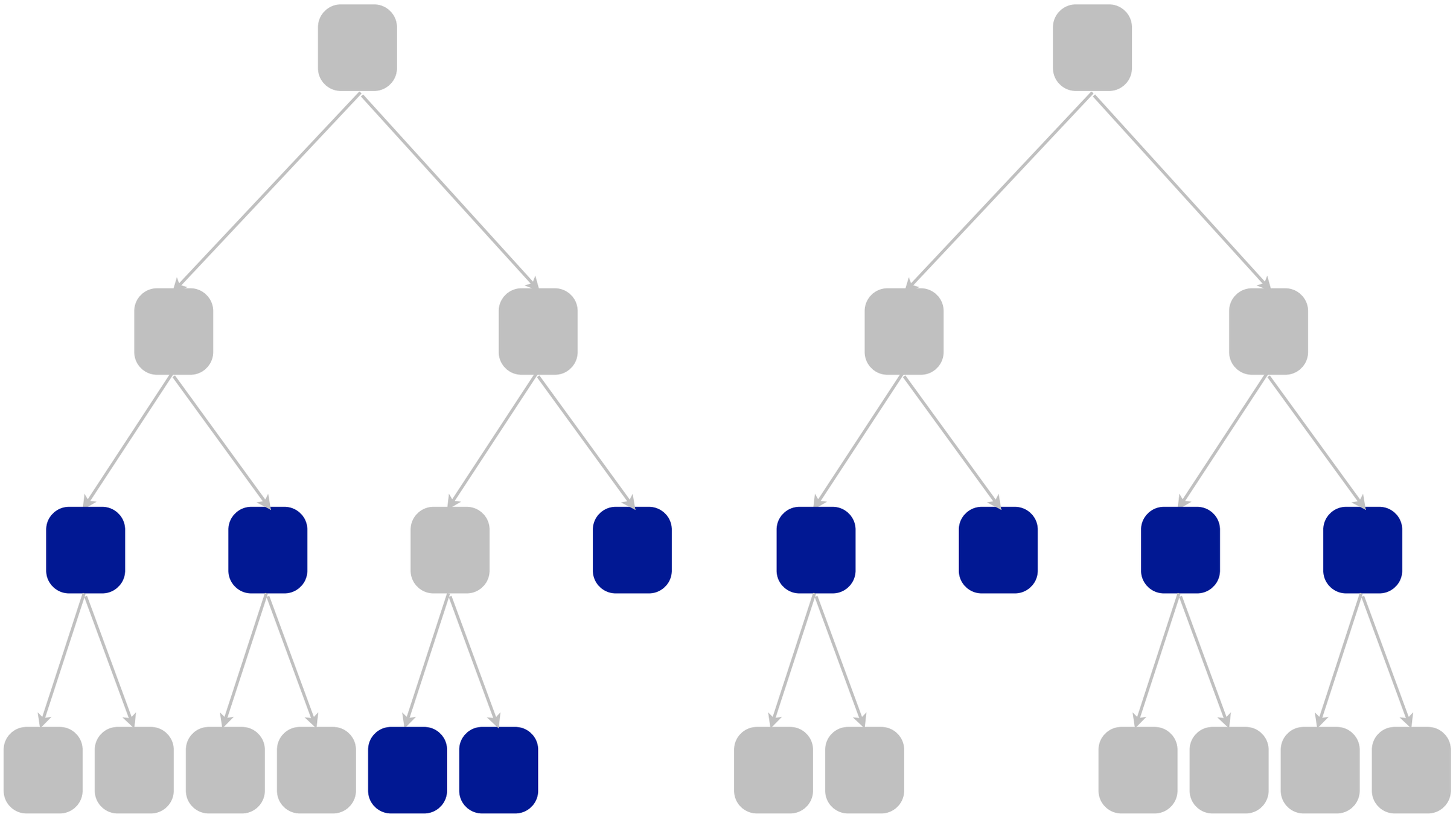

v
what to split
v1
v2
how to split

base mesh

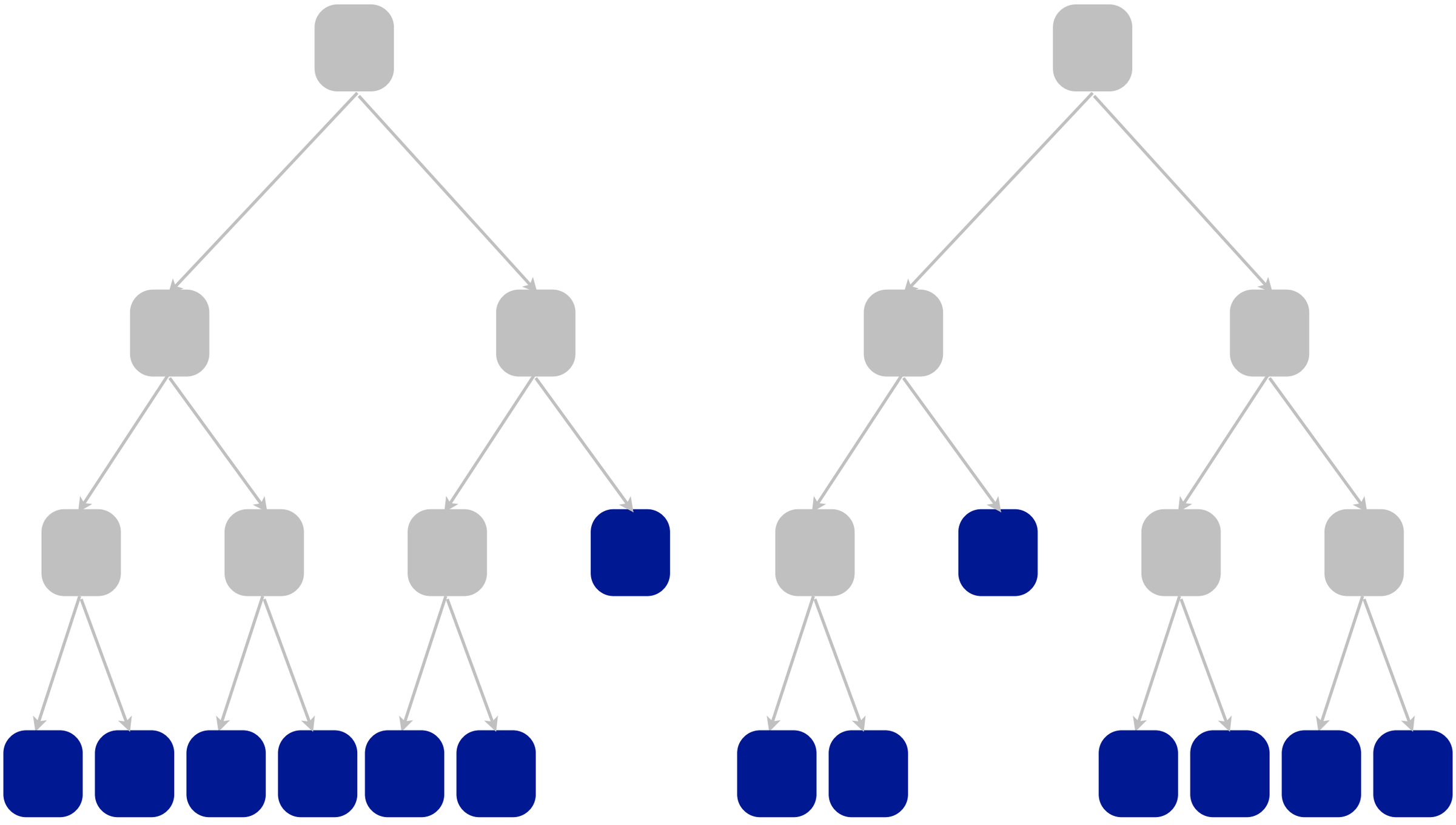




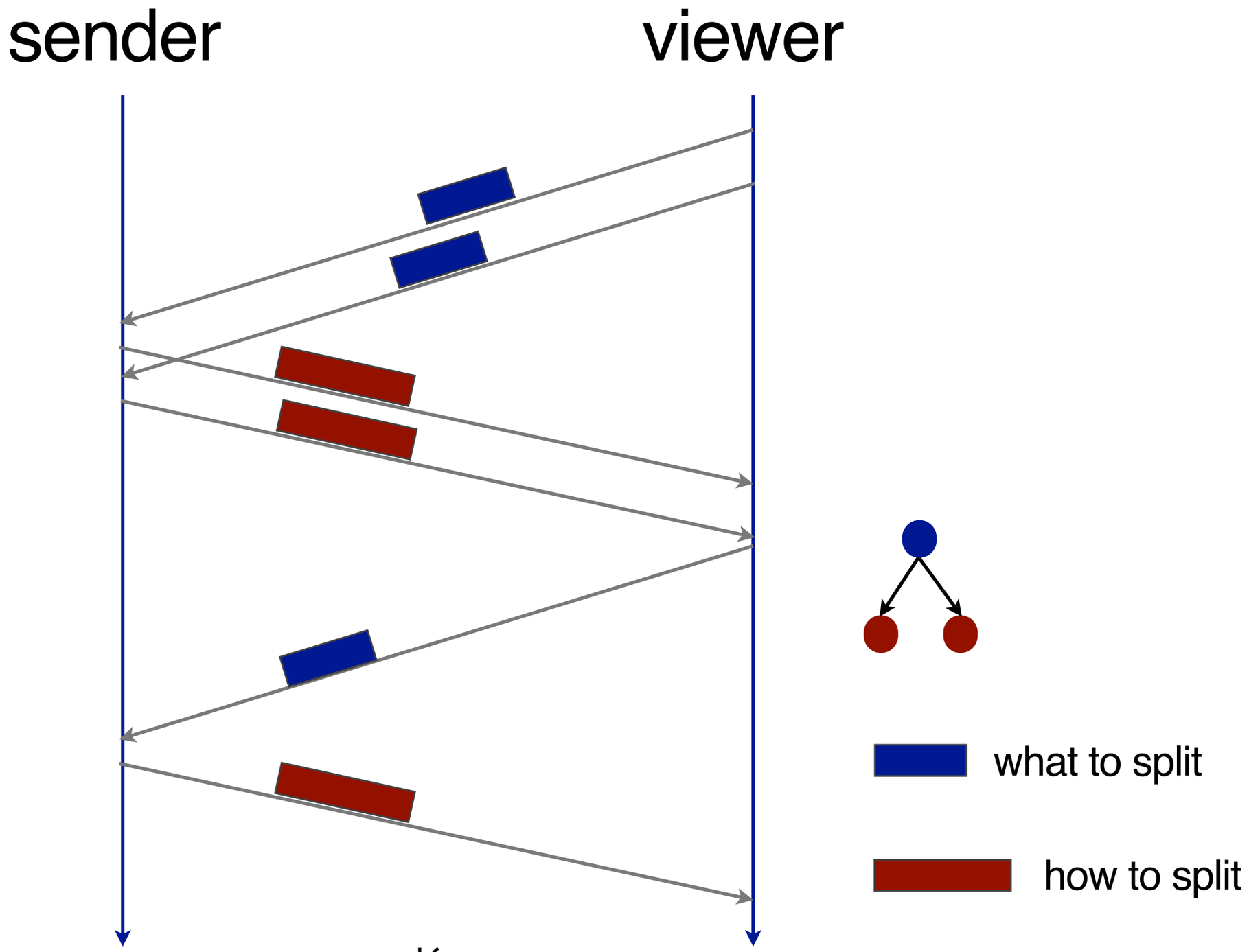




