

# **Stochastic Optimization Models for Virtual Content Delivery Network Planning**

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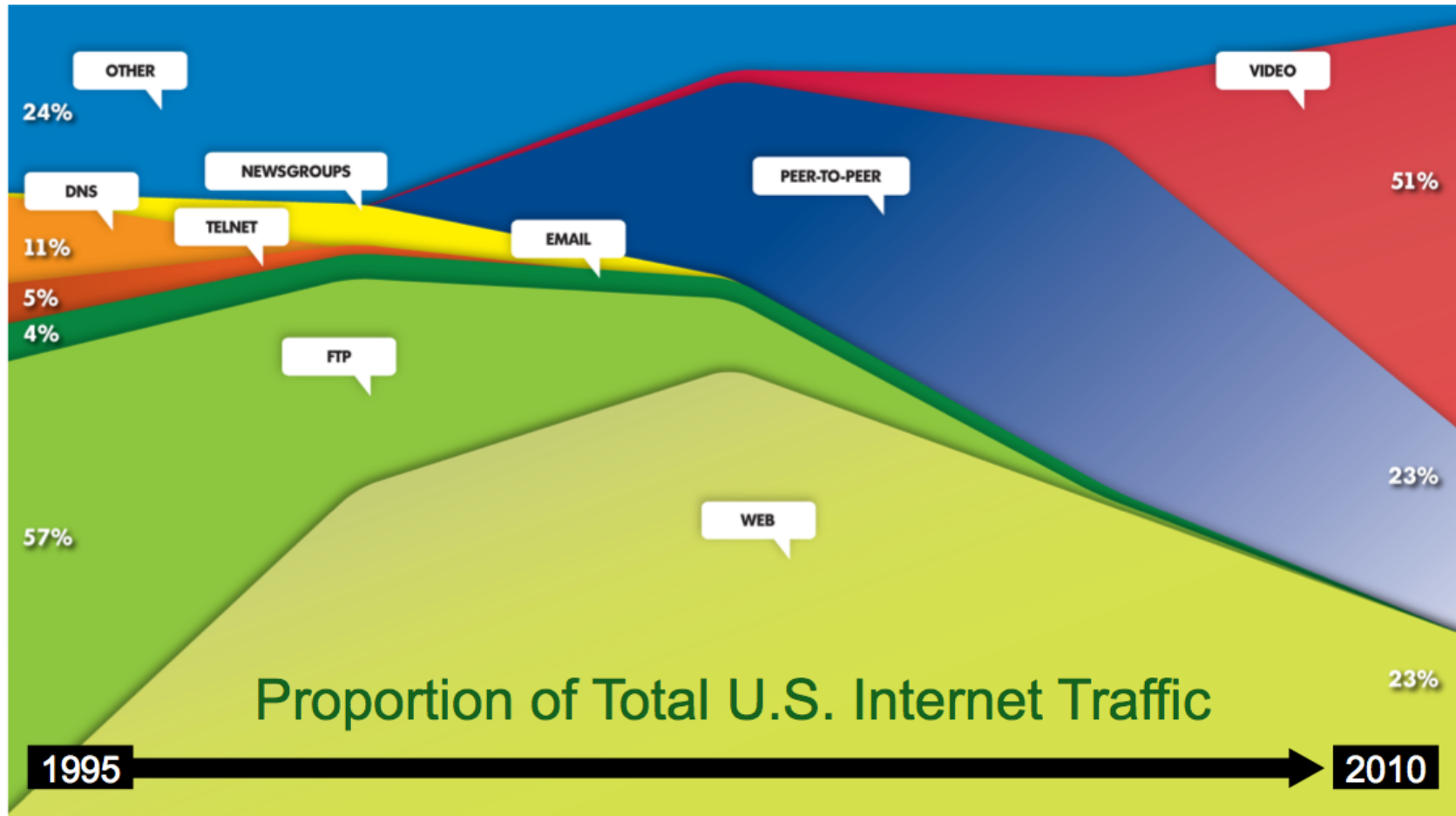
Fabio Martignon

# Outline of the Presentation

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1. Introduction
2. Stochastic Planning for vCDN on NFV
  - System Model
  - Two-stage Stochastic Optimization Model
  - Solution Methods
3. Numerical Results
4. Conclusion

