

# Churn Possibilities and Impossibilities

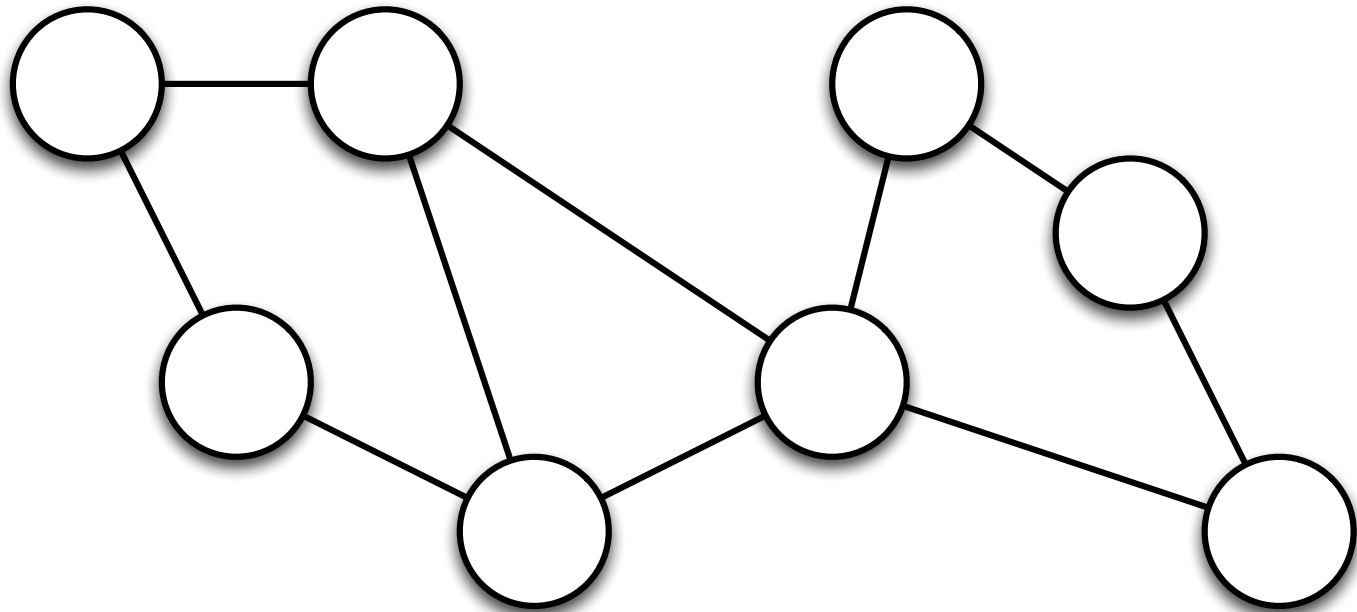
Dianne Foreback, Mikhail Nesterenko,  
**Sébastien Tixeuil**

**NETYS, Essaouira, May 10, 2018**

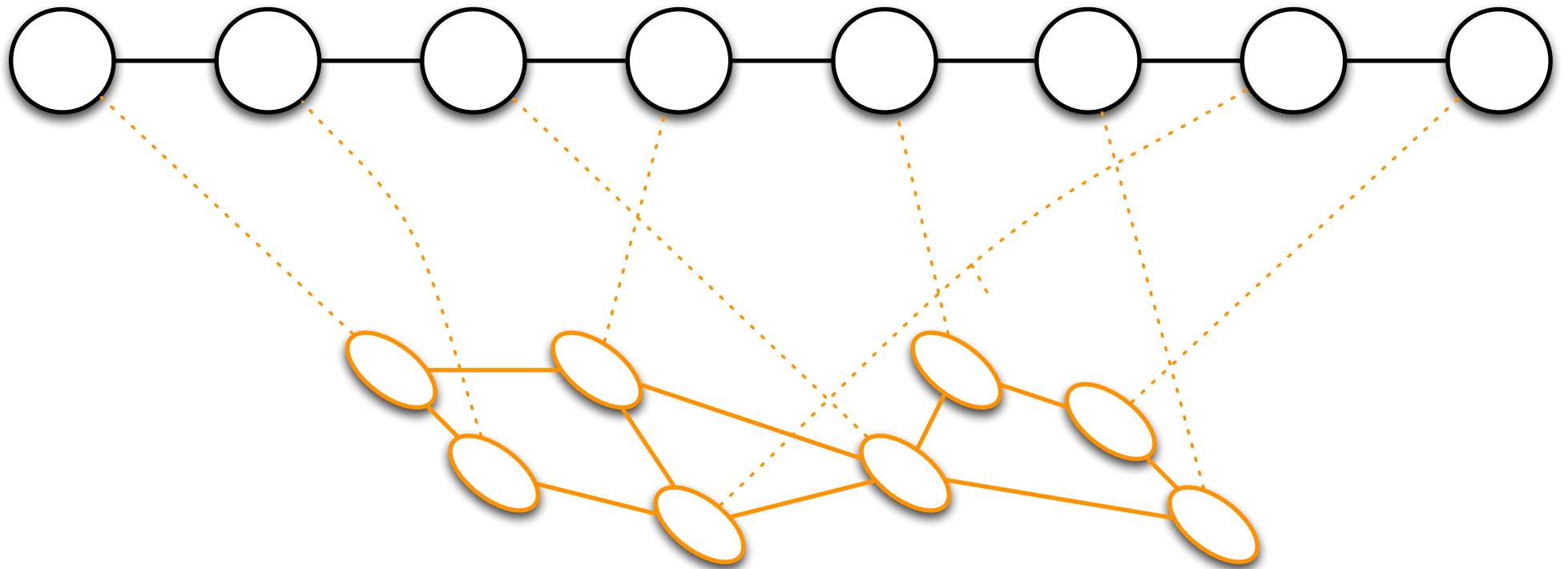


# Context & Motivation

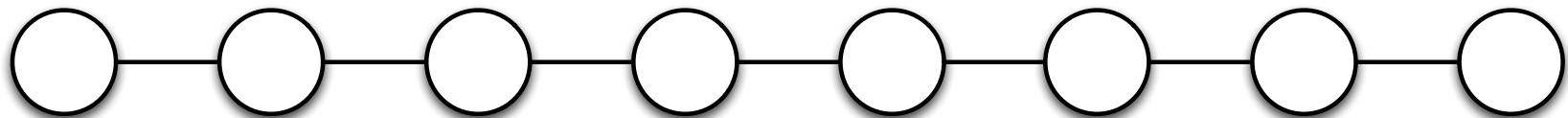
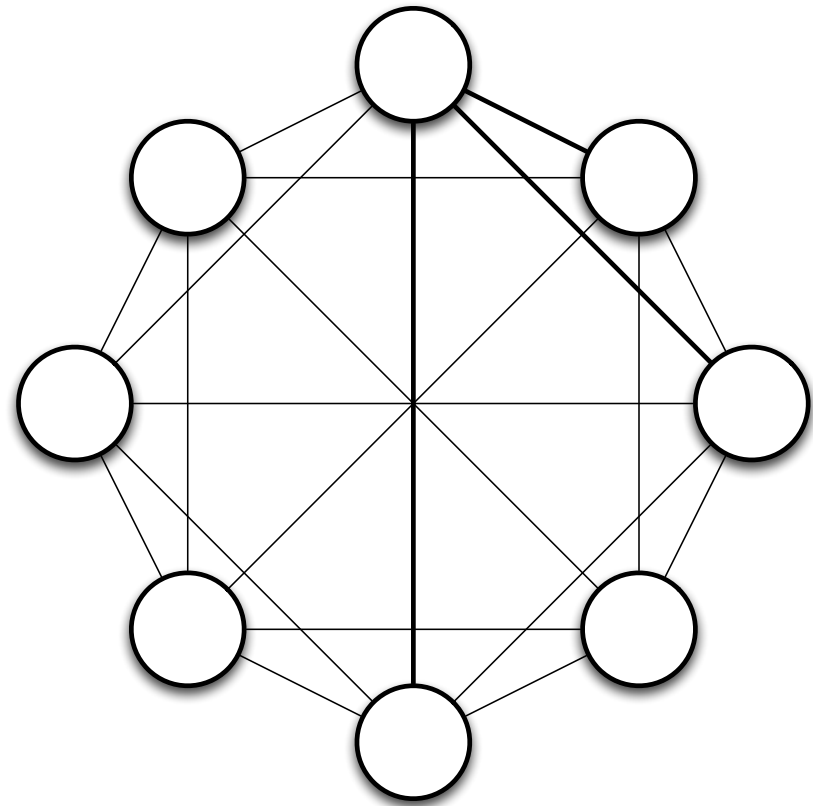
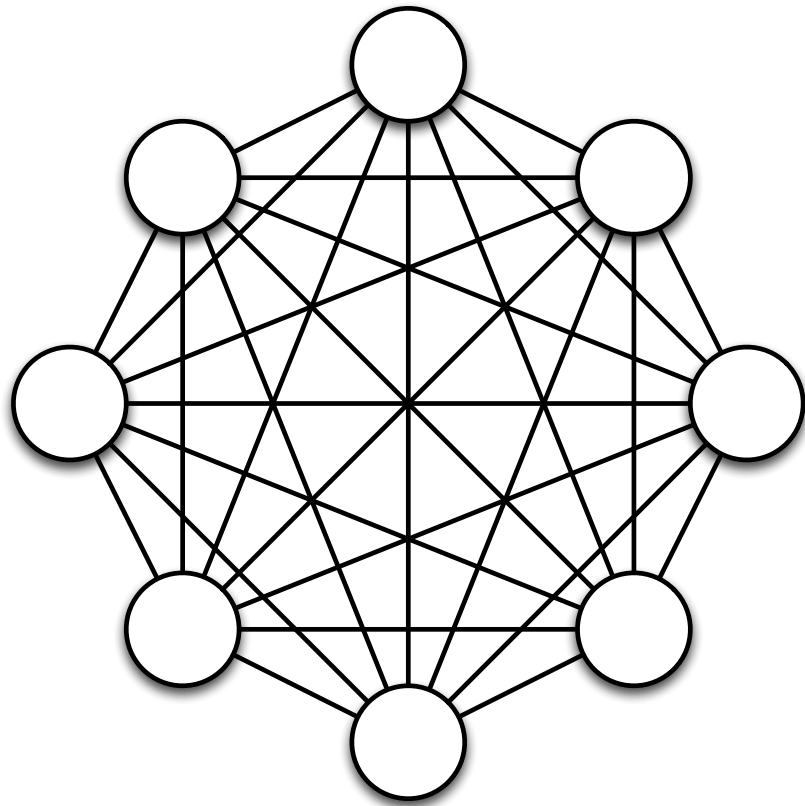
# Distributed Systems



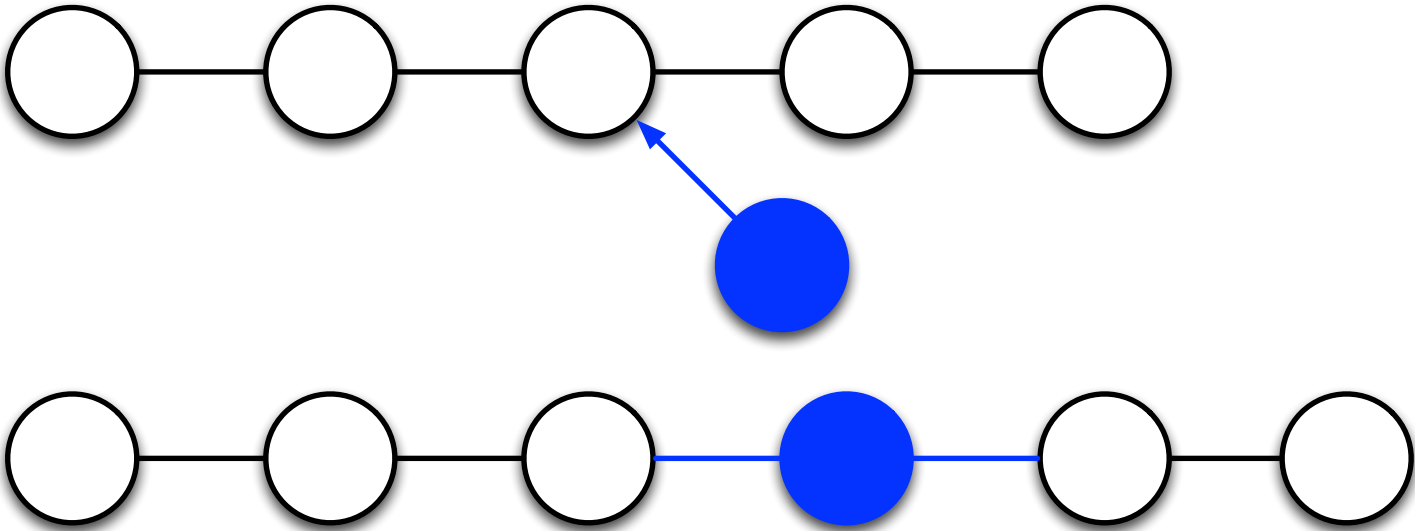
# Overlay Networks



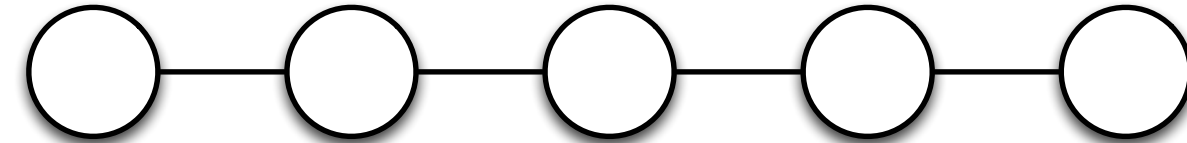
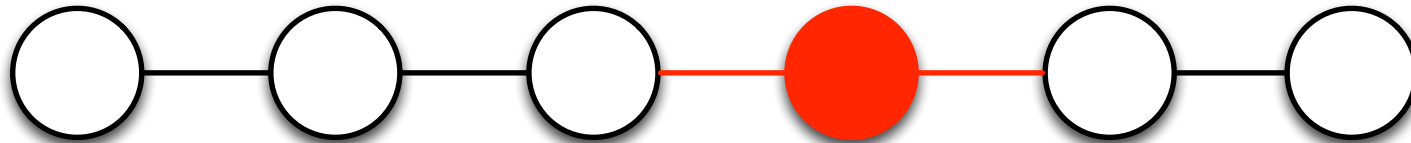
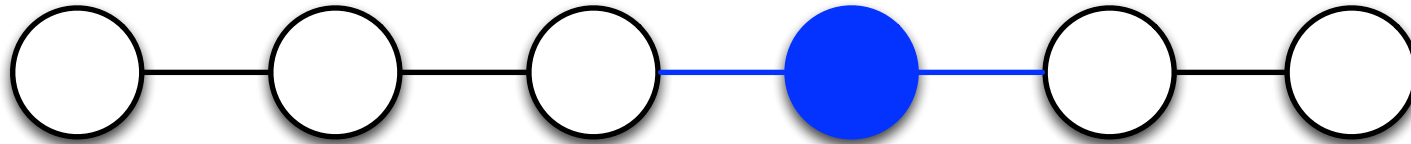
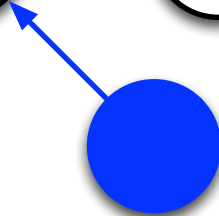
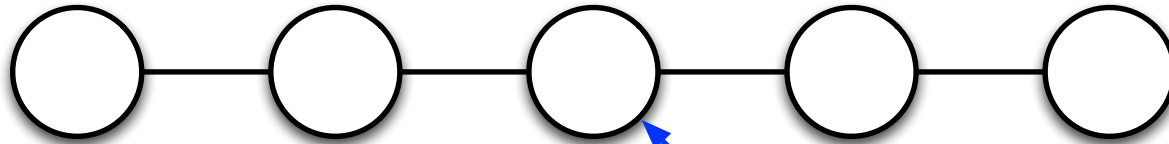
# Overlay Networks



