

# Splitting the Scene Graph

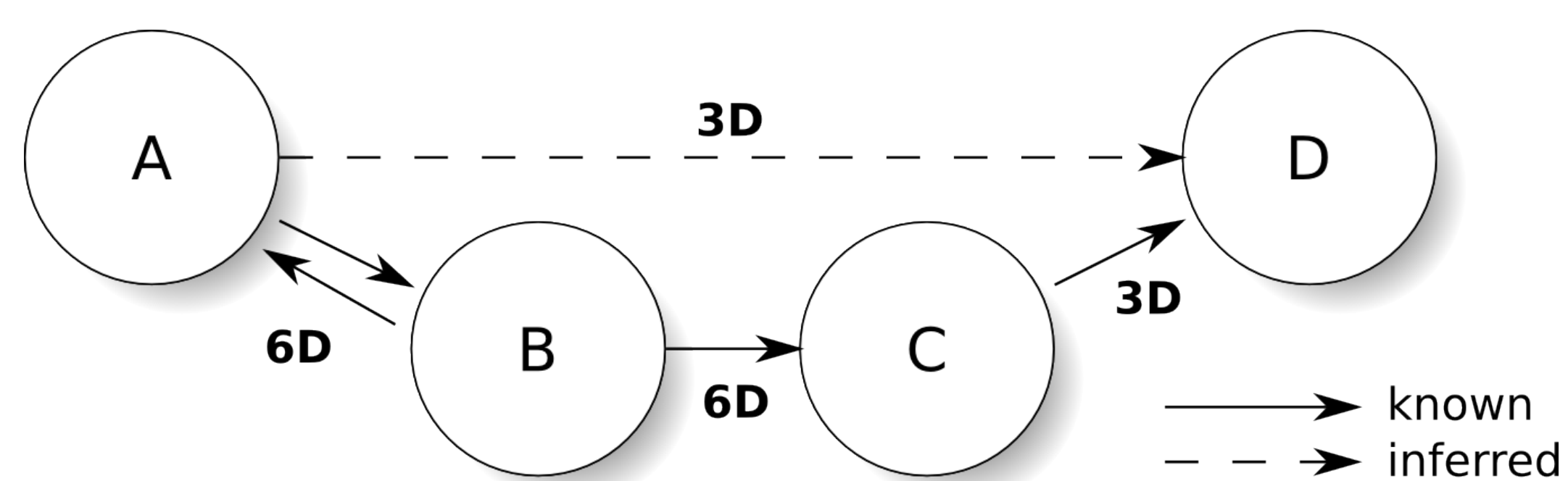
## Using Spatial Relationship Graphs instead of Scene Graphs in Augmented Reality

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### Abstraction Concepts for Augmented Reality