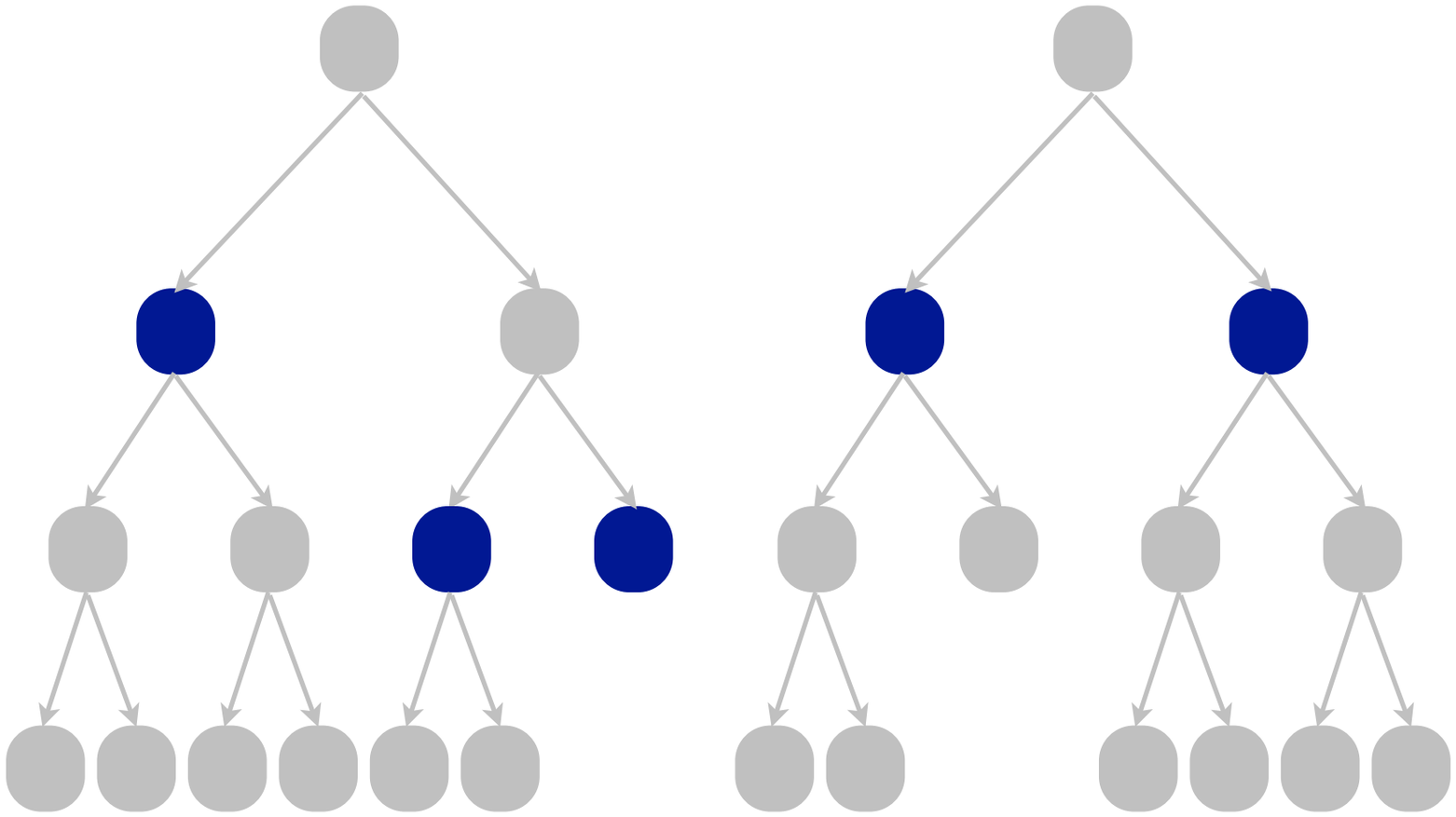
complete mesh



Receiver-Driven Protocol



View-Dependent Streaming:
only request what is visible, in decreasing order of importance