# Churn



# Churn

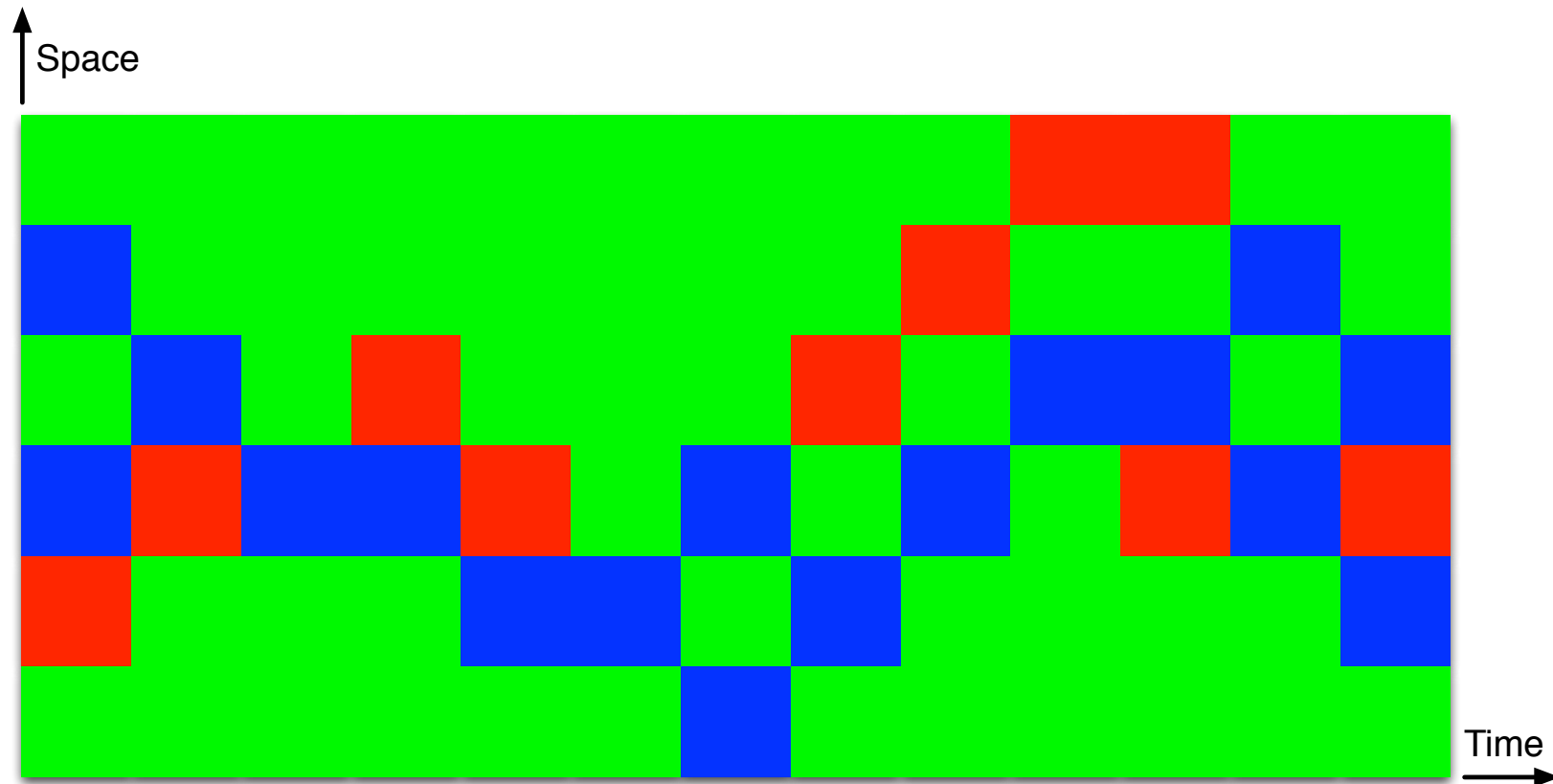


# Churn

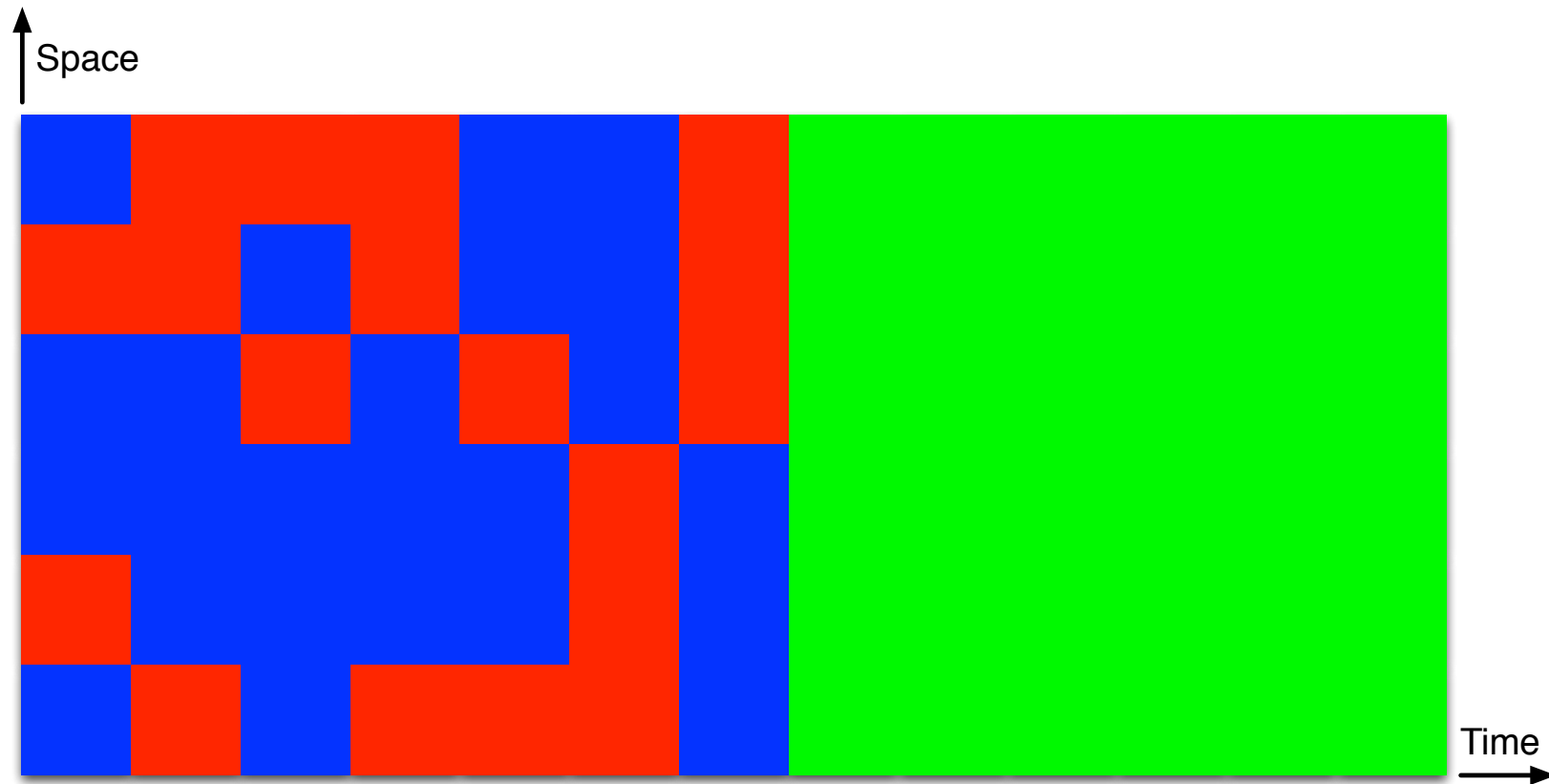




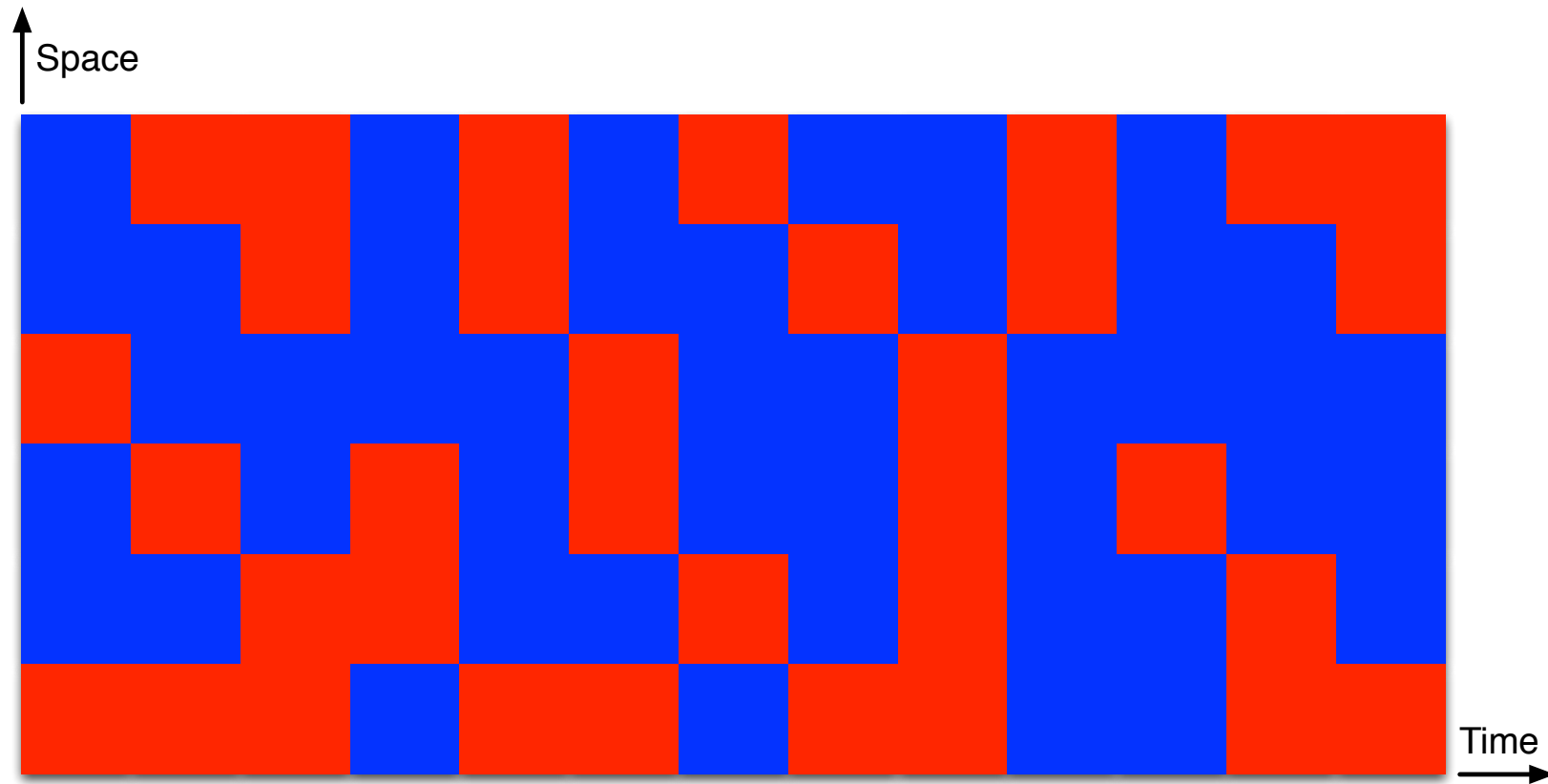
# Limited Churn



# Finite Churn

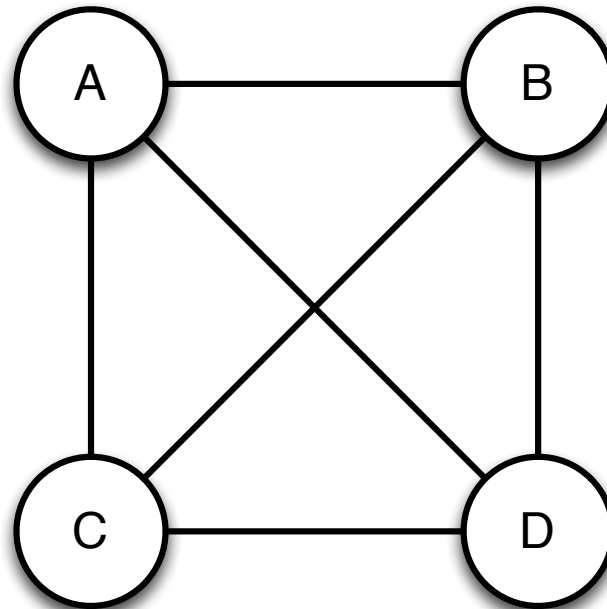


# Unlimited and Infinite Churn

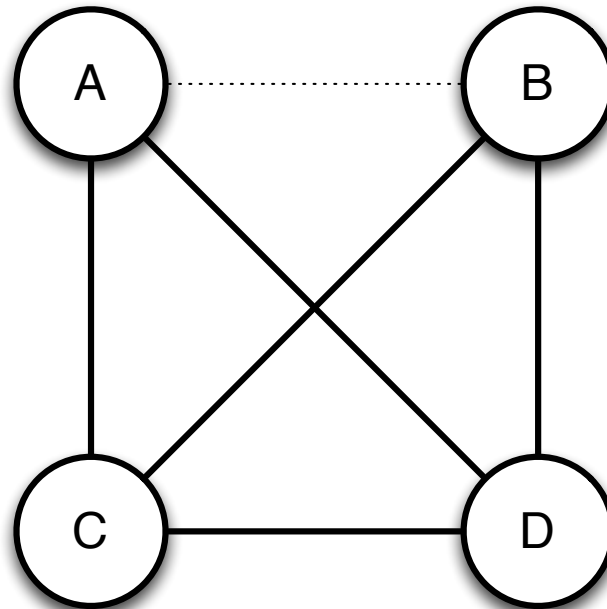


# **Adversarial vs. Cooperative Churn**

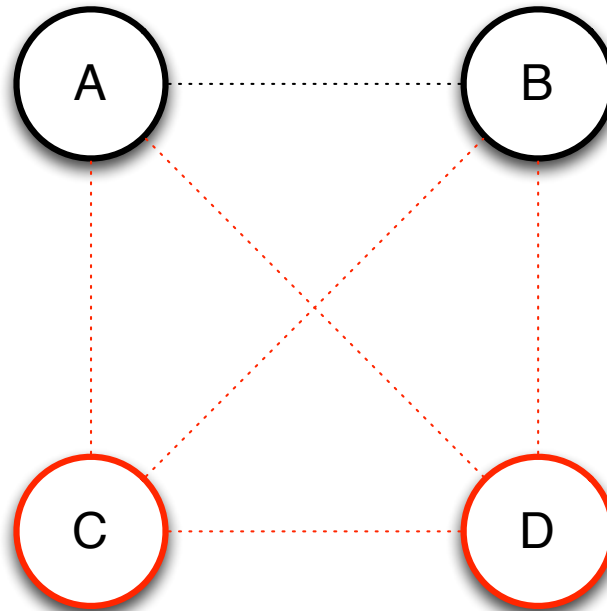
# Unlimited Adversarial Churn



# Unlimited Adversarial Churn



# Unlimited Adversarial Churn



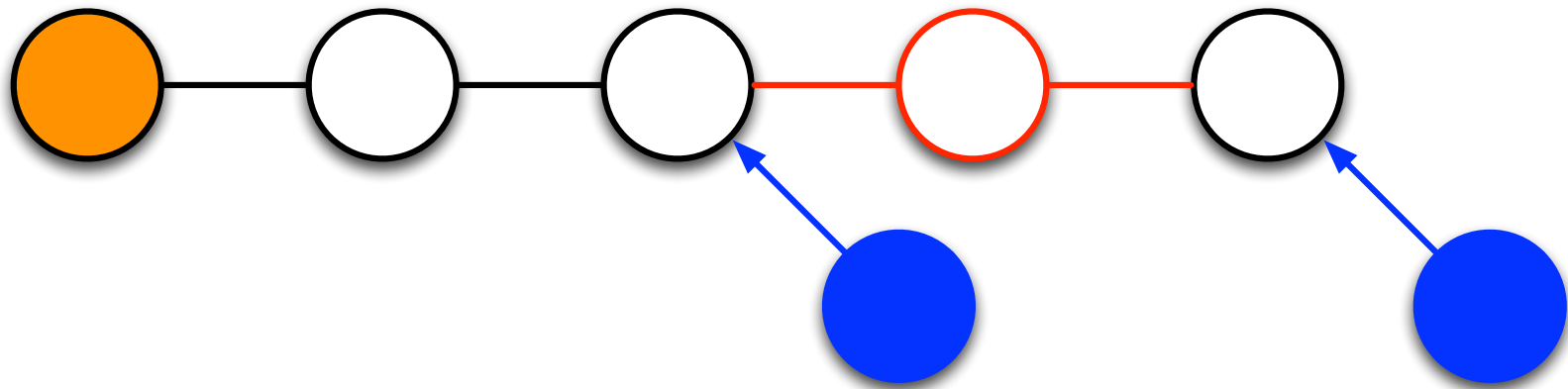
# Unlimited Adversarial Churn

	Unlimited
Adversarial	Impossible
Cooperative	?