# Traffic Trends: The Past & The Present



Limelight Networks – Investor Overview – Nov. 2012

# Traffic Trends: The Past & The Present

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OTHER

VIDEO

Users nowadays exploit Internet as a  
**Content Distribution Infrastructure!**

*A usage scenario that is very different compared to the original design goals that drove the engineering of the Internet Protocol...*

In fact, IP is focused on the **two end-points**, since it was designed in the late 60's to share computational resources available remotely

Proportion of Total U.S. Internet Traffic

23%

1995

2010

# Introduction

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- **Network Functions Virtualization (NFV)**
  - Network functions executed in a *virtualized environment*, on a *shared physical infrastructure*
  - Physical infrastructure is made of *industry standard high volume servers, storage and switches*

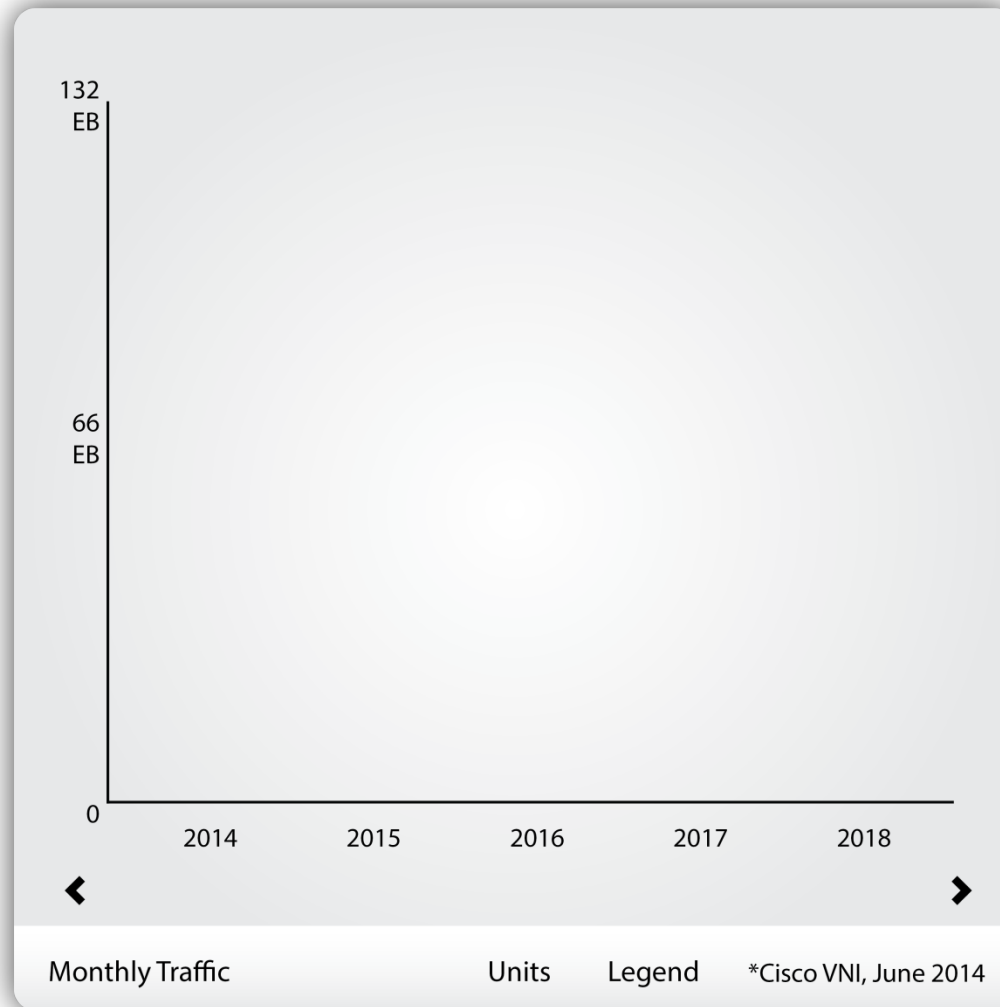
# Introduction

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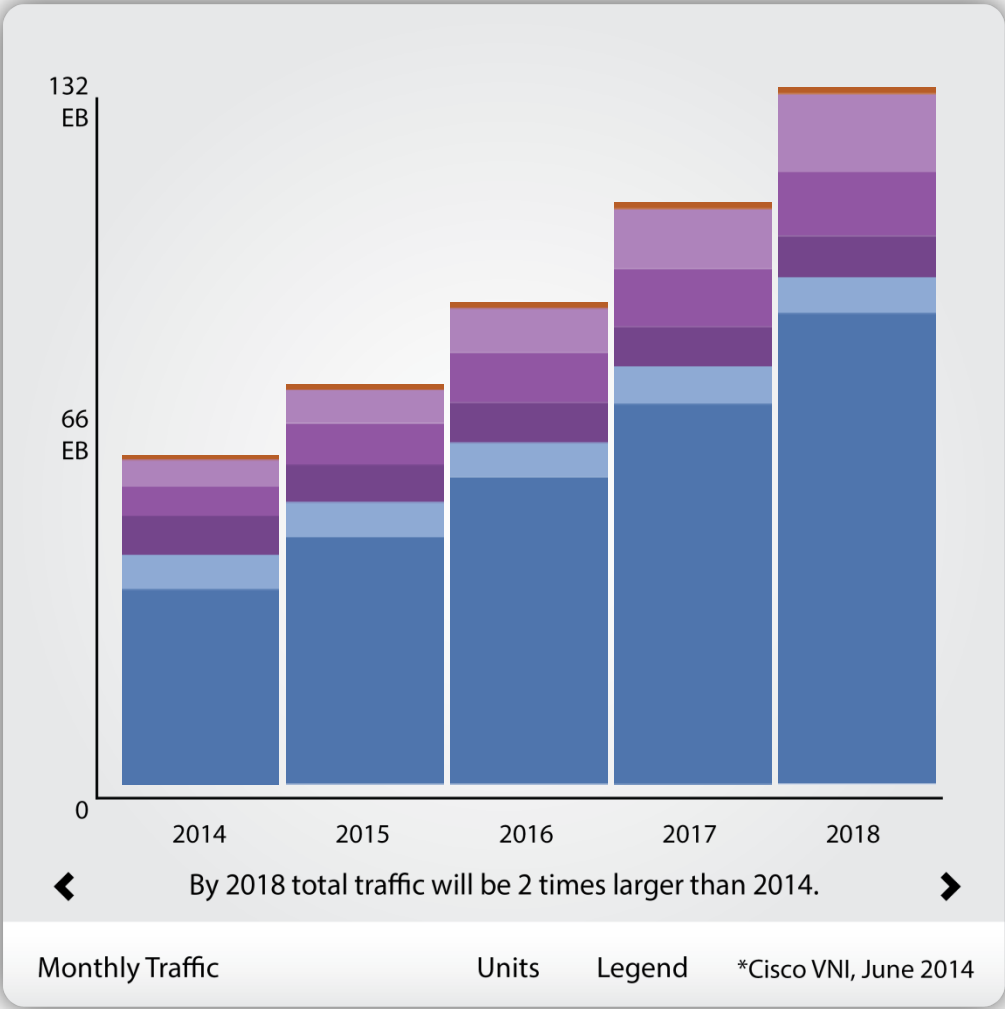
- **Network Functions Virtualization (NFV)**
  - Network functions executed in a *virtualized environment*, on a *shared physical infrastructure*
  - Physical infrastructure is made of *industry standard high volume servers, storage and switches*
  
- One of the use cases for NFV:  
**Virtual Content Delivery Network (vCDN)**
  - We tackle the *optimal network planning* problem for a vCDN