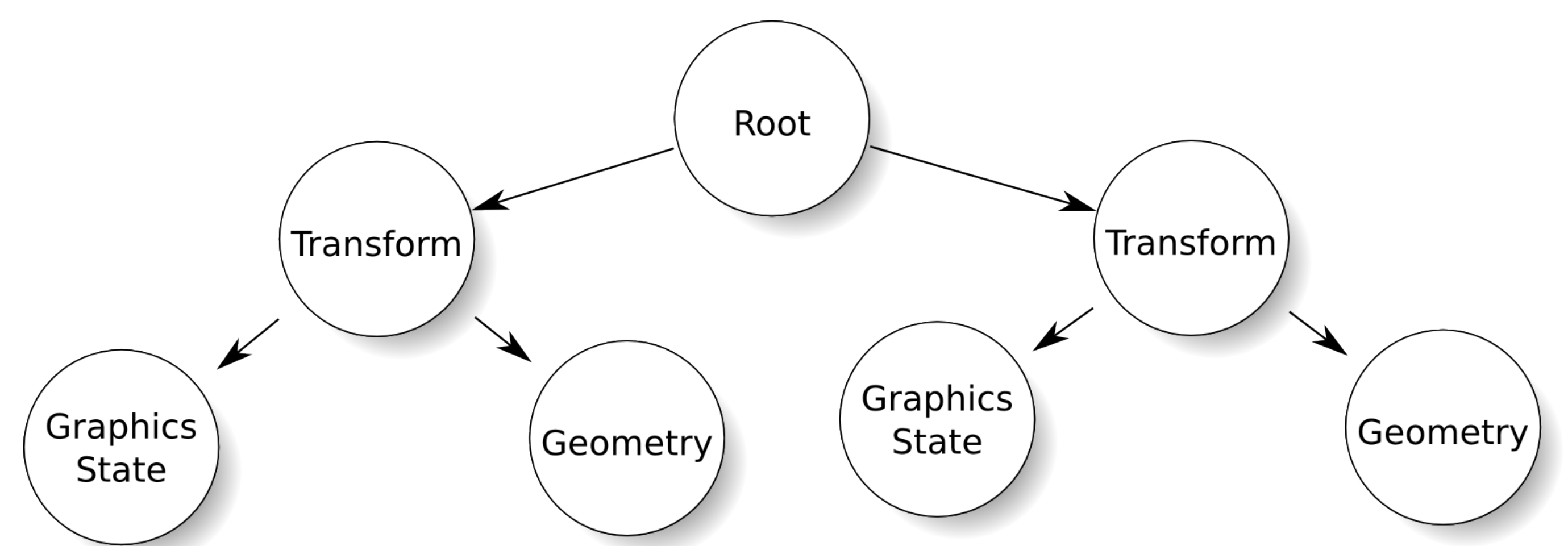
#### The Spatial Relationship Graph

- Generalized directed graph
- Nodes  $\hat{=}$  coordinate systems
- Edges  $\hat{=}$  coordinate transformations (e.g. trackers)
- Edge attributes:
  - Static/dynamic
  - Known/unknown
  - Type of transformation (3D, 6D, ...)
- Drawbacks:
  - Large graphs with, e.g., many CG primitives infeasible
- Advantages:
  - Intuitive representation of real-world setup
  - Supports sensor fusion through graph-search



#### The Scene Graph

- Tree-like structure (sometimes DAG)
- Nodes: spatial or graphics mode states
- Traversed by depth-first search
- Drawbacks:
  - No consistent representation of non-renderable coordinate systems
- Advantages:
  - Fast scene traversal
  - Inheritance of graphics state