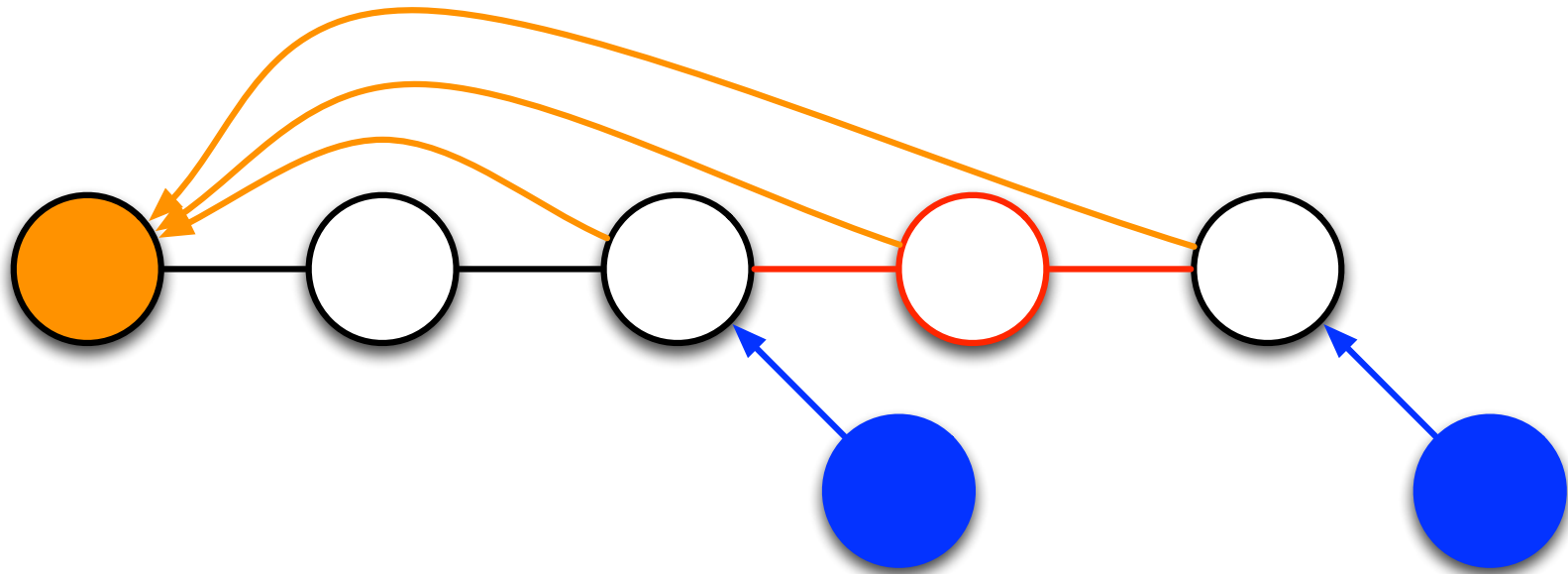


# **Global *vs.* Local Protocols**

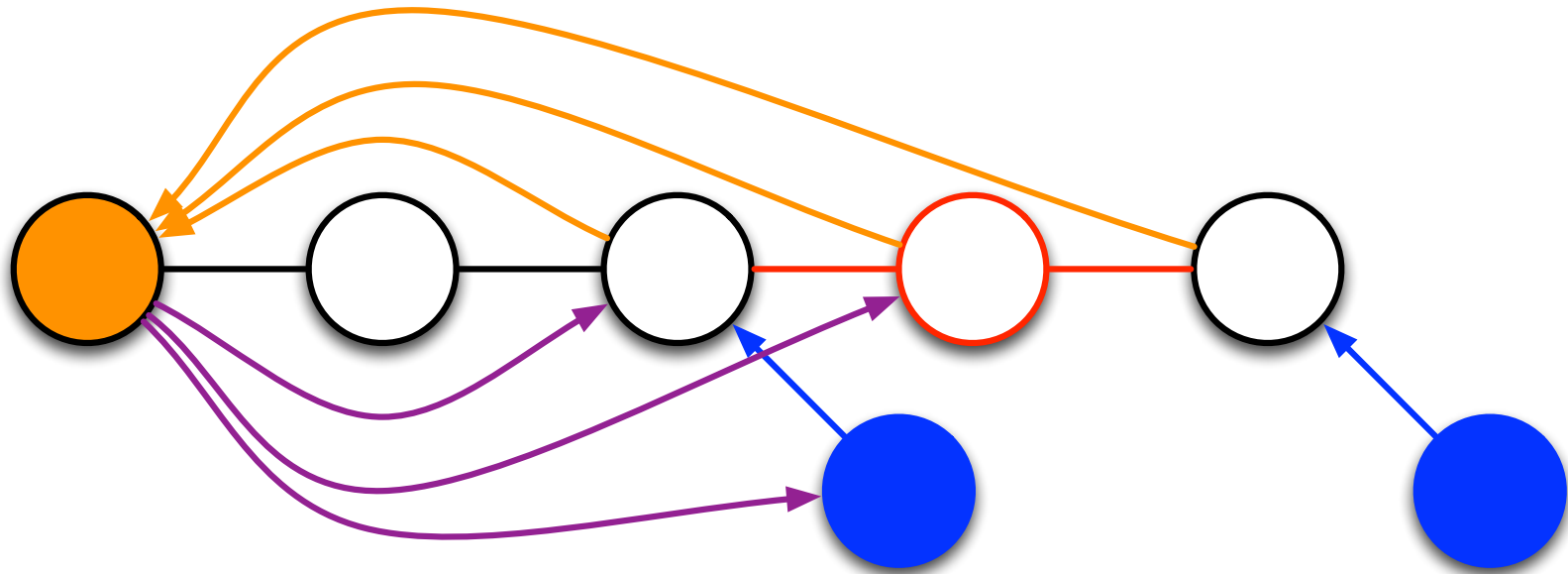
# Infinite Unlimited Global Protocol



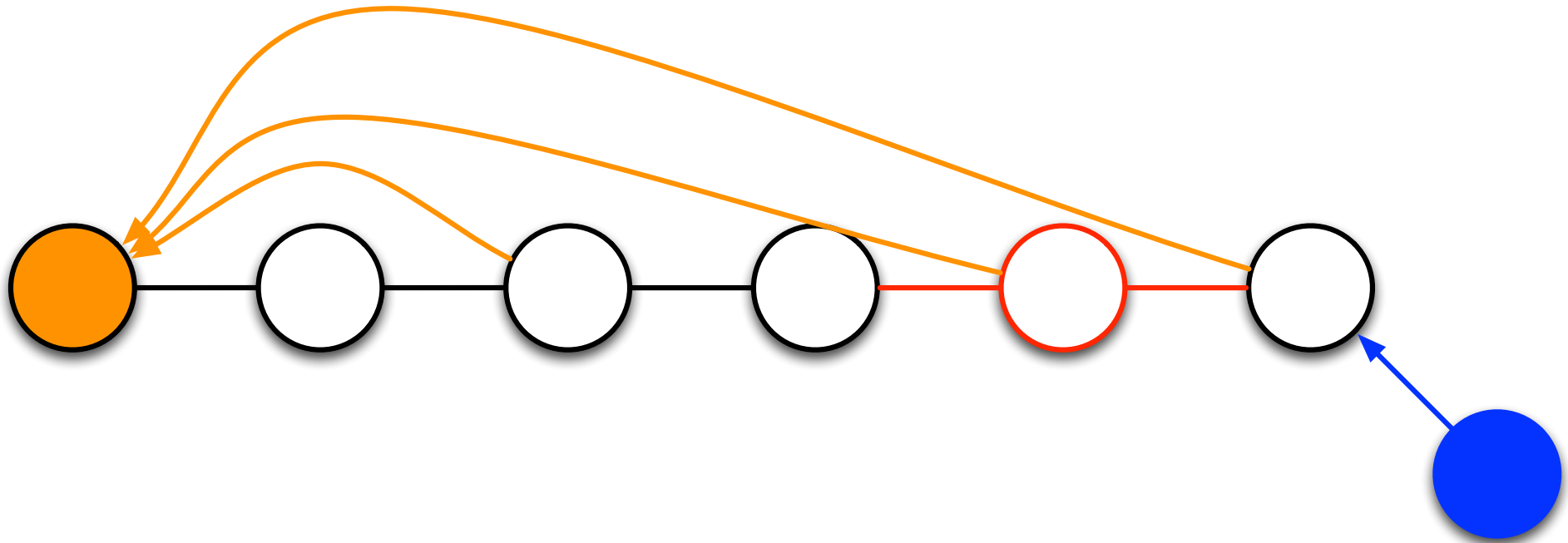
# Infinite Unlimited Global Protocol



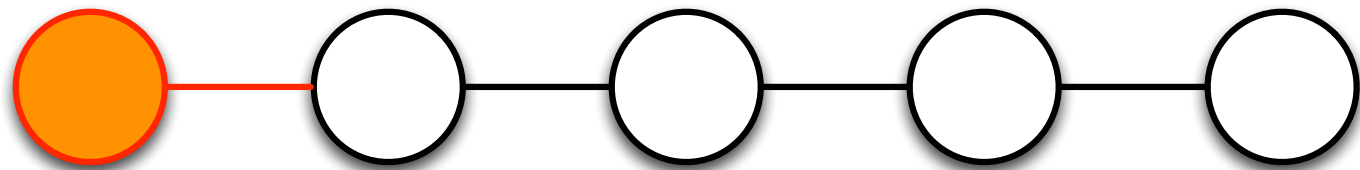
# Infinite Unlimited Global Protocol



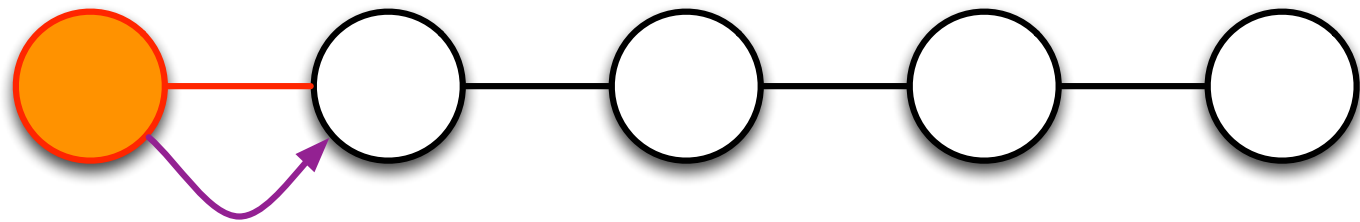
# Infinite Unlimited Global Protocol



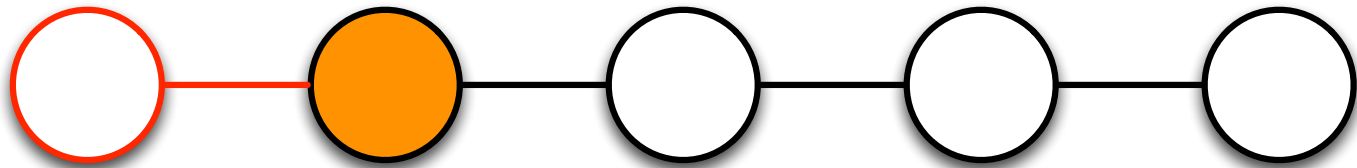
# Infinite Unlimited Global Protocol



# Infinite Unlimited Global Protocol

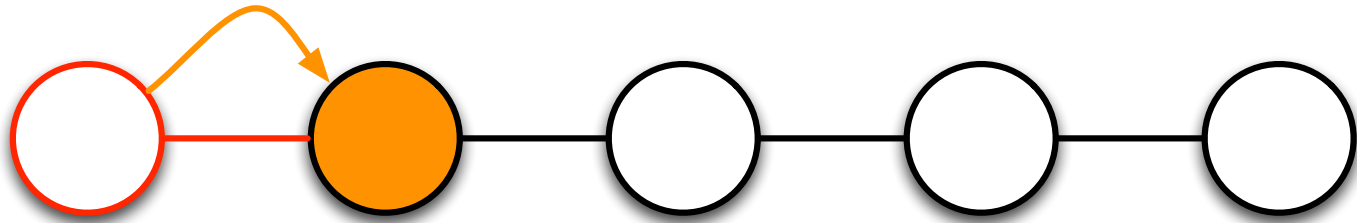


# Infinite Unlimited Global Protocol





# Infinite Unlimited Global Protocol

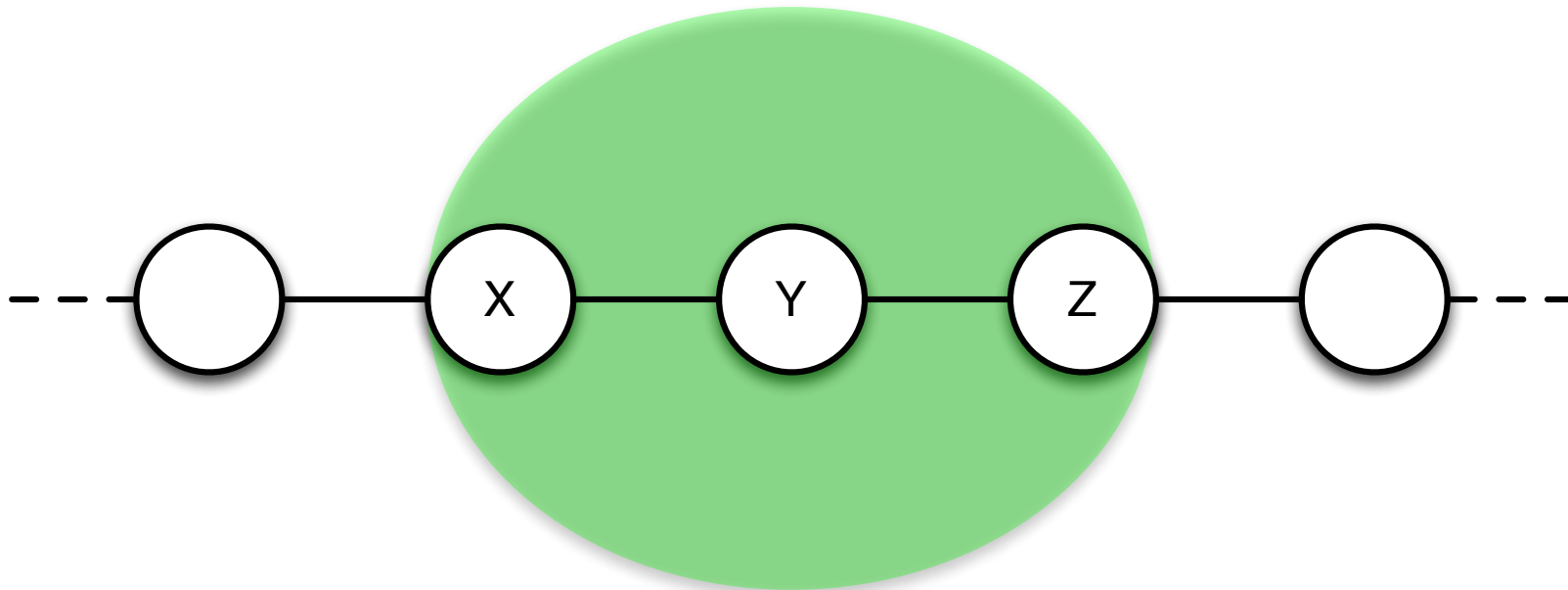


# Global Solution

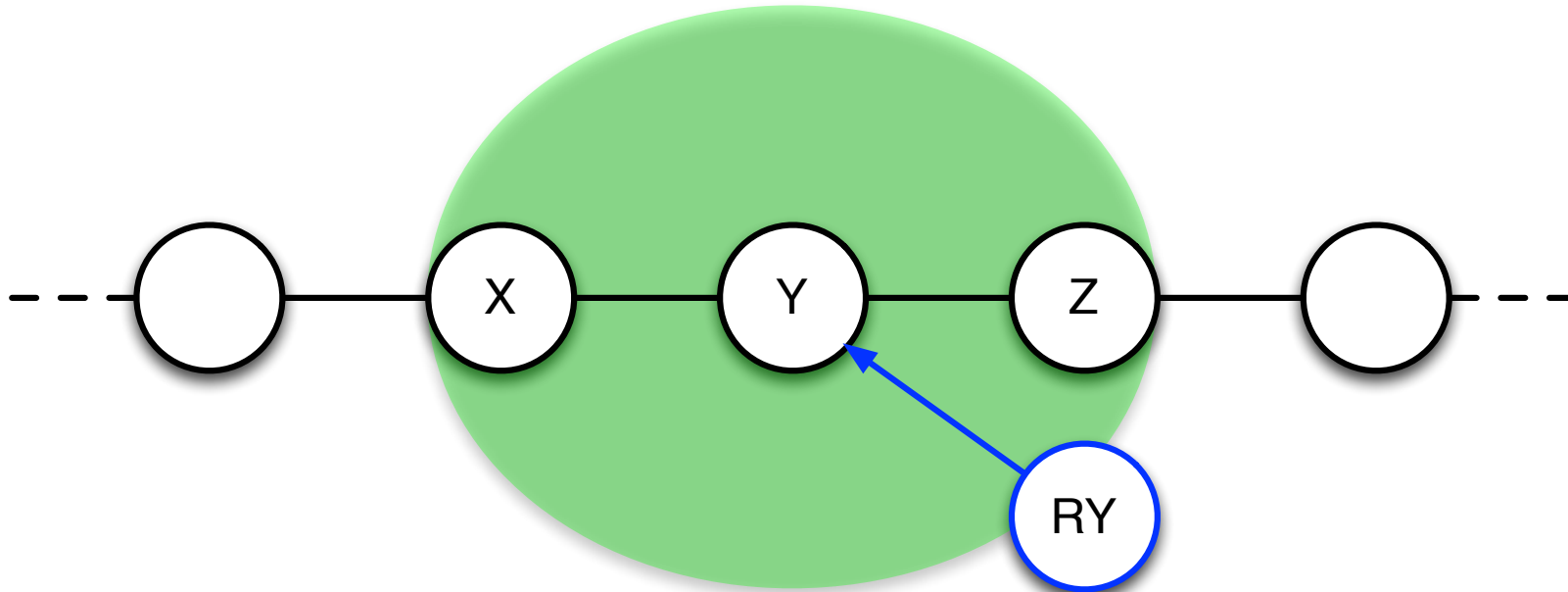
		Infinite and Unlimited
Adversarial		Impossible
Cooperative	Global	Possible
	Local	?