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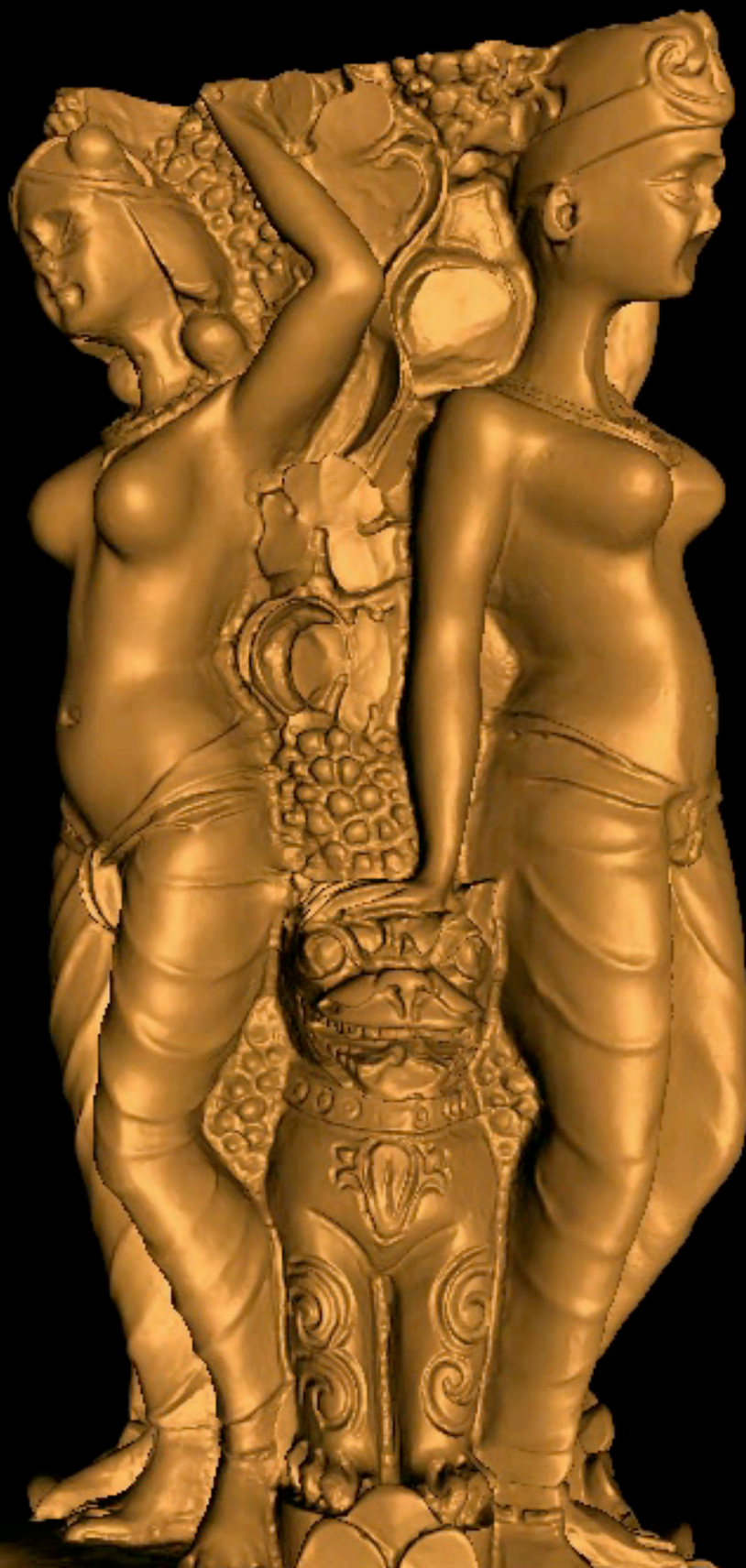