# Traffic Demand Forecasts

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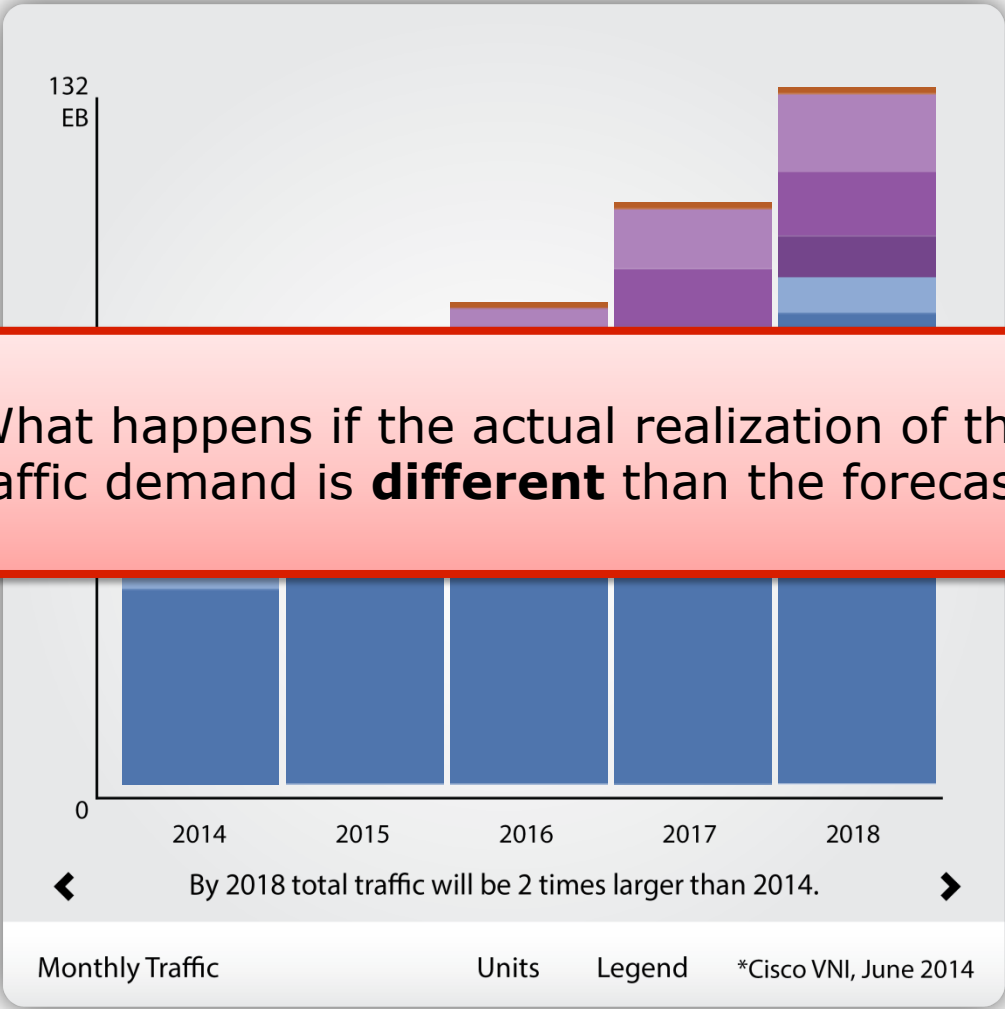