# Local Protocols

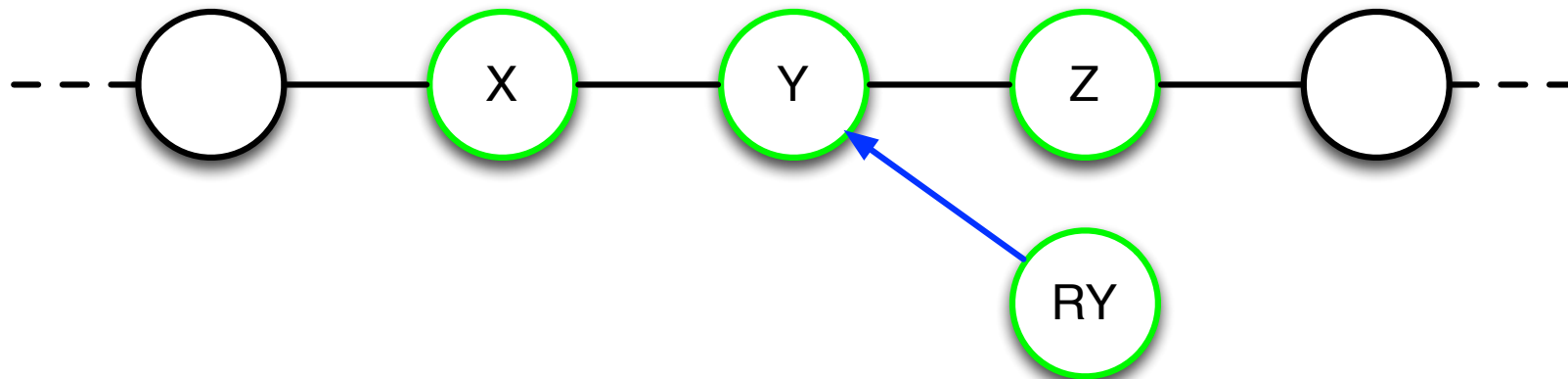
# Local Protocol



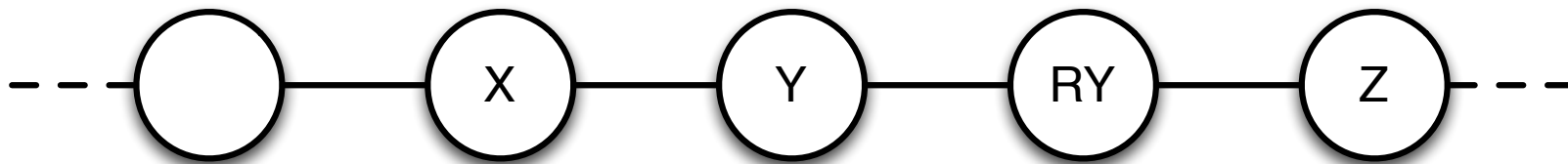
# Local Protocol



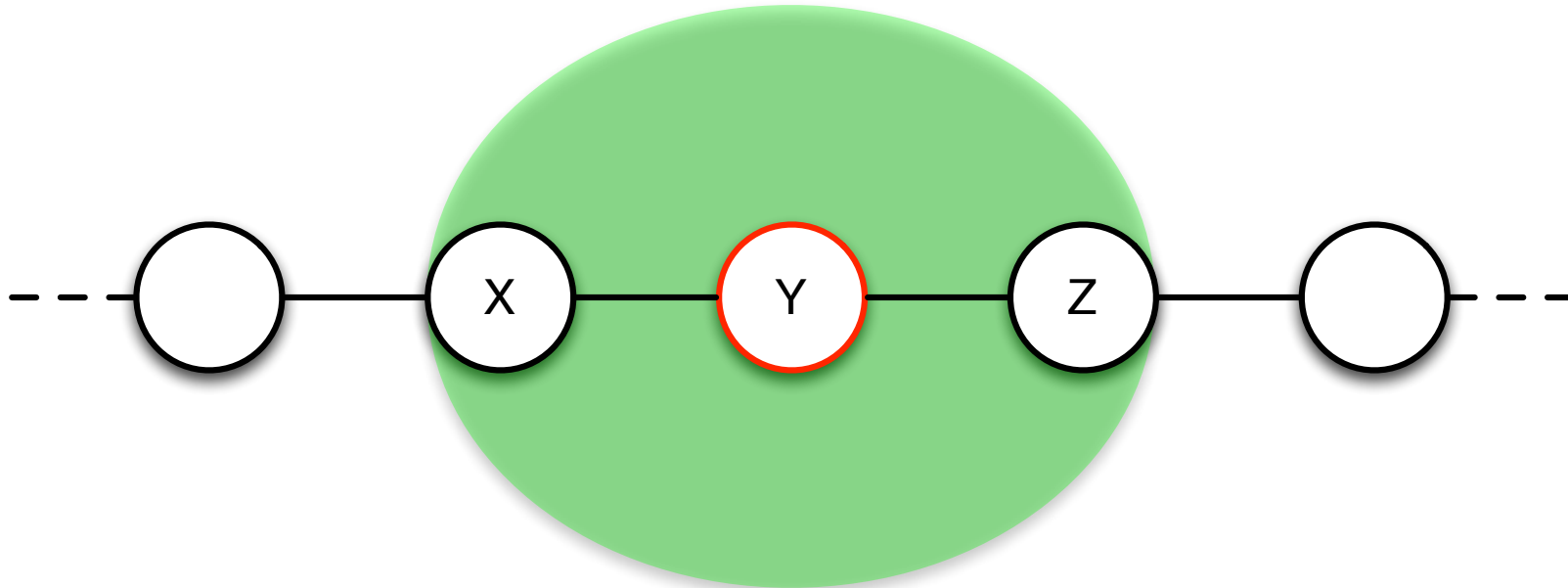
# Local Protocol Join



# Local Protocol Join

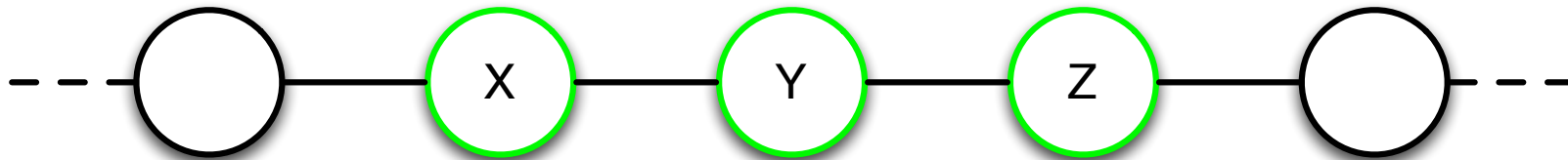


# Local Protocol Leave

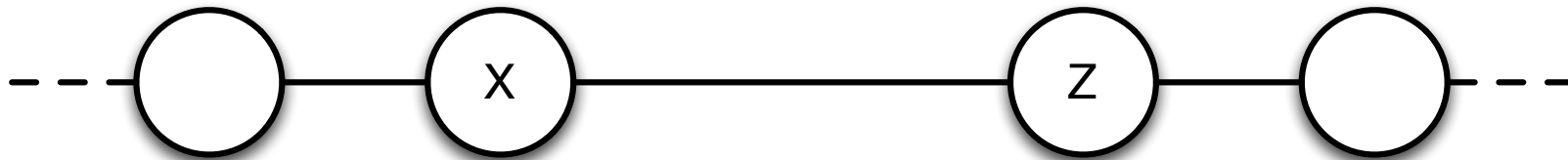




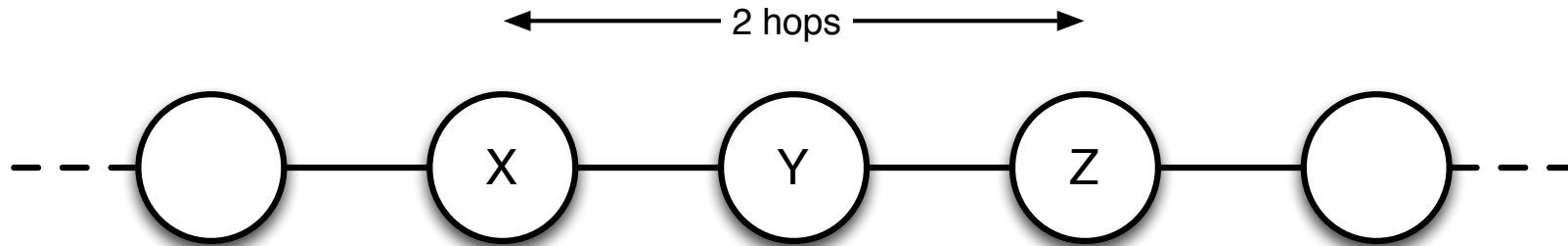
# Local Protocol Leave



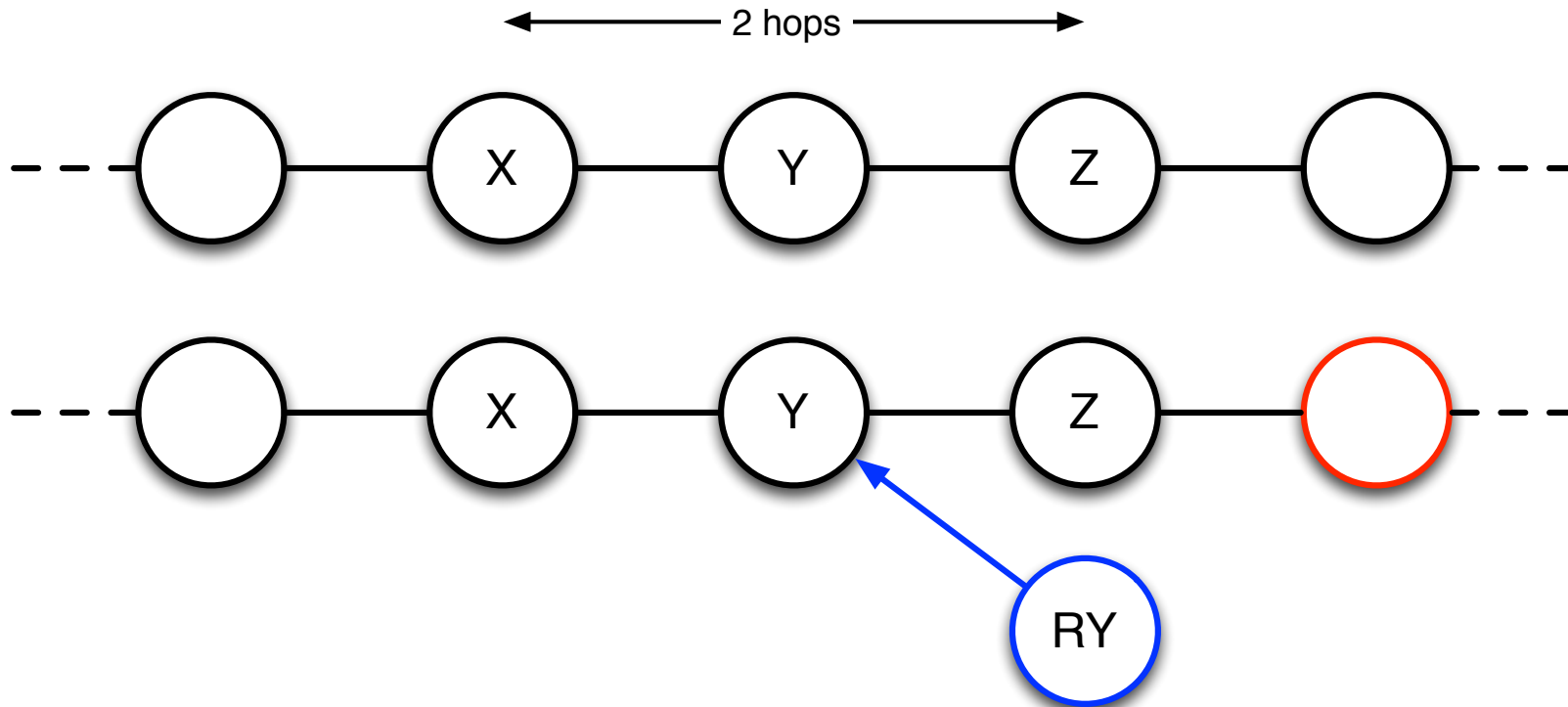
# Local Protocol Leave



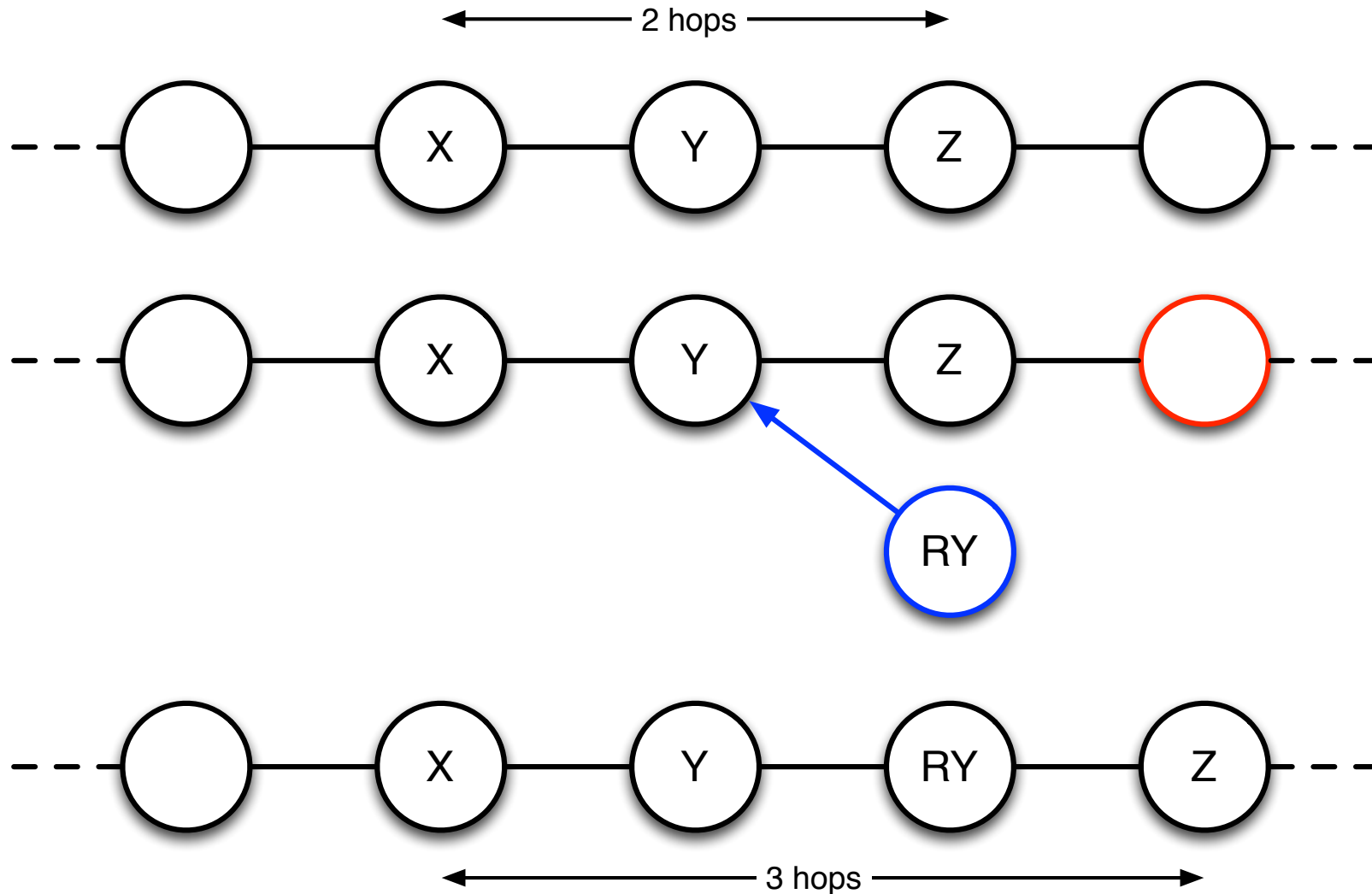