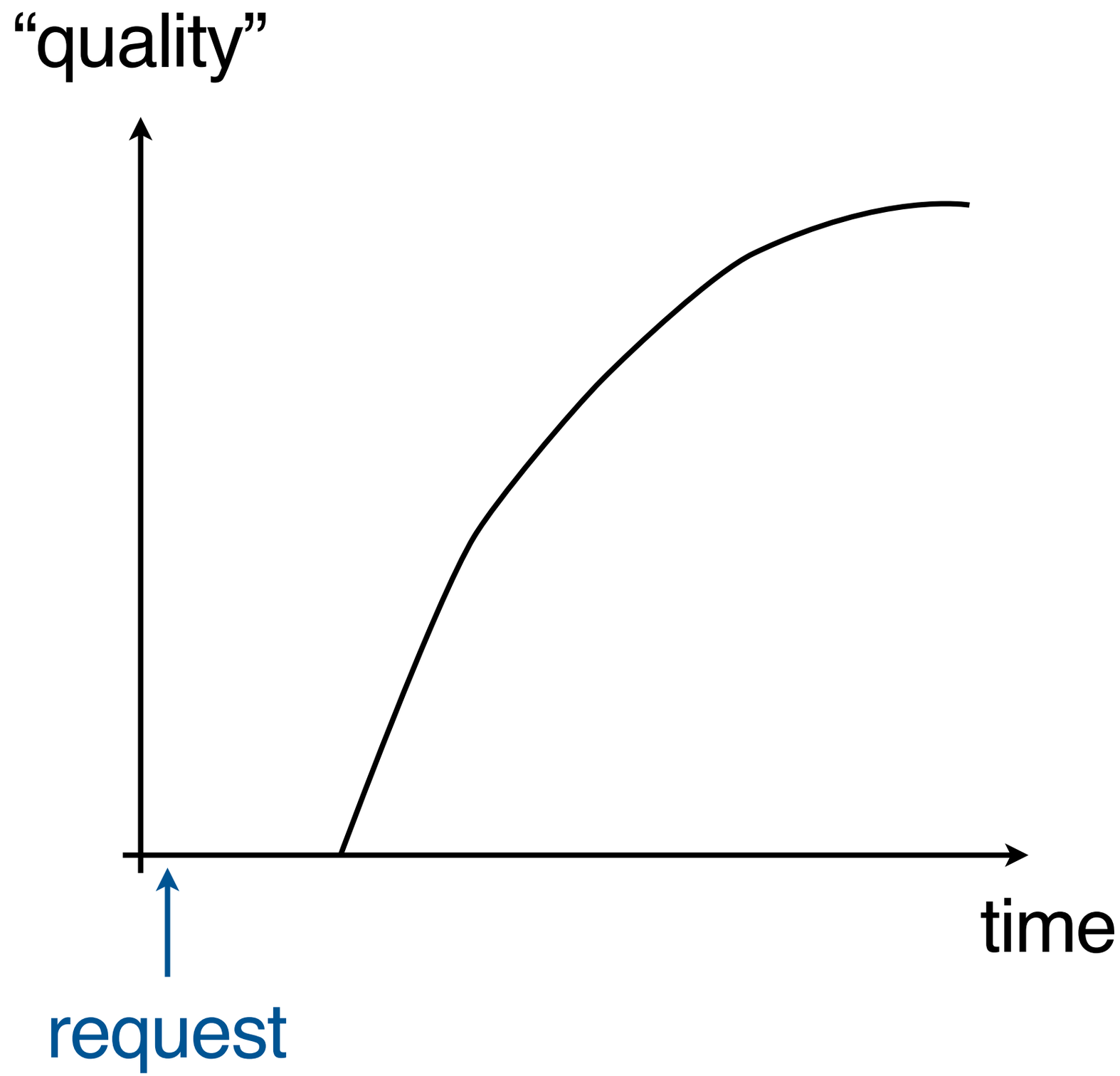
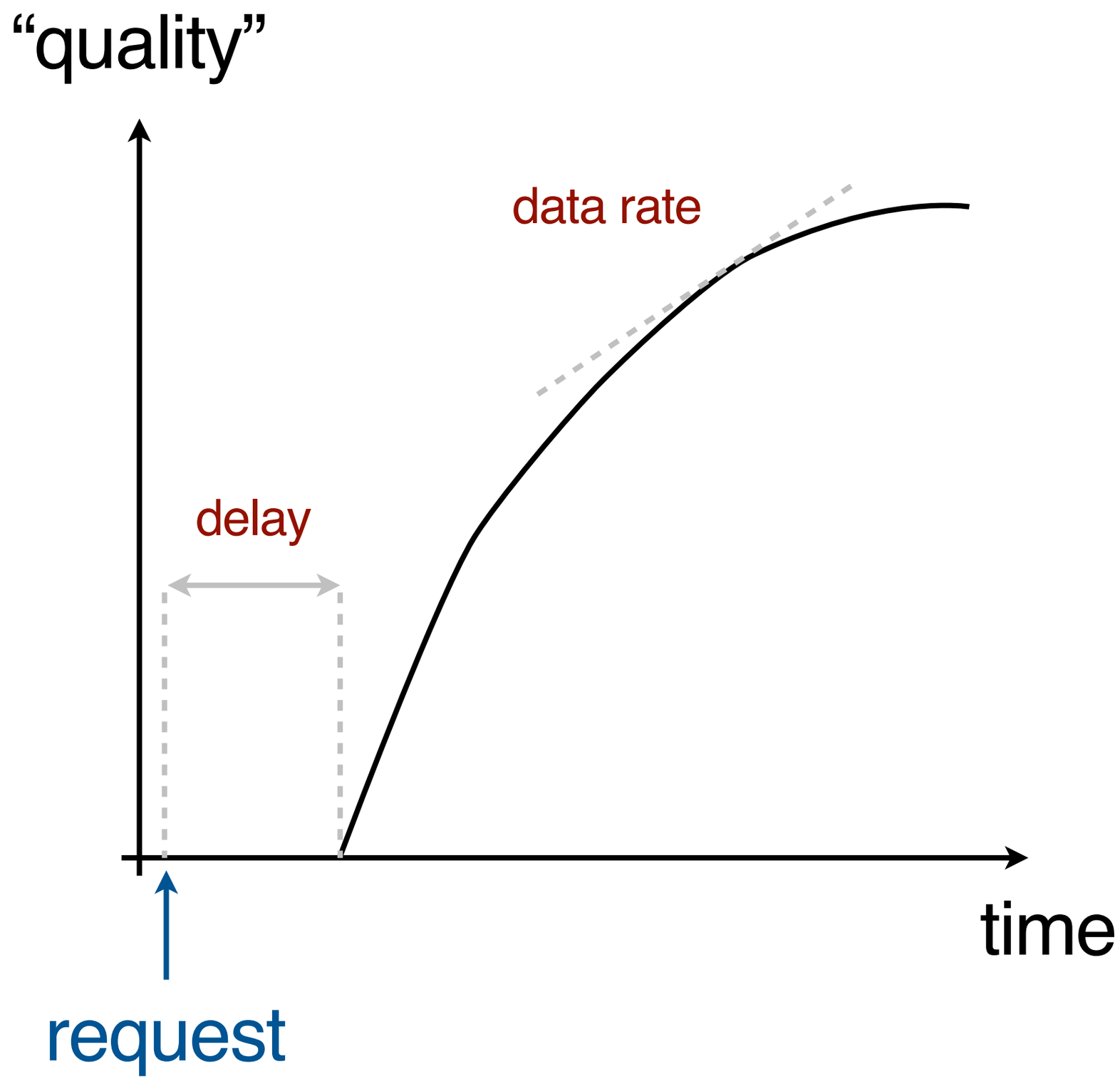
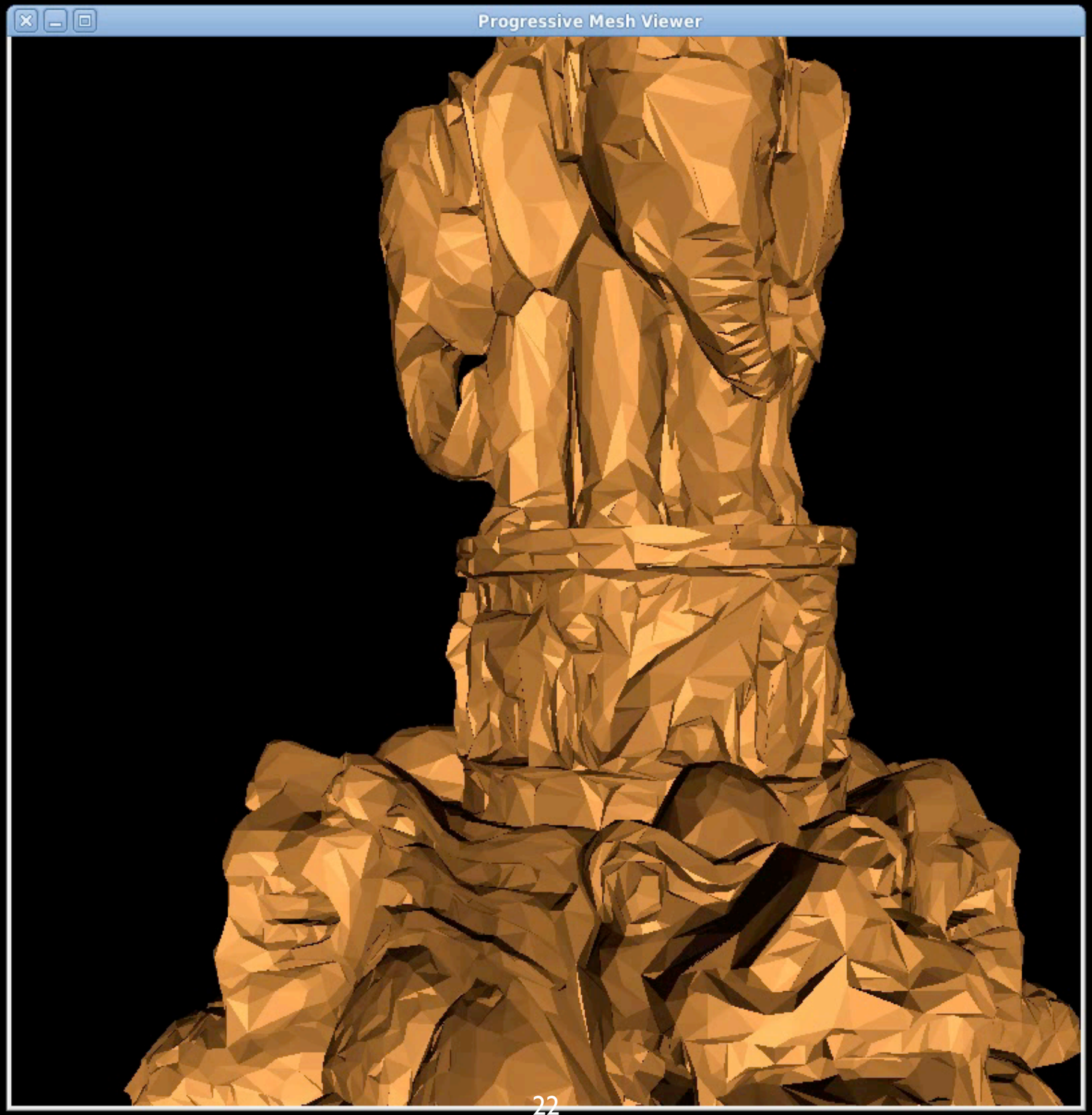