# Traffic Demand Forecasts

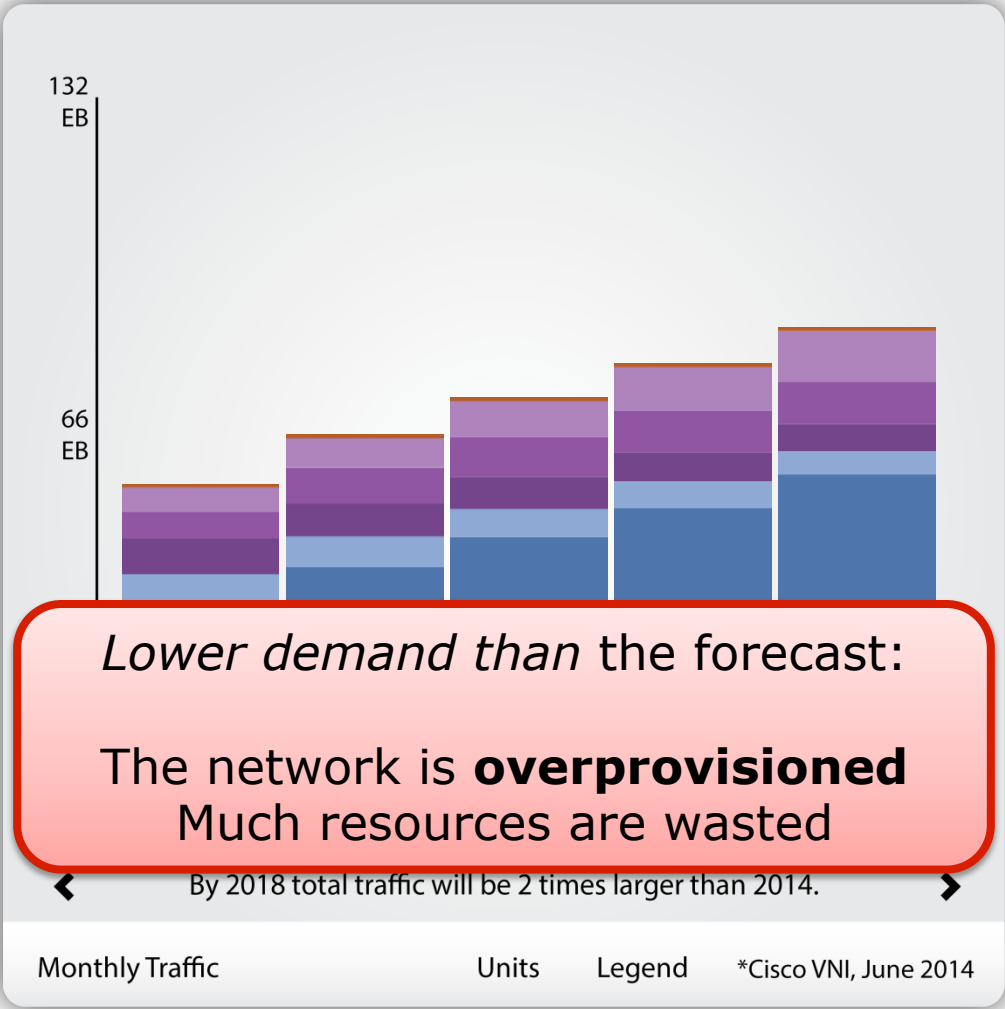




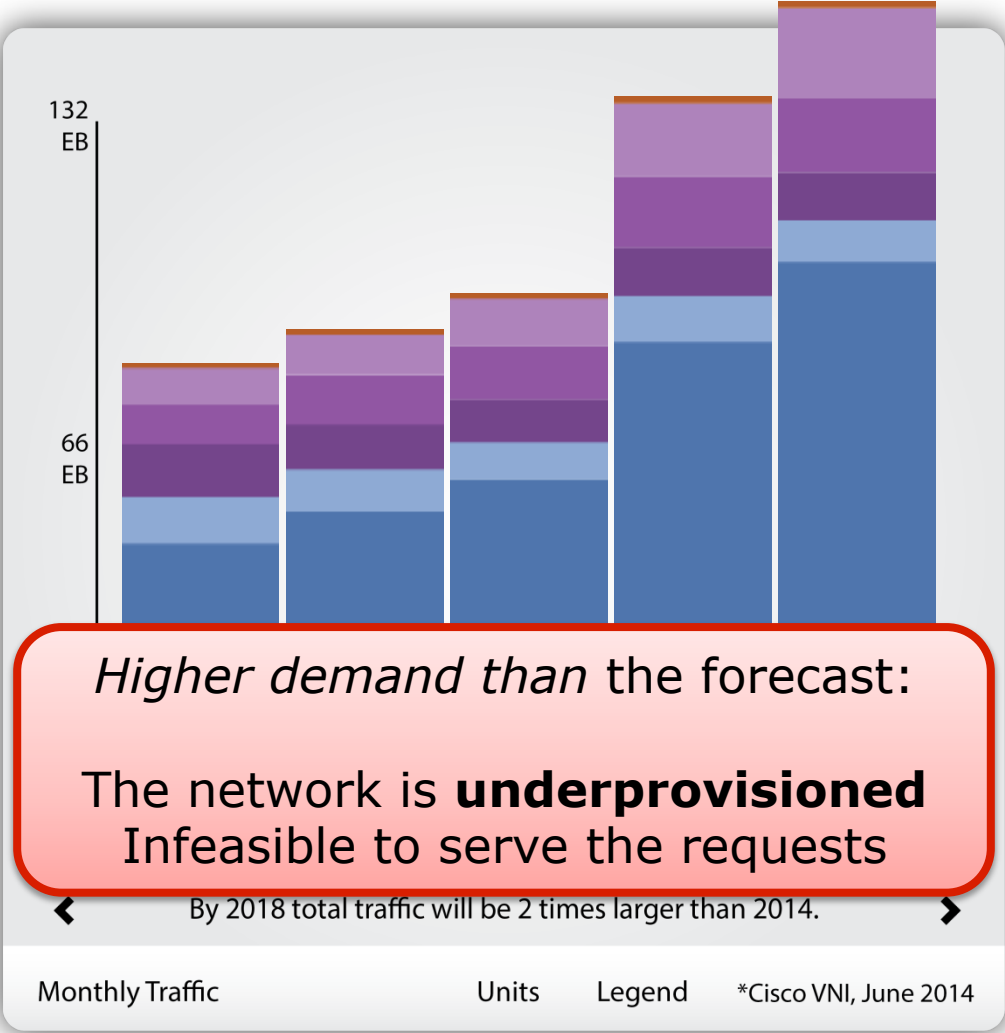