# Expansive Overlays



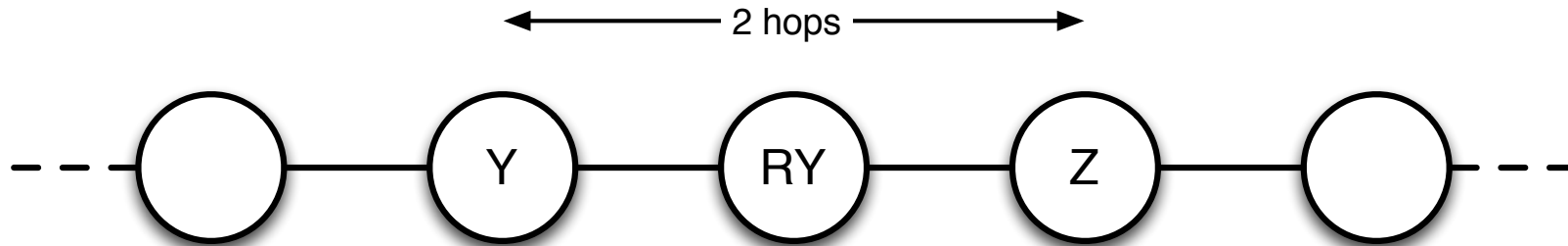
# Expansive Overlays



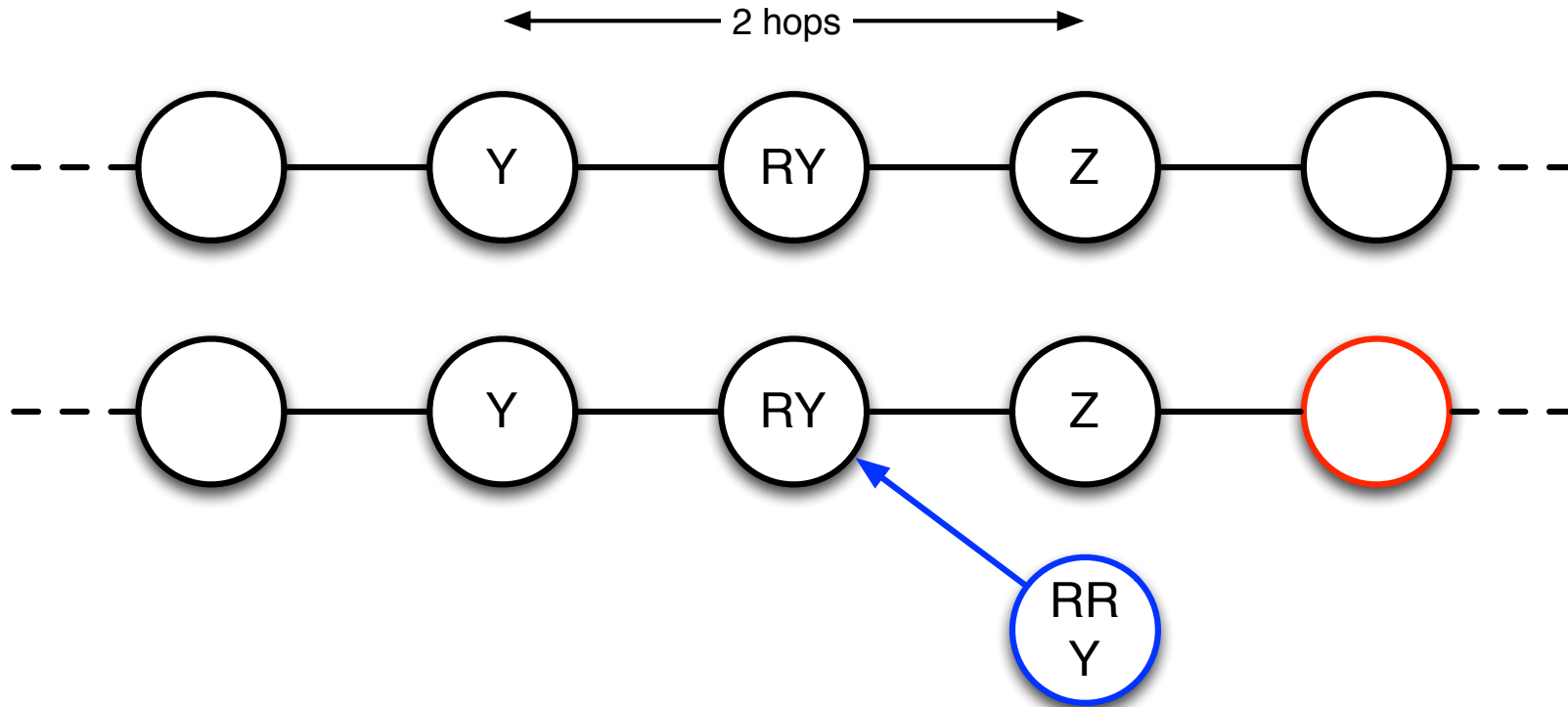
# Expansive Overlays



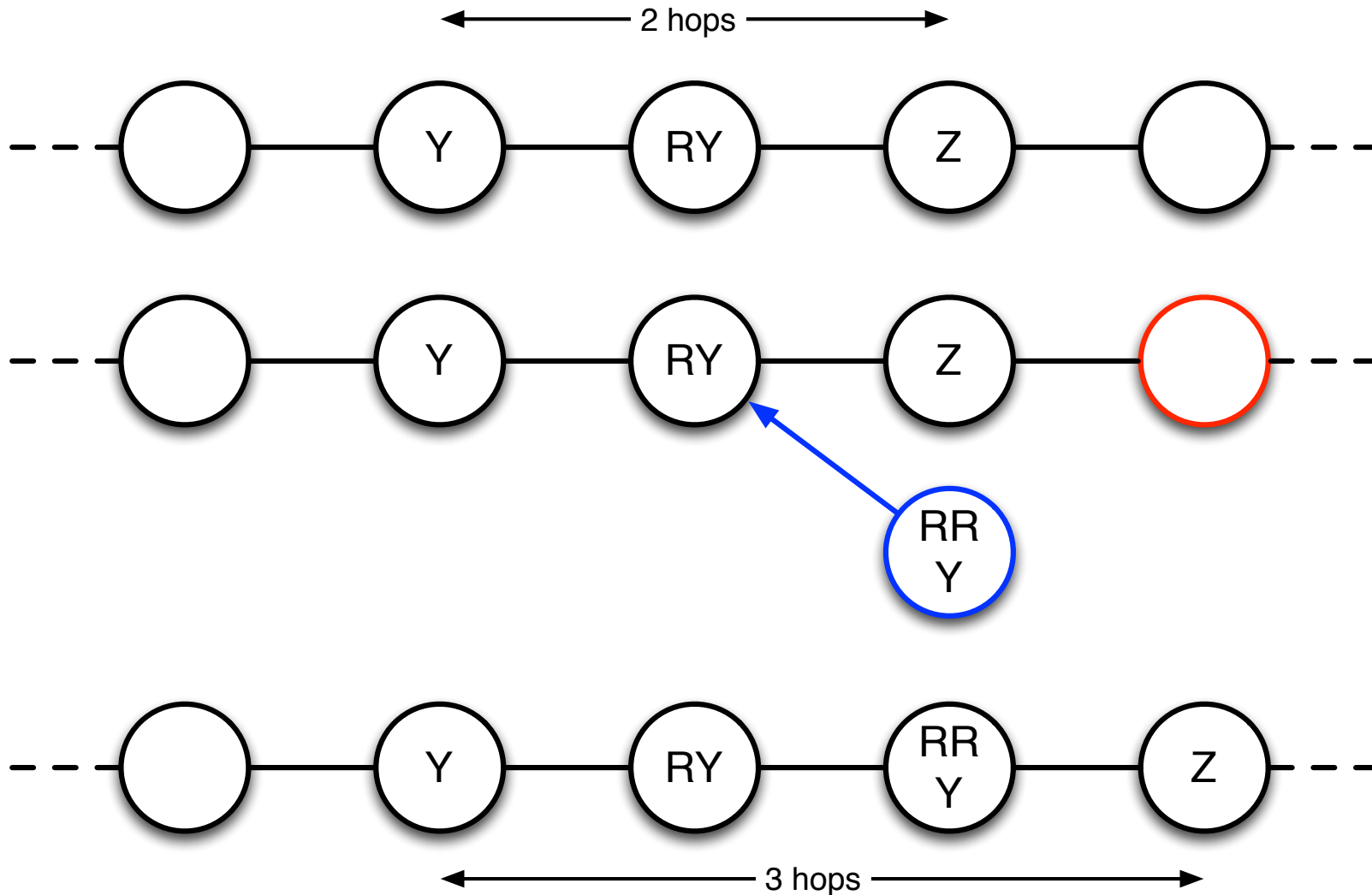
# Expansive Overlays



# Expansive Overlays



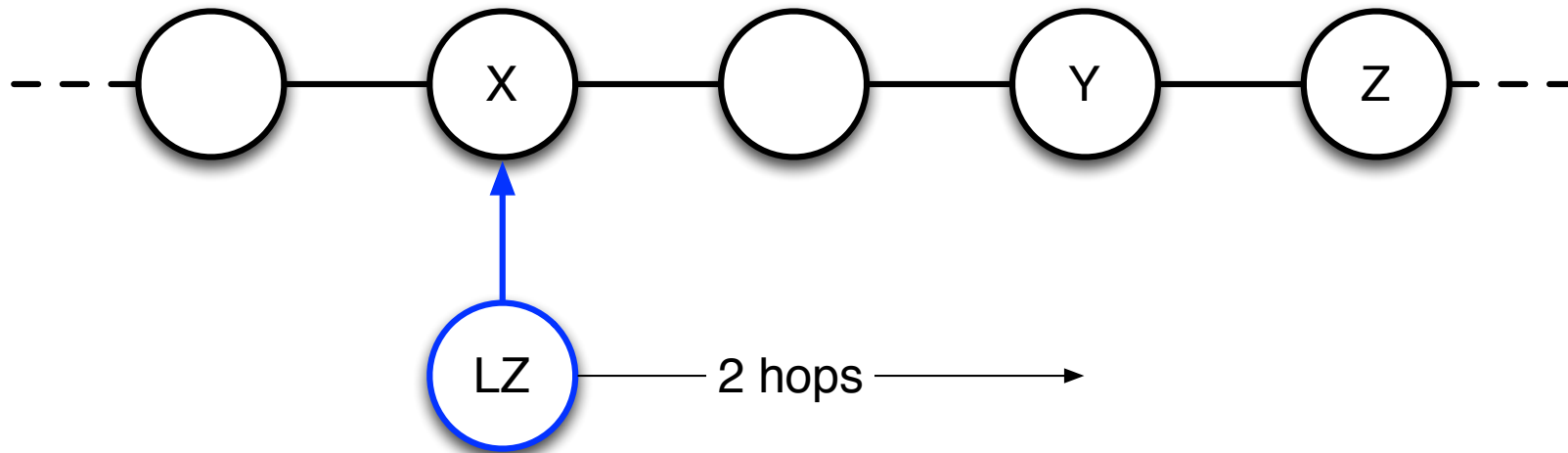
# Expansive Overlays



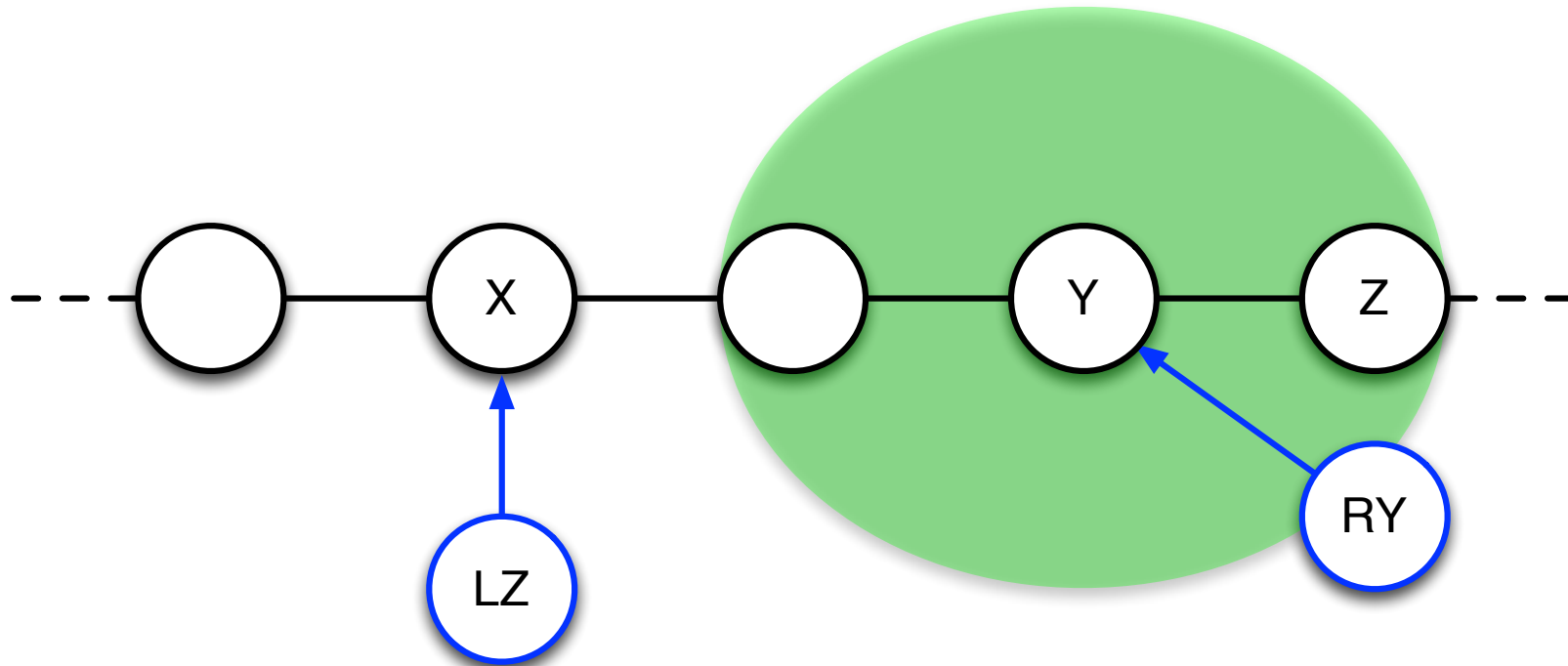


# **Fair vs. Unfair Protocols**

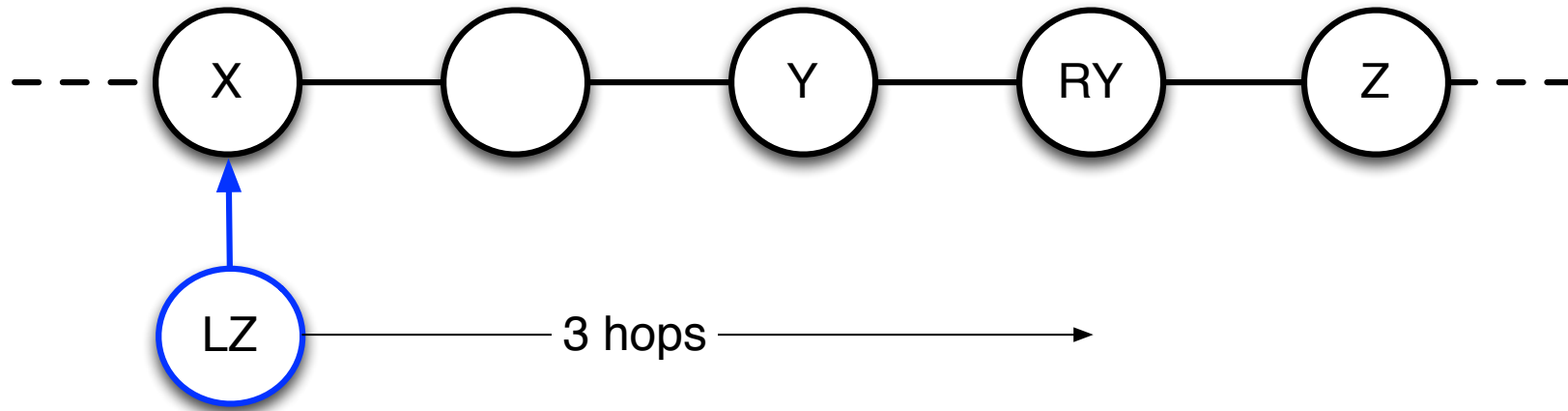
# Fair Local Protocols?



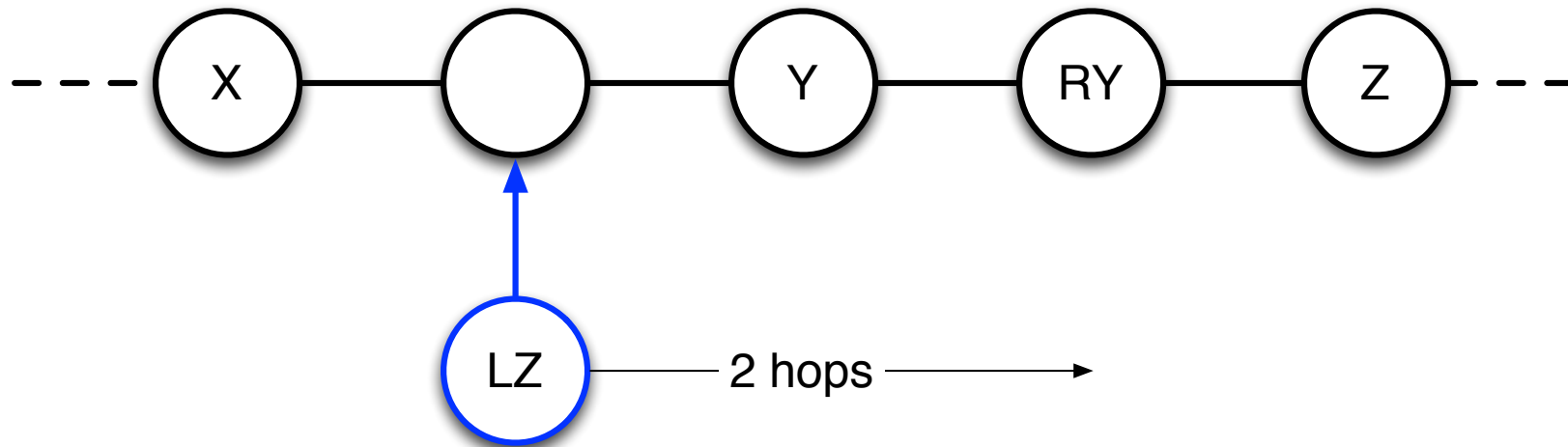
# Fair Local Protocols?