“quality”
time
request


“quality”
data rate
delay
time
request

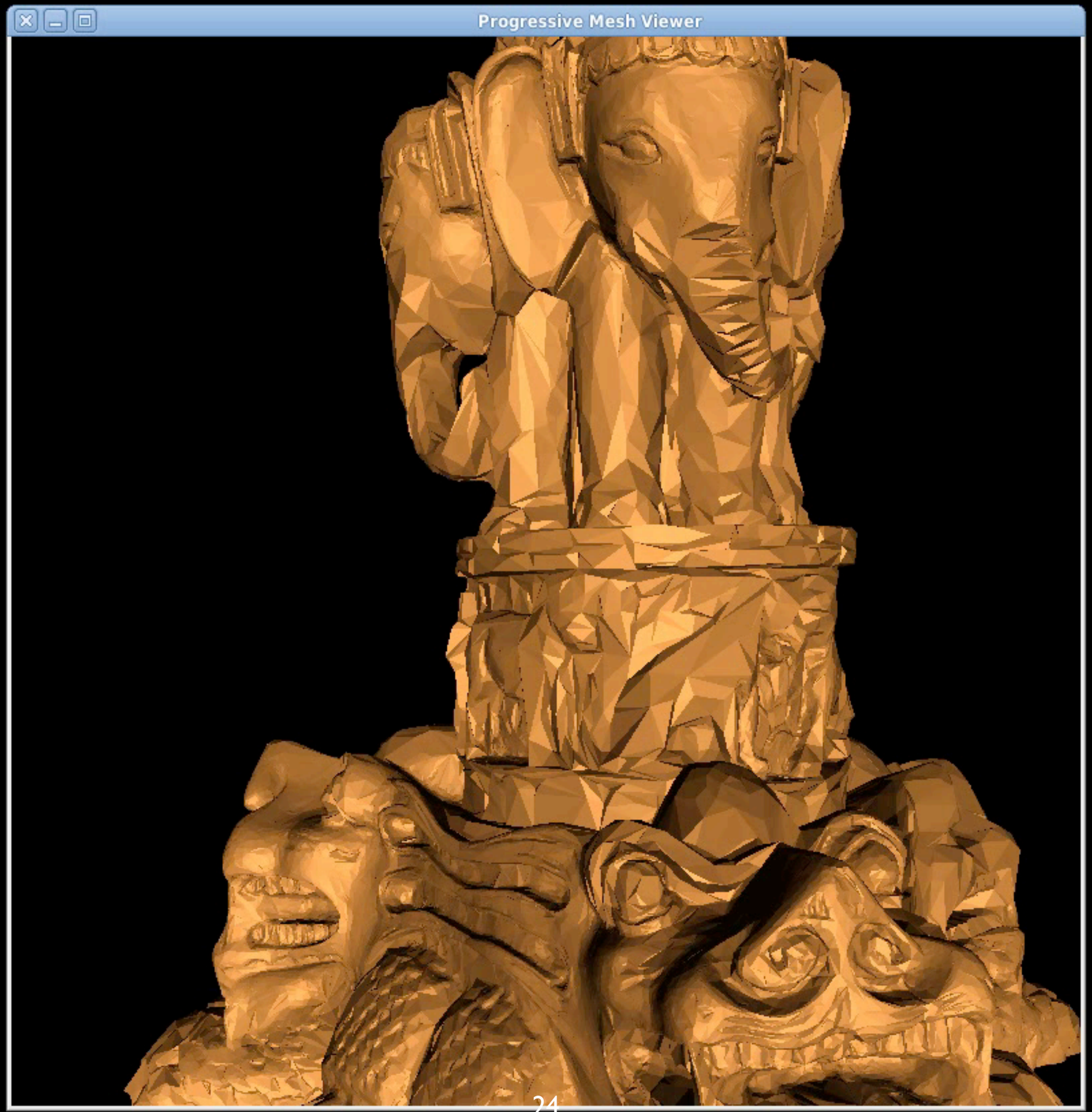
6 seconds

120 KBps


Progressive Mesh Viewer

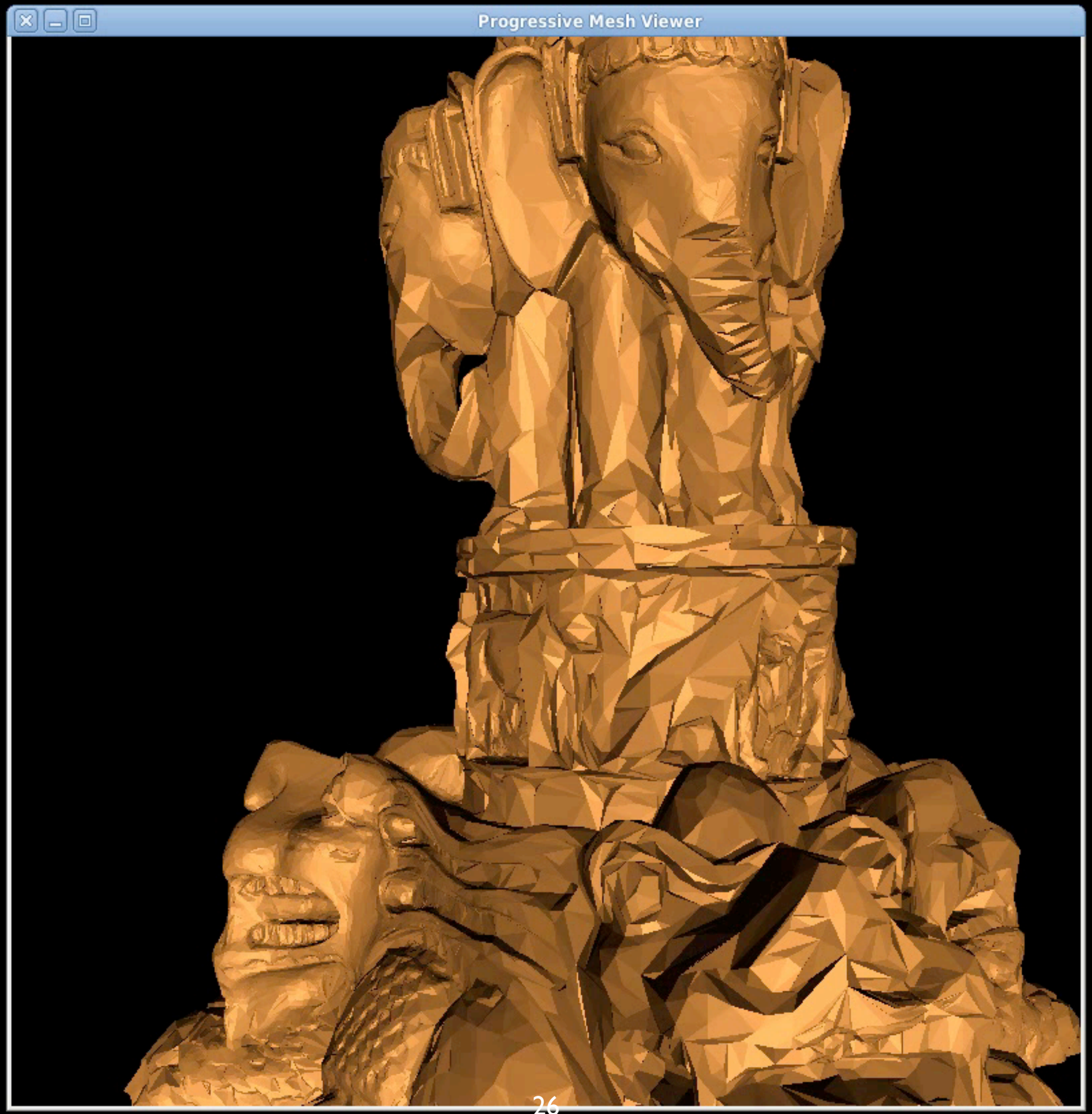
400 ms

120 KBps


Progressive Mesh Viewer

400 ms

20 KBps


Progressive Mesh Viewer

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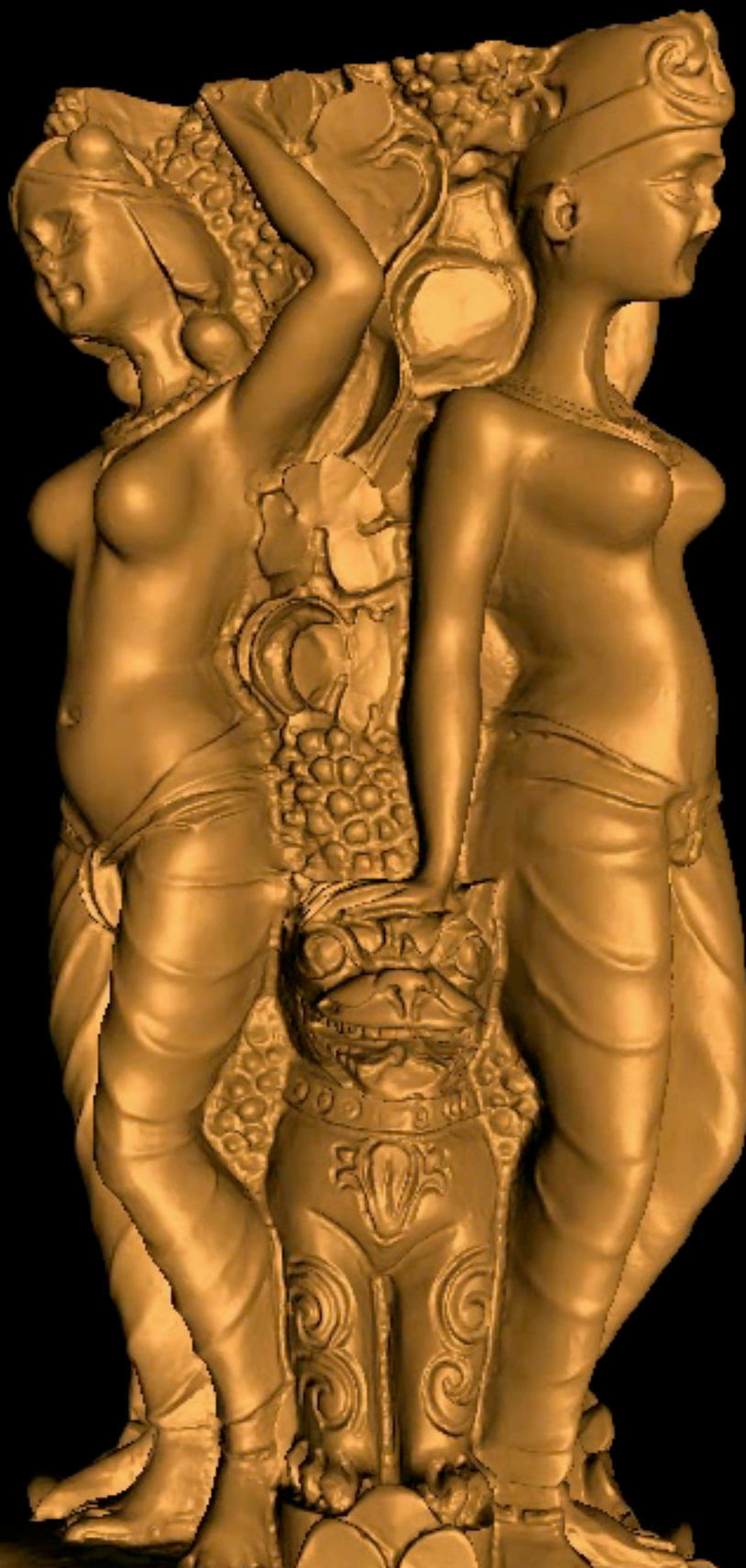


what are the
acceptable delay
and data rate
when streaming
progressive meshes?

why?

design of

peer discovery protocol

provisioning

sender's bandwidth

designing

error control protocol

what affects user tolerance level?

shape and size of **mesh**

user **task**

eye-mesh **distance**

shape and size of **mesh**

user **task**

eye-mesh **distance**

how?

let users interact with meshes transmitted with specific (delay, data rate) parameters

ask: is it acceptable?