# Traffic Demand Forecasts



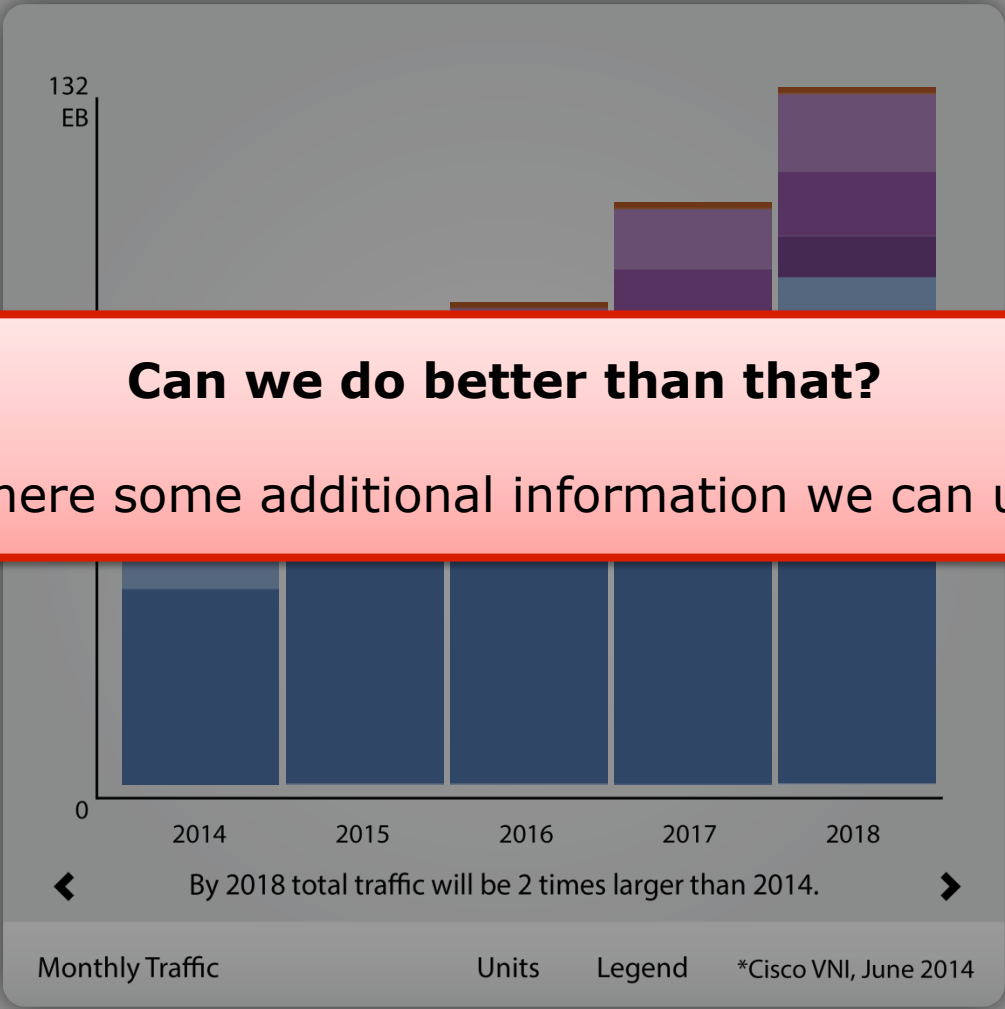
# Traffic Demand Forecasts