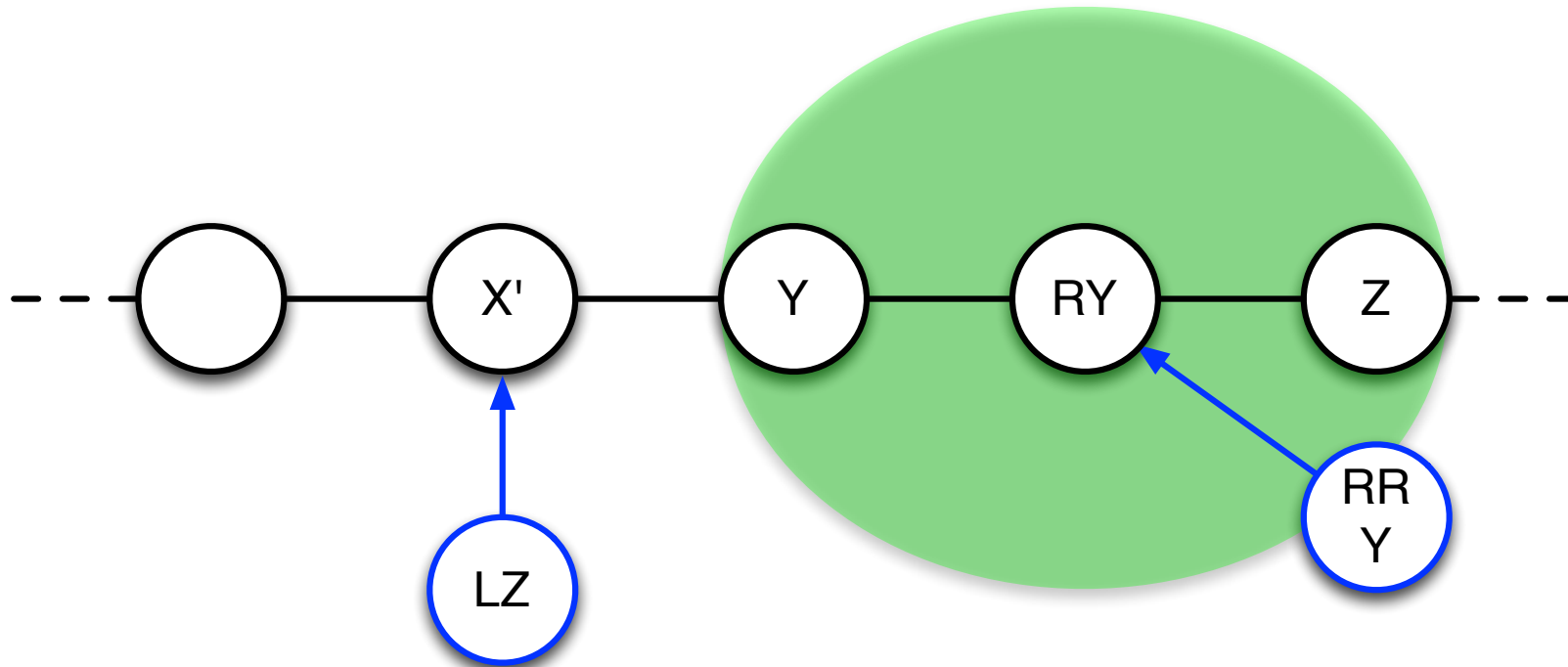
# Fair Local Protocols?



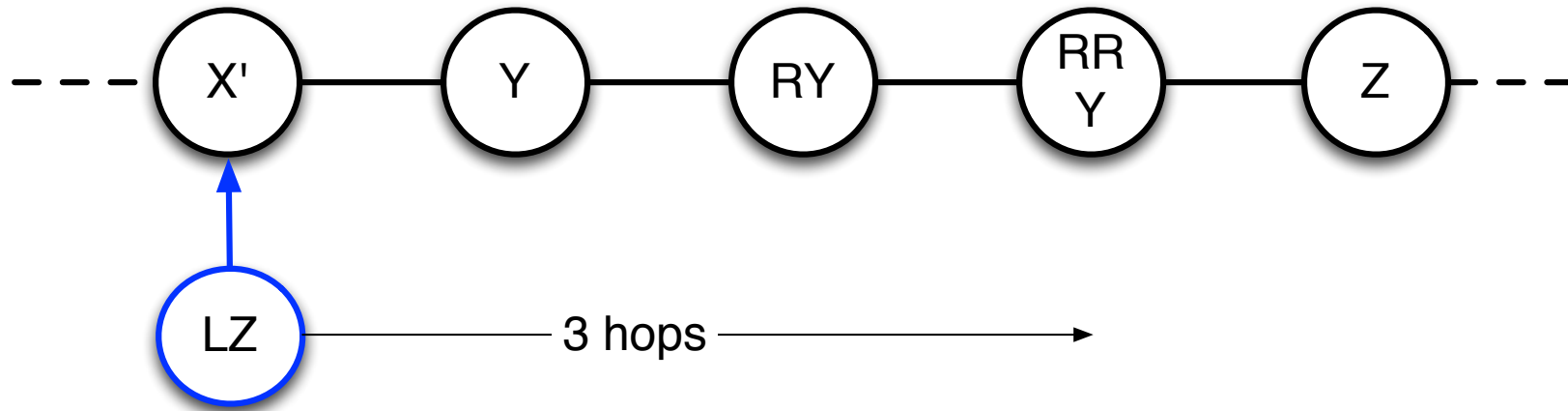
# Fair Local Protocols?



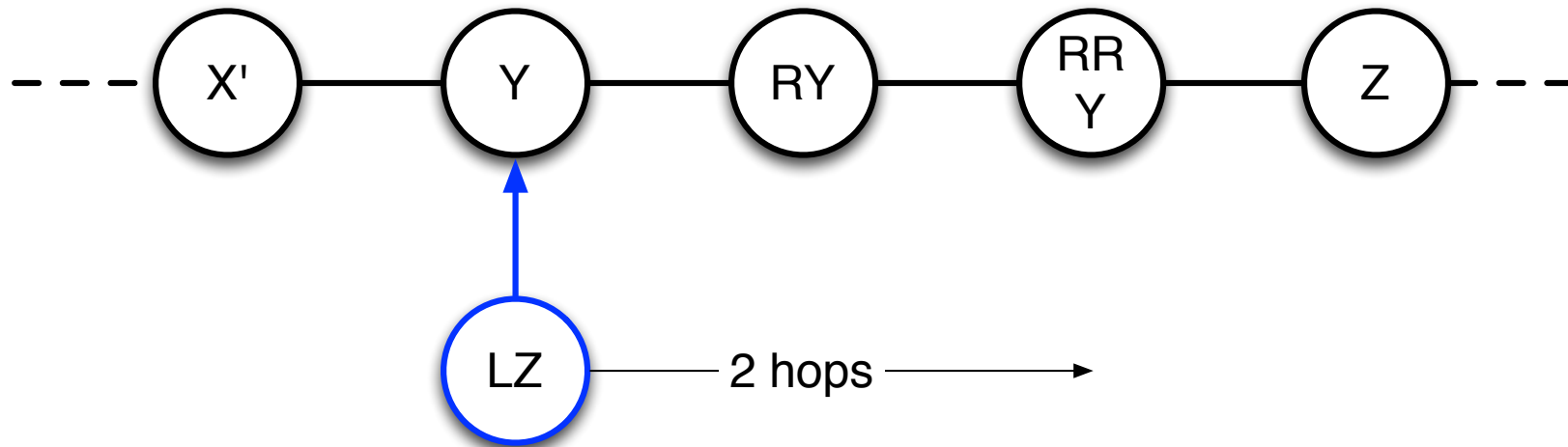
# Fair Local Protocols?



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# Fair Local Protocols?





# Fair Local Protocols?

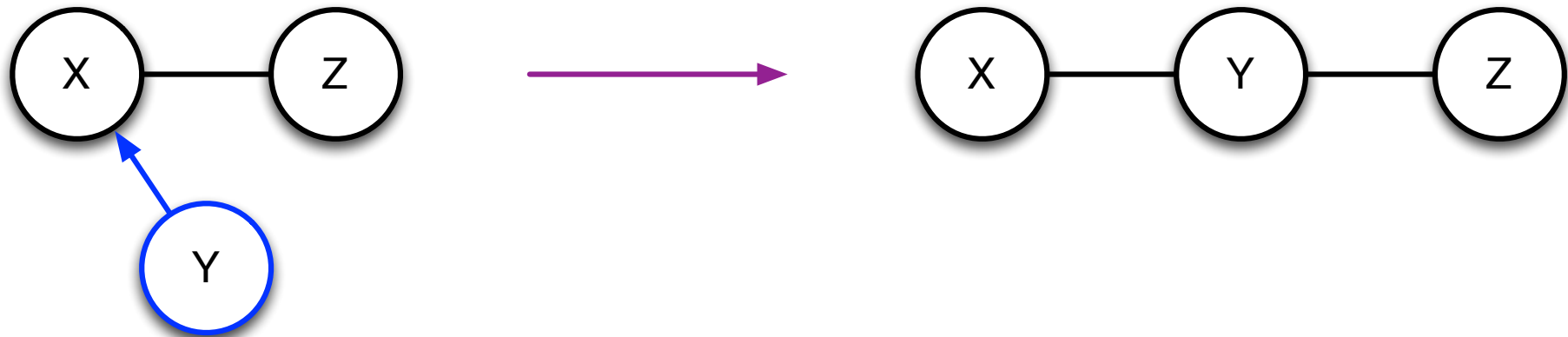
		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	?	Impossible	?	
	Unfair	?			

# Fair Local Protocols?

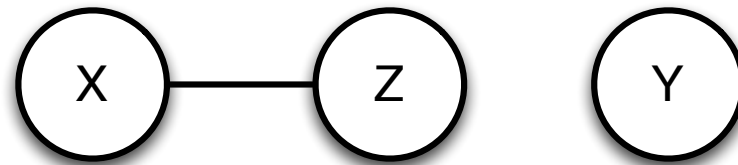
		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	?		Impossible	
	Unfair	?			

# Unfair Overlays

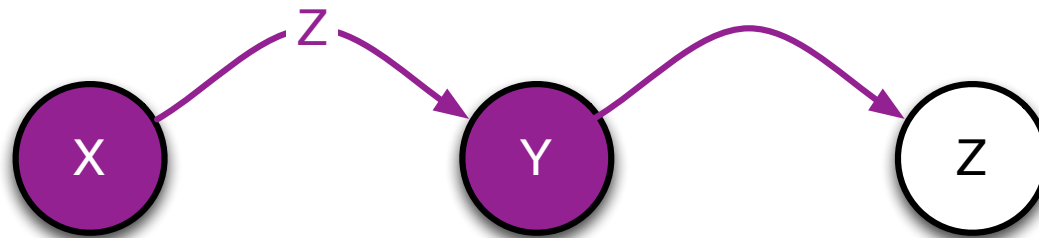
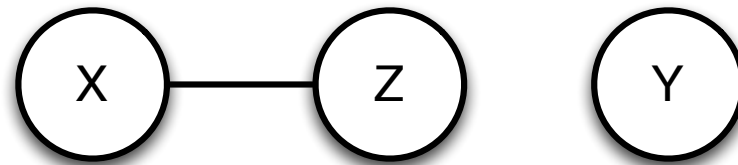
# Unfair Infinite Unlimited Linear Overlay



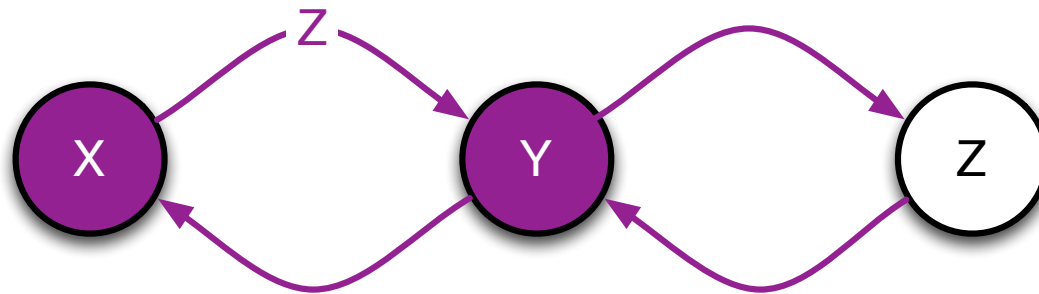
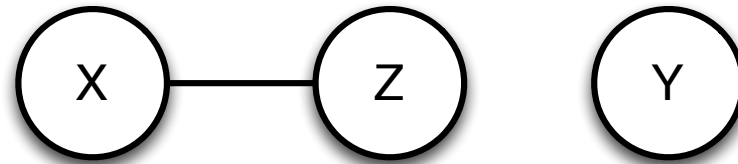
# Unfair Infinite Unlimited Linear Join



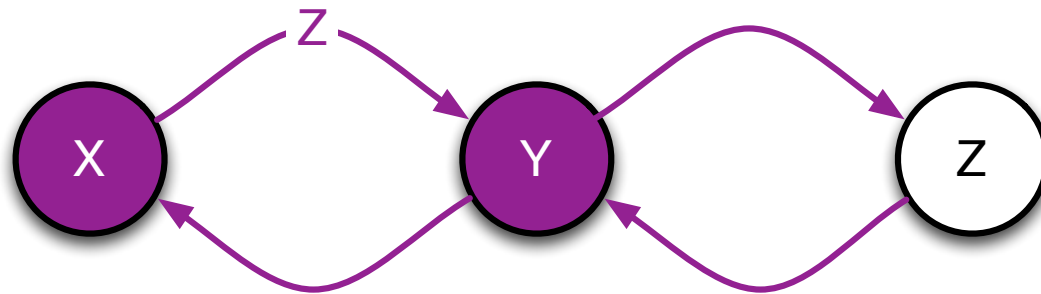
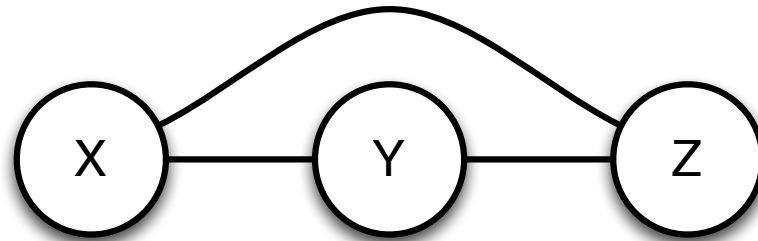
# Unfair Infinite Unlimited Linear Join



# Unfair Infinite Unlimited Linear Join

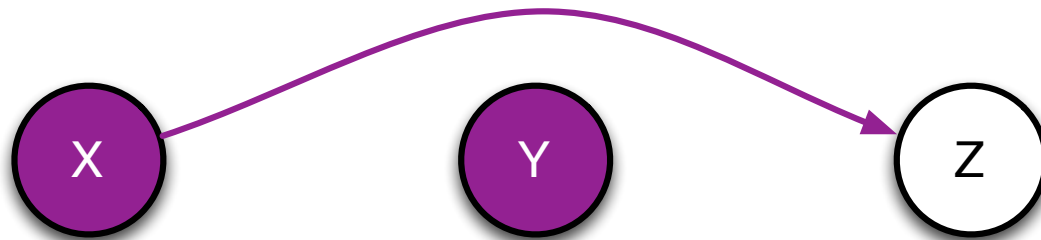
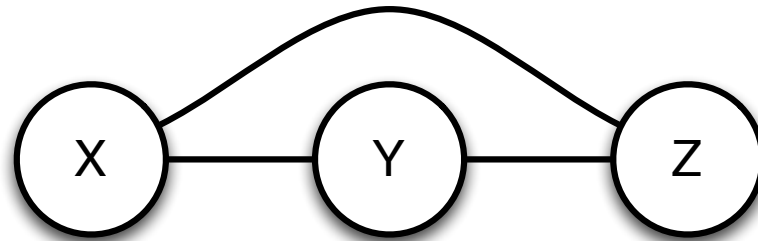


# Unfair Infinite Unlimited Linear Join

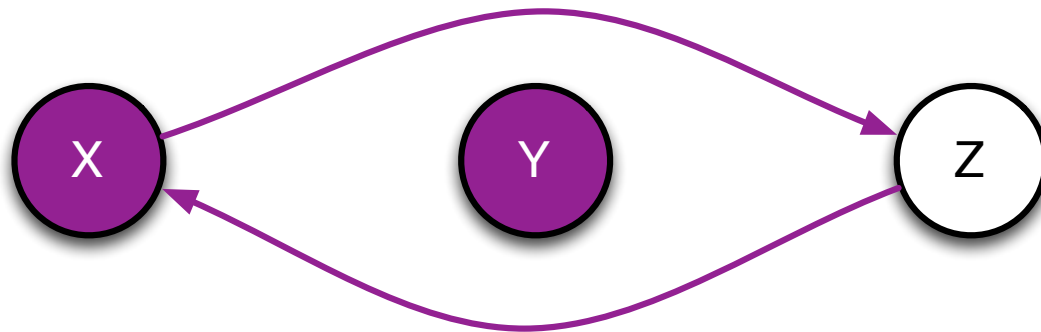
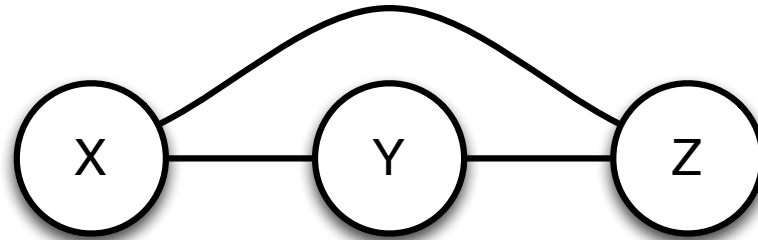