The Details

Thai Statue

253 KB + 16.8 MB

Happy Buddha

221 KB + 2 MB

Progressive Mesh Viewer

Dragon

247 KB + 12.1 MB

XYZ RGB

	20 KBps	**40** KBps	**60** KBps	**80** KBps	**100** KBps
0.4 s					
1 s					
2 s					
3 s					
4 s					
5 s					
6 s					

	20 KBps	**40** KBps	**60** KBps	**80** KBps	**100** KBps
0.4 s					
1 s					
2 s					
3 s					
4 s					
5 s					
6 s					

show to user in **random order**

user **unaware** of parameters

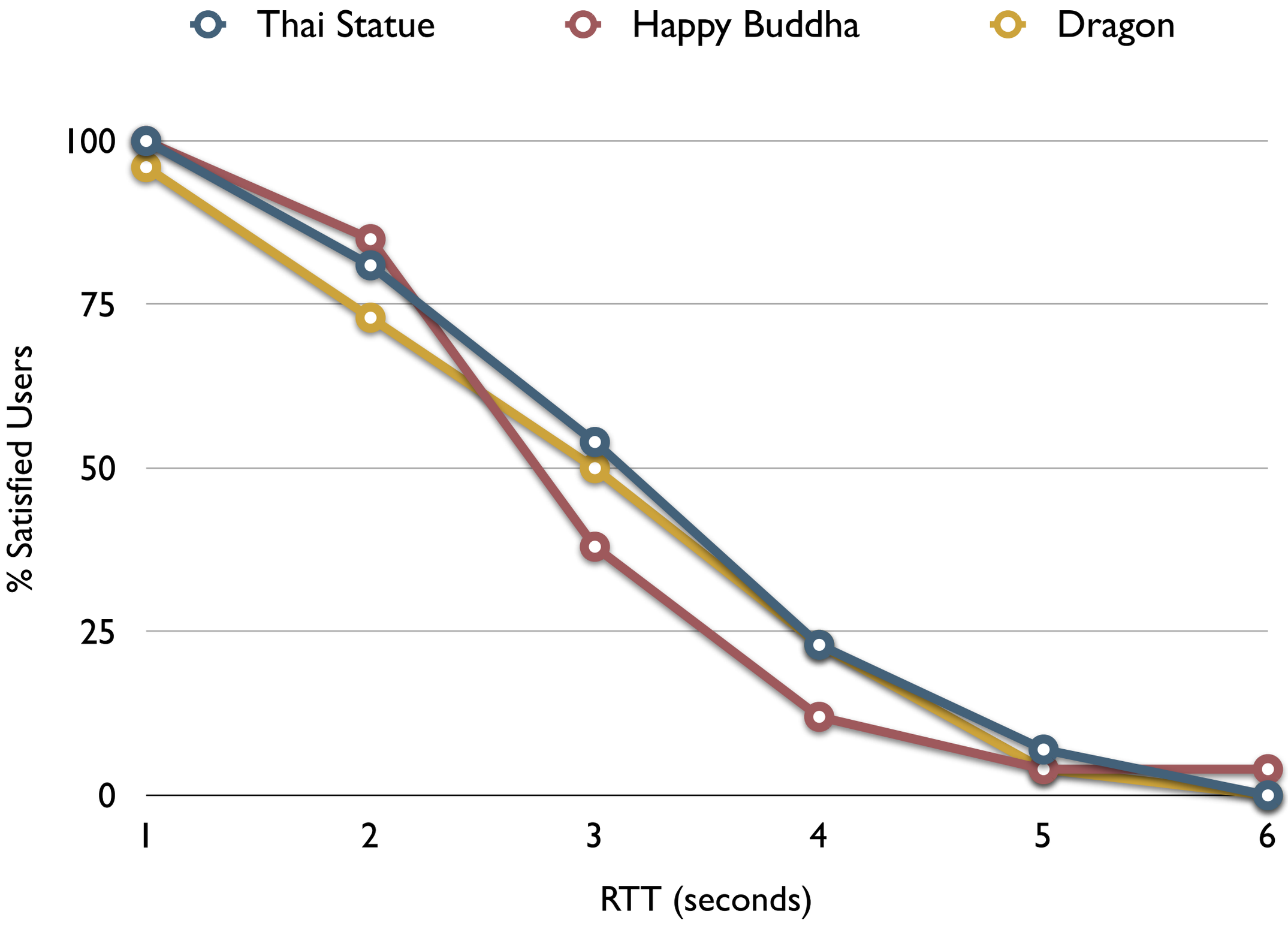
user can **rotate/translate**

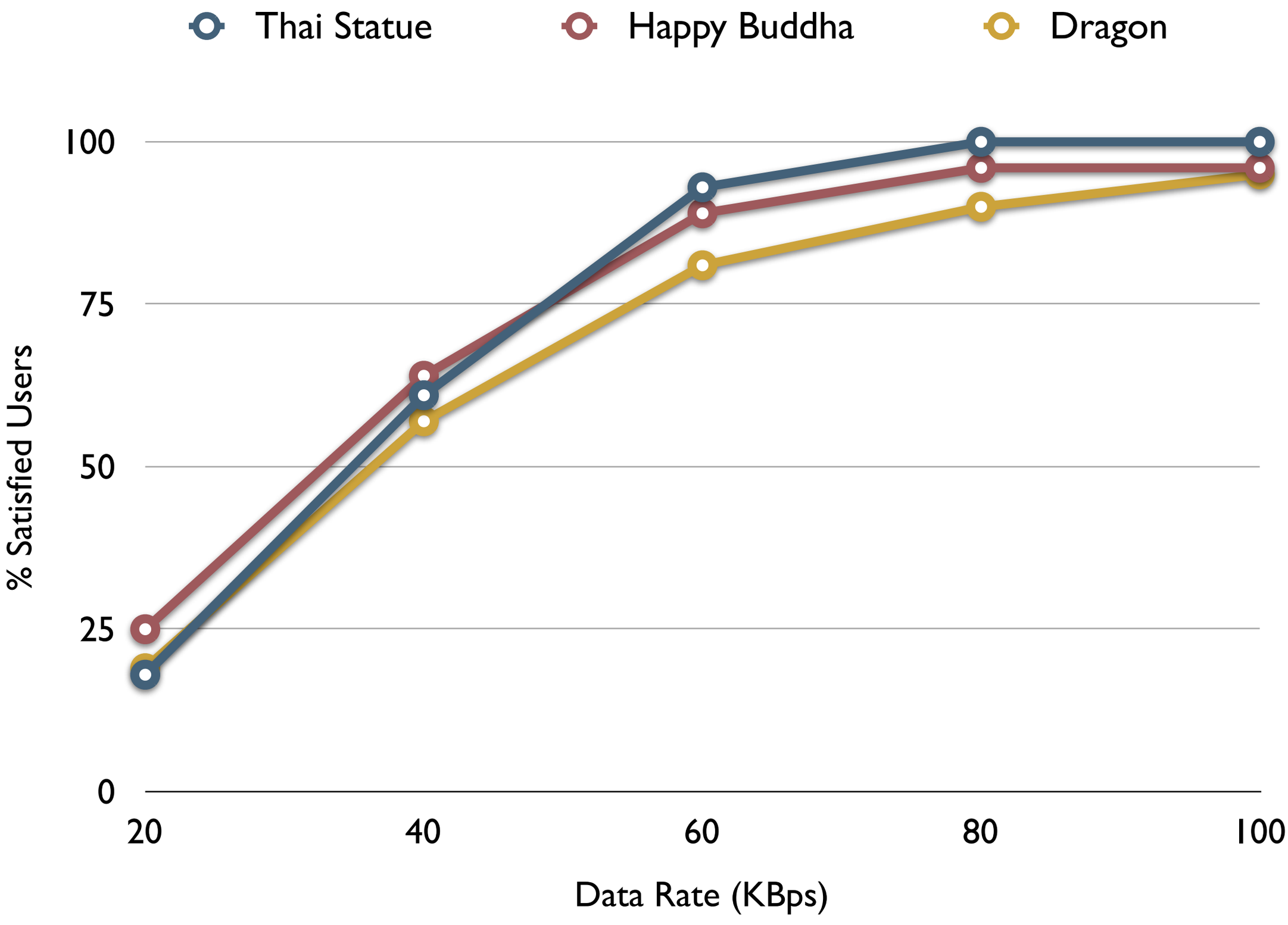
user indicates **whether quality is satisfiable**

38

participants

	20 KBps	**40** KBps	**60** KBps	**80** KBps	**100** KBps
0.4 s	✗	✓	✗	✓	✓
1 s					
2 s	Inconsistent results are filtered out				
3 s					
4 s					
5 s					
6 s					


Thai Statue
Happy Buddha
Dragon
100
75
50
25
0
% Satisfied Users
1
2
3
4
5
6
RTT (seconds)


Thai Statue
Happy Buddha
Dragon
100
75
50
25
0
% Satisfied Users
20
40
60
80
100
Data Rate (KBps)

	20 KBps	**40** KBps	**60** KBps	**80** KBps	**100** KBps
0.4 s	✗	✗	?	✓	
1 s					✓
2 s					?
3 s					✗
4 s					✗
5 s					✗
6 s					✗

what does it mean?

1 sec

users have higher delay tolerance compared to other interactive media applications

progressiveness helps?

480 kbps

16 - 18 K vertices / seconds

average US upstream BW: **1.1** Mbps

average YouTube video: **328** kbps

what's next?

shape and size of **mesh**

user **task**

eye-mesh **distance**

prefer

higher rate

or

lower latency?

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