### Goal: Combine the Advantages

#### Splitting the Scene Graph

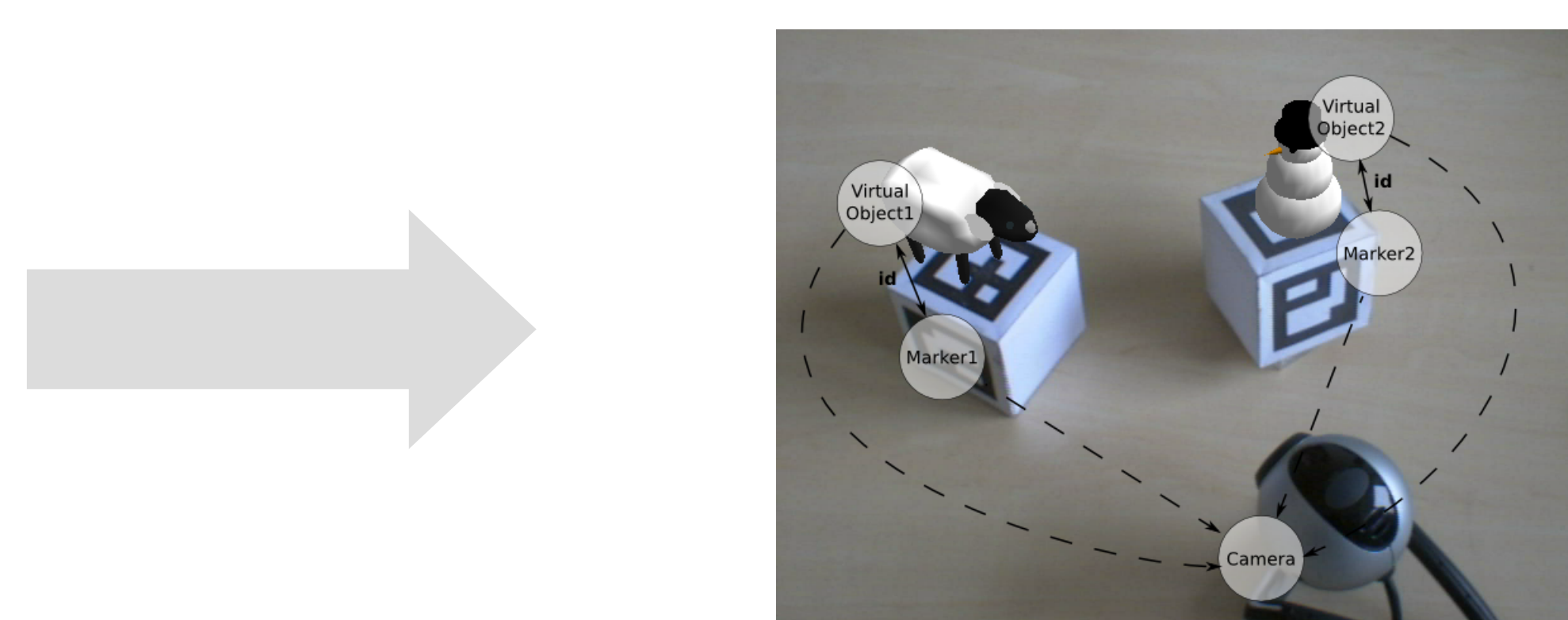
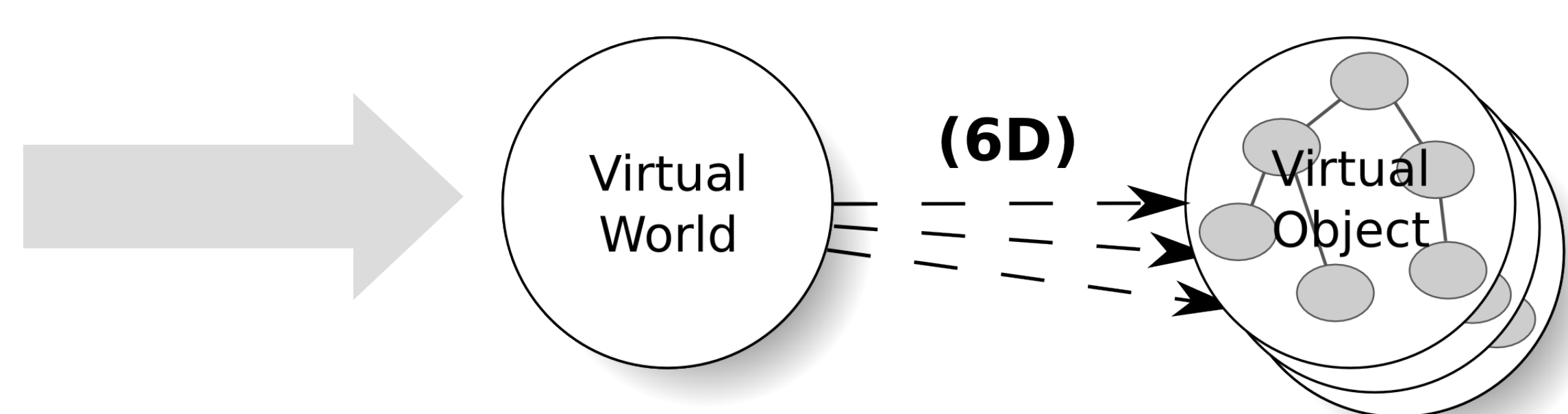
- Split scenegraph into static subtrees (no external transformations)
- Encapsulate subtrees into SRG nodes
- Construct rest of SRG as usual (trackers, markers ..)

#### Implementation

- Based on Ubitrack [3] + TinyXML libraries
- X3D memory representation as scenegraph
- Traversal/rendering using Visitor pattern

#### Results

- Drawbacks:
  - State sorting of CG objects difficult
- Advantages:
  - Entire AR application represented as a single graph
  - Dynamic transformations from scenegraph moved to SRG
  - Rendering code traverses tracked objects only
  - Single object representation can be reused



#### References

- [1] Newman, J., Wagner, M., Bauer, M., MacWilliams, A., Pintaric, T., Beyer, D., Pustka, D., Strasser, F., Schmalstieg, D., and Klinker, G. (2004). **Ubiquitous Tracking for Augmented Reality**. In *Proceedings of the 3<sup>rd</sup> International Symposium on Mixed and Augmented Reality (ISMAR)*.
- [2] Pustka, D., Huber, M., Bauer, M. and Klinker, G. (2006). **Spatial Relationship Patterns: Elements of Reusable Tracking and Calibration Systems**. In *Proceedings of the 5<sup>th</sup> International Symposium on Mixed and Augmented Reality (ISMAR)*.
- [3] Huber, M., Pustka, D., Keitler, P., Echtler, F. and Klinker, G. (2007). **A System Architecture for Ubiquitous Tracking Environments**. In *Proceedings of the 6<sup>th</sup> International Symposium on Mixed and Augmented Reality (ISMAR)*.