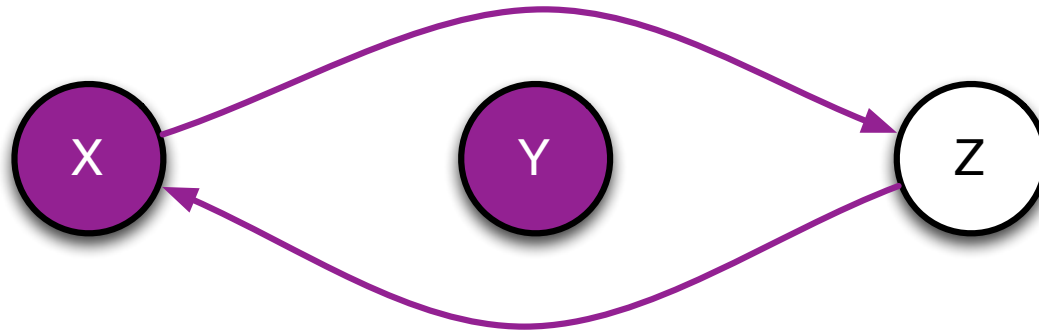
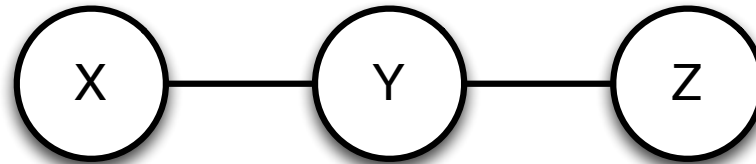
# Unfair Infinite Unlimited Linear Join



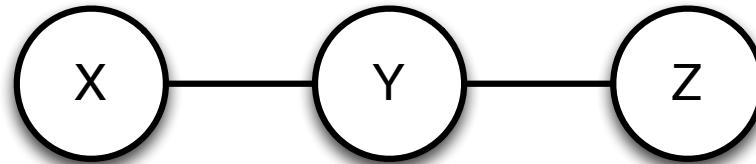
# Unfair Infinite Unlimited Linear Join



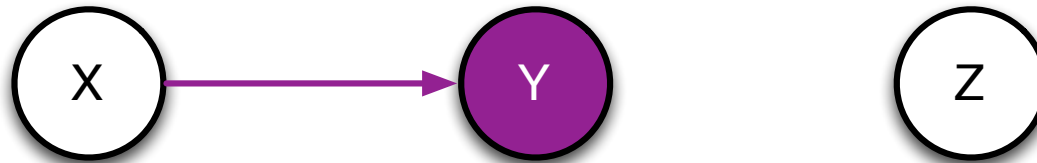
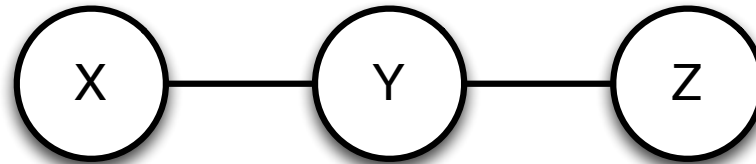
# Unfair Infinite Unlimited Linear Join



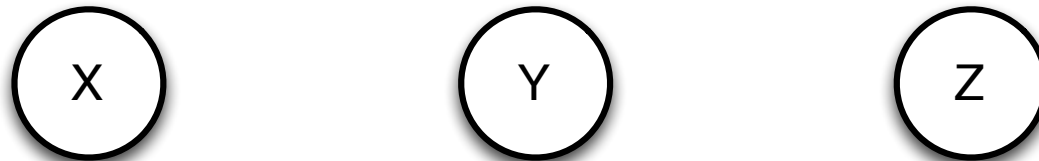
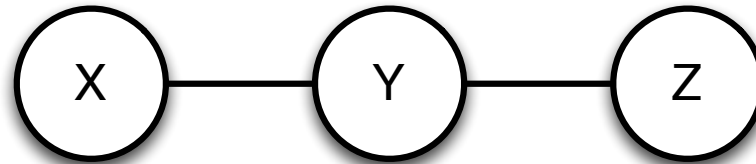
# Unfair Infinite Unlimited Linear Join



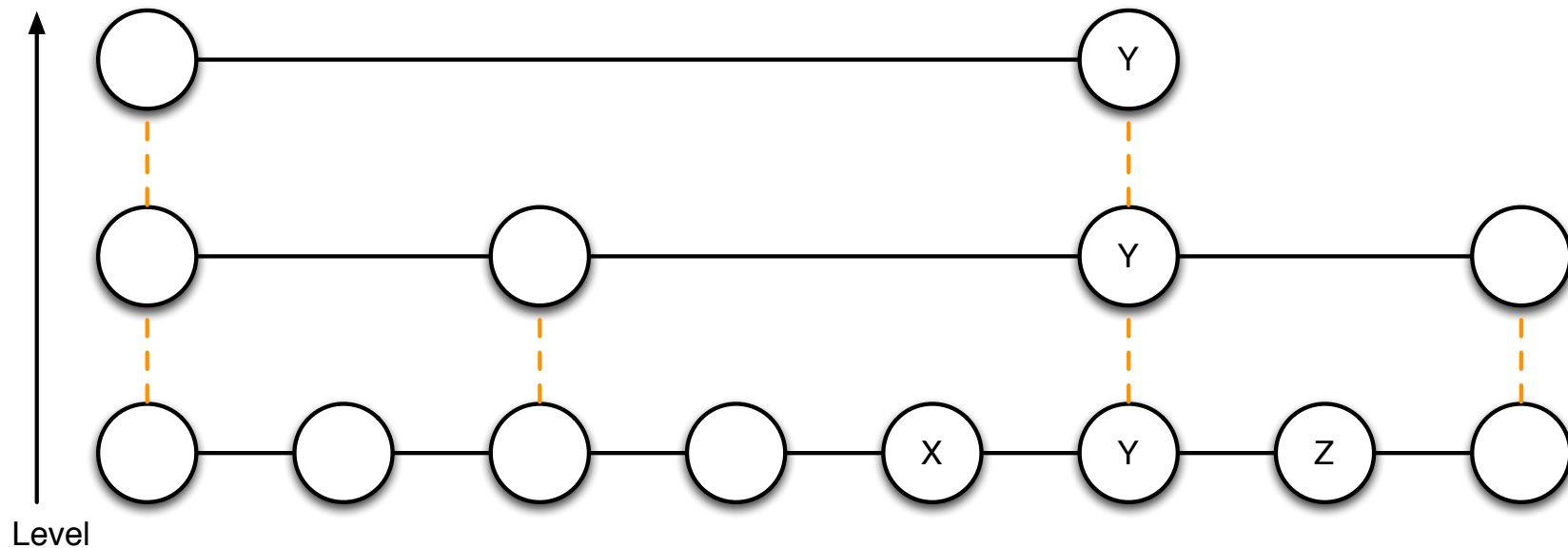
# Unfair Infinite Unlimited Linear Join



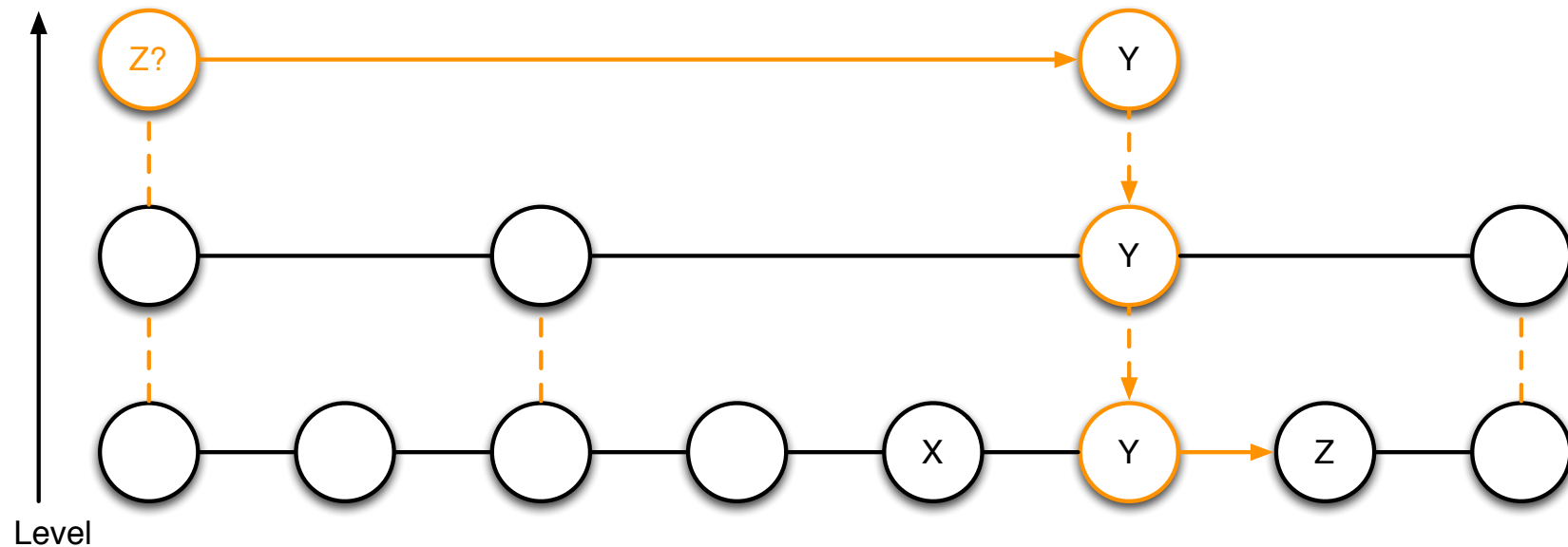
# Unfair Infinite Unlimited Linear Join



# Unfair Infinite Unlimited 1-2 Skip List Overlay



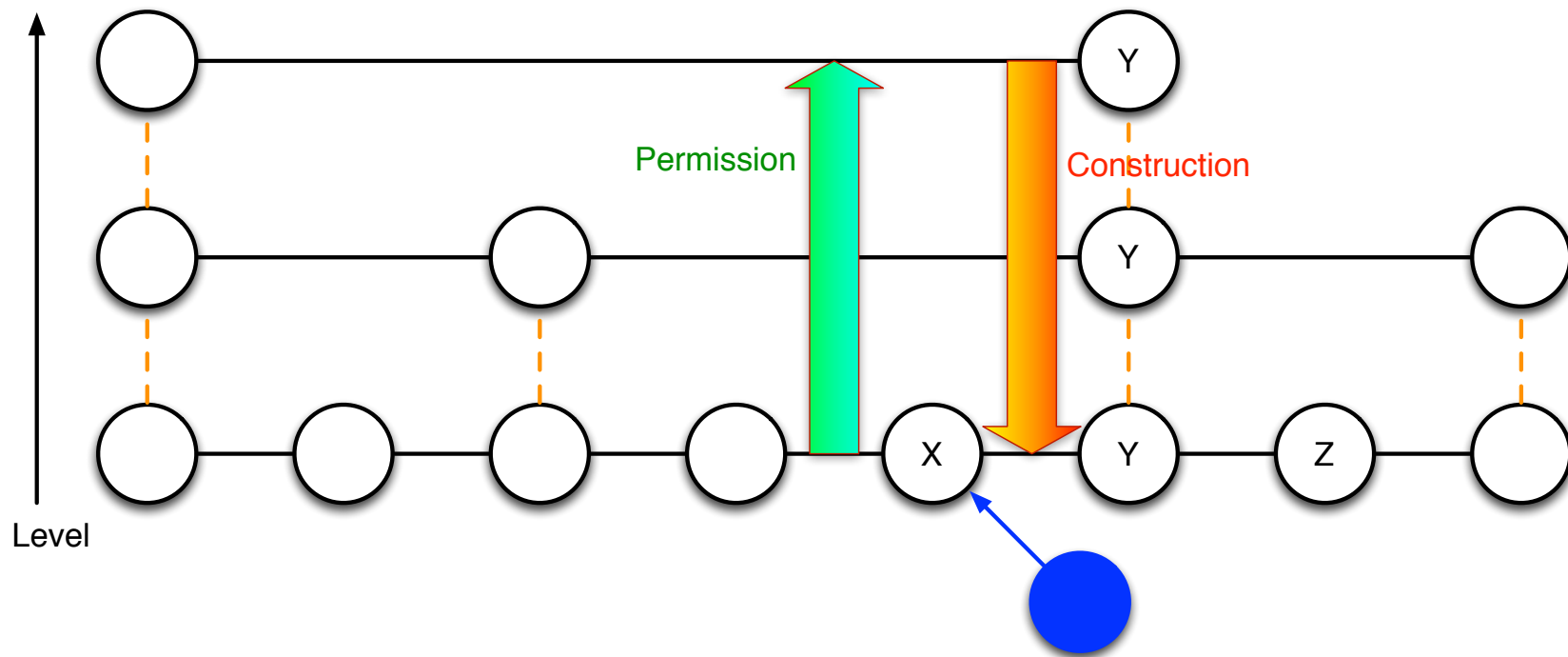
# Unfair Infinite Unlimited 1-2 Skip List Overlay





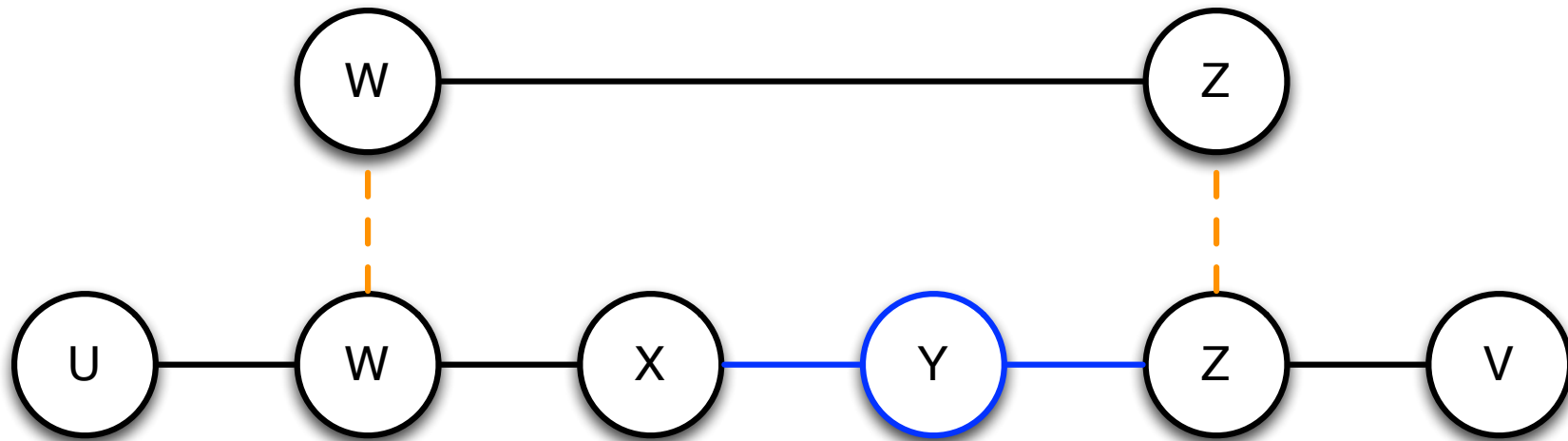
# Unfair Infinite Unlimited

## 1-2 Skip List Join



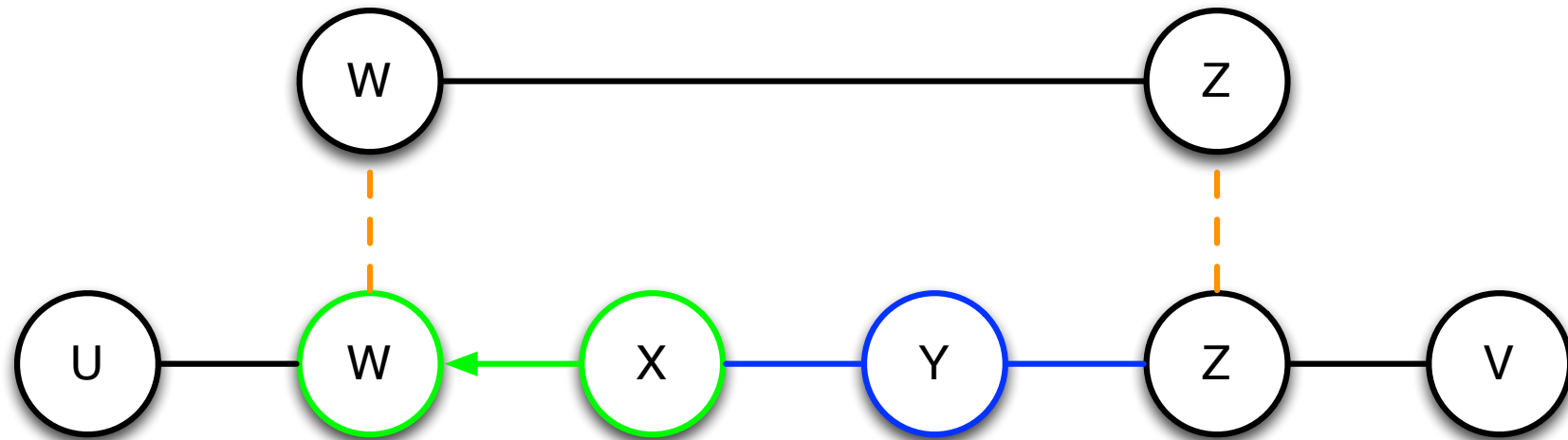
# Unfair Infinite Unlimited

## 1-2 Skip List Join (1/5)



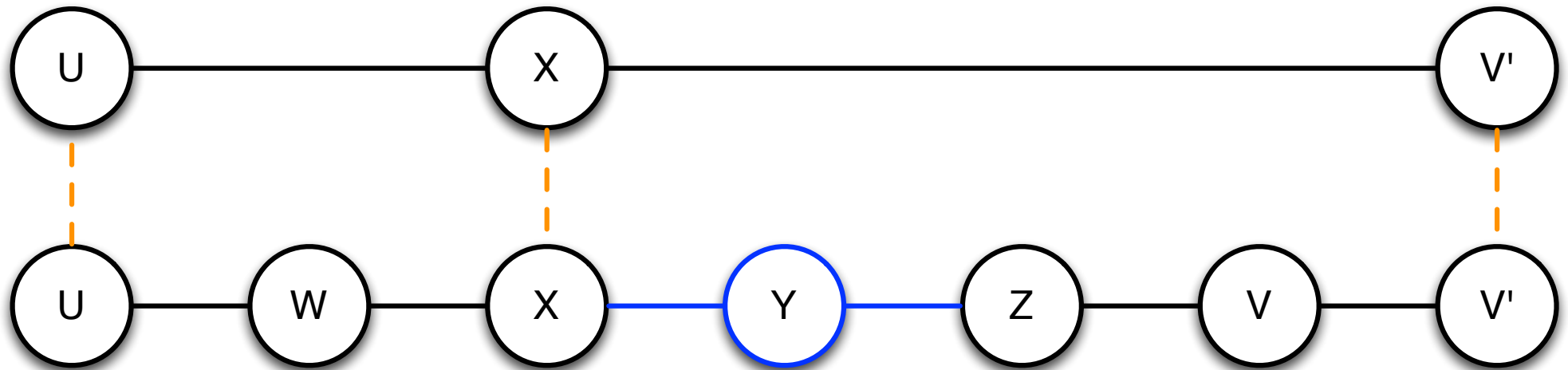
# Unfair Infinite Unlimited

## 1-2 Skip List Join (1/5)



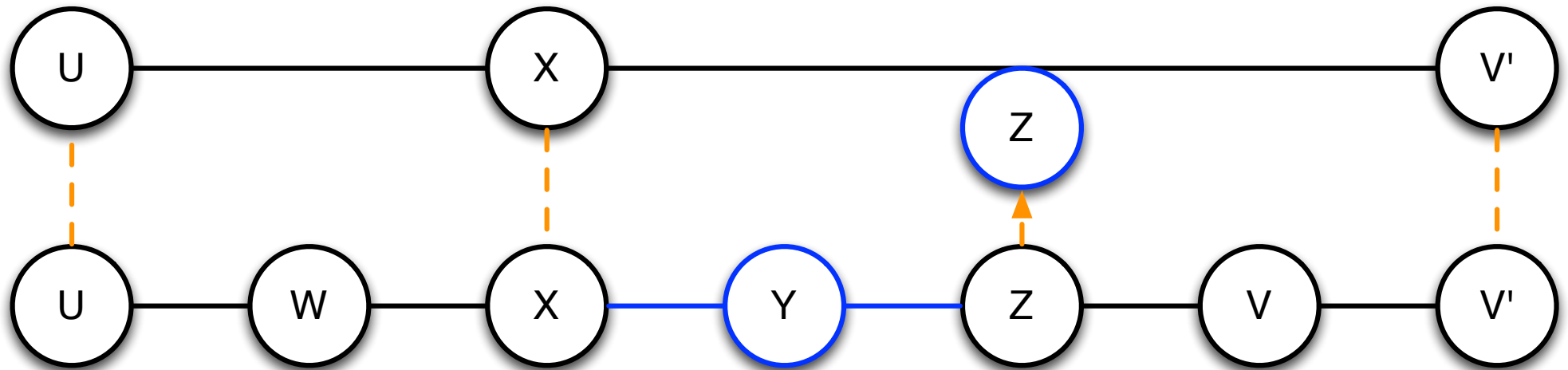
# Unfair Infinite Unlimited

## 1-2 Skip List Join (2/5)



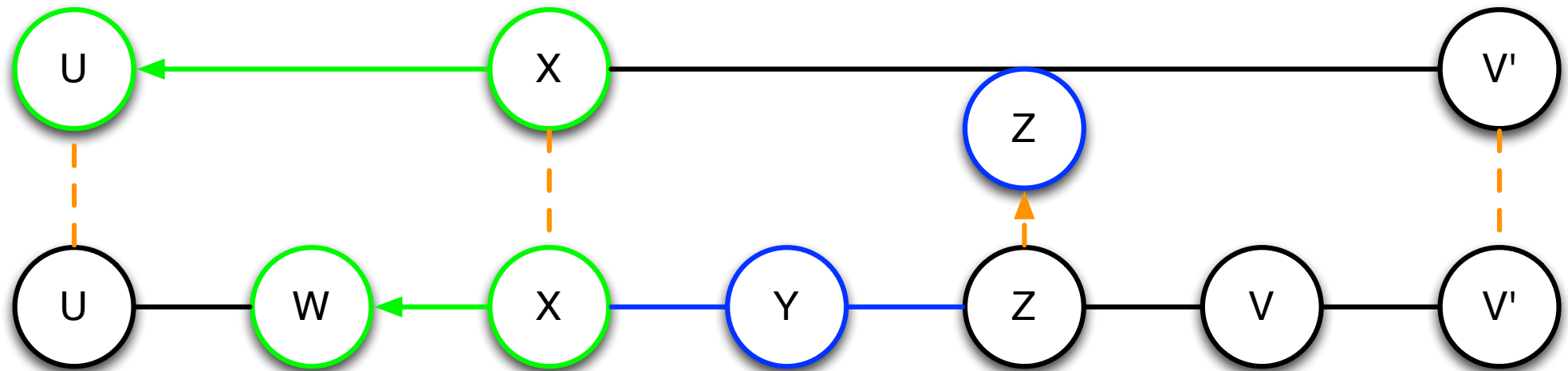
# Unfair Infinite Unlimited

## 1-2 Skip List Join (2/5)



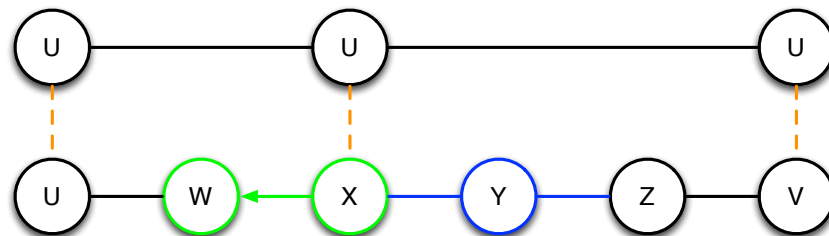
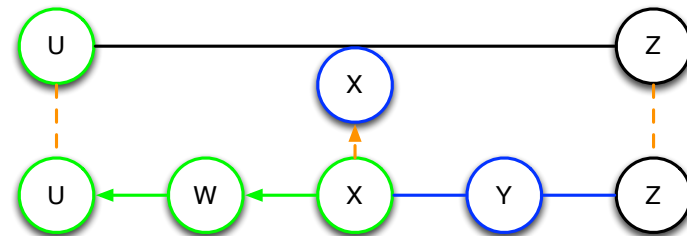
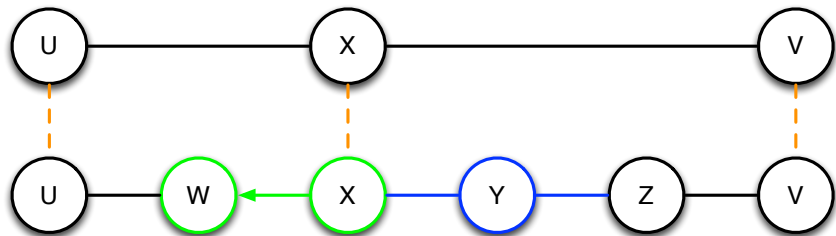
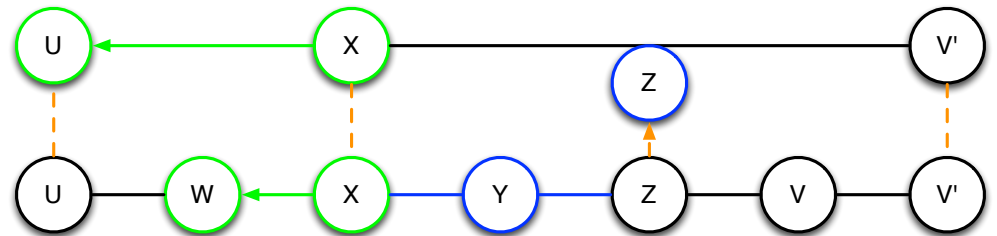
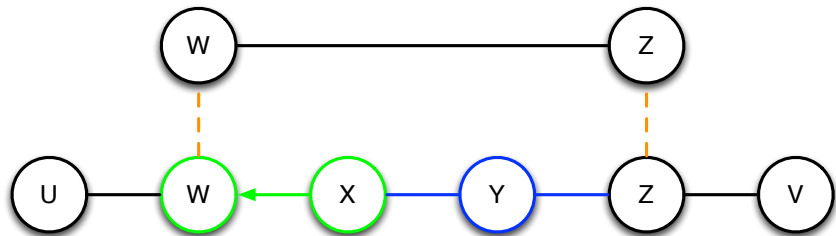
# Unfair Infinite Unlimited

## 1-2 Skip List Join (2/5)



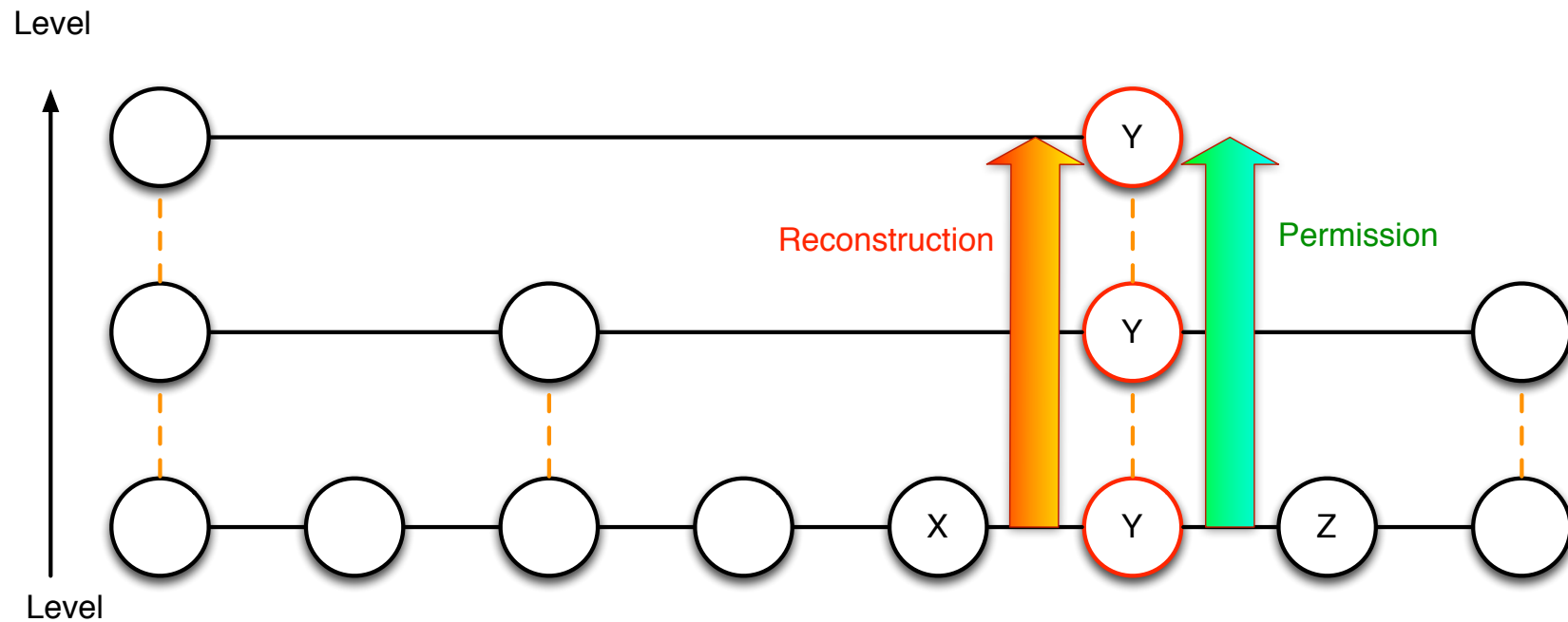
# Unfair Infinite Unlimited

## 1-2 Skip List Join



# Unfair Infinite Unlimited

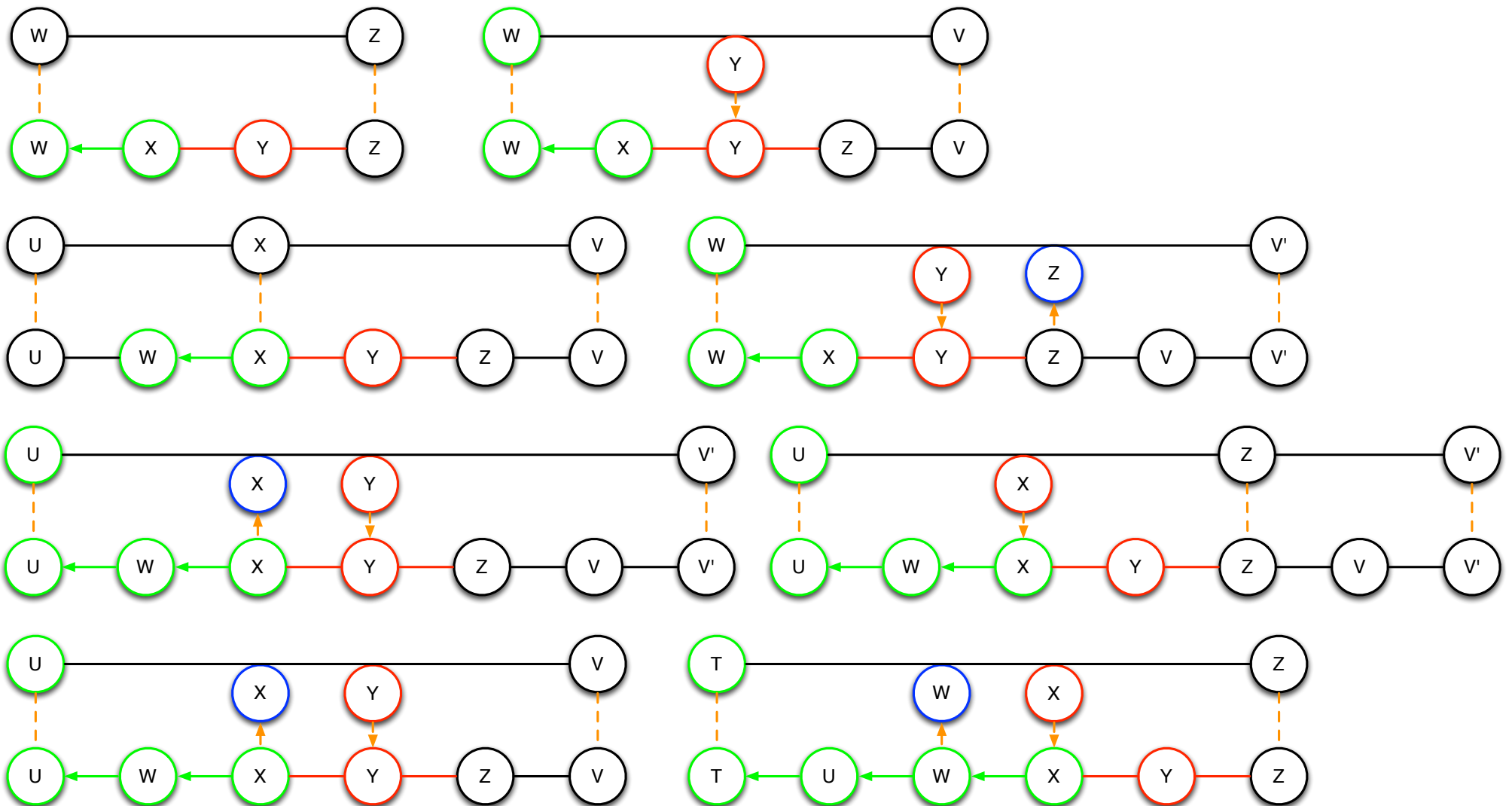
## 1-2 Skip List Leaf





# Unfair Infinite Unlimited

## 1-2 Skip List Leave



# Unfair Infinite Unlimited

## 1-2 Skip List

		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	?		Impossible	
	Unfair	?			Possible

# Unfair Infinite Unlimited

## 1-2 Skip List

		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	?		Impossible	
	Unfair	?		Possible	

# Unfair Infinite Unlimited

## 1-2 Skip List

		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	?		Impossible	
	Unfair	Possible			

# Unfair Infinite Unlimited

## 1-2 Skip List

		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	Possible		Impossible	
	Unfair	Possible			

**Conclusion**

# Churn Possibilities and Impossibilities

		Finite		Infinite	
		Limited	Unlimited	Limited	Unlimited
Global		Possible			
Local	Fair	Possible		Impossible	
	Unfair	Possible			

# Open Questions

- **Other topologies:**
  - 2-3 skip list,
  - Chord, ...
- **Practical impact of unfairness**



**Thank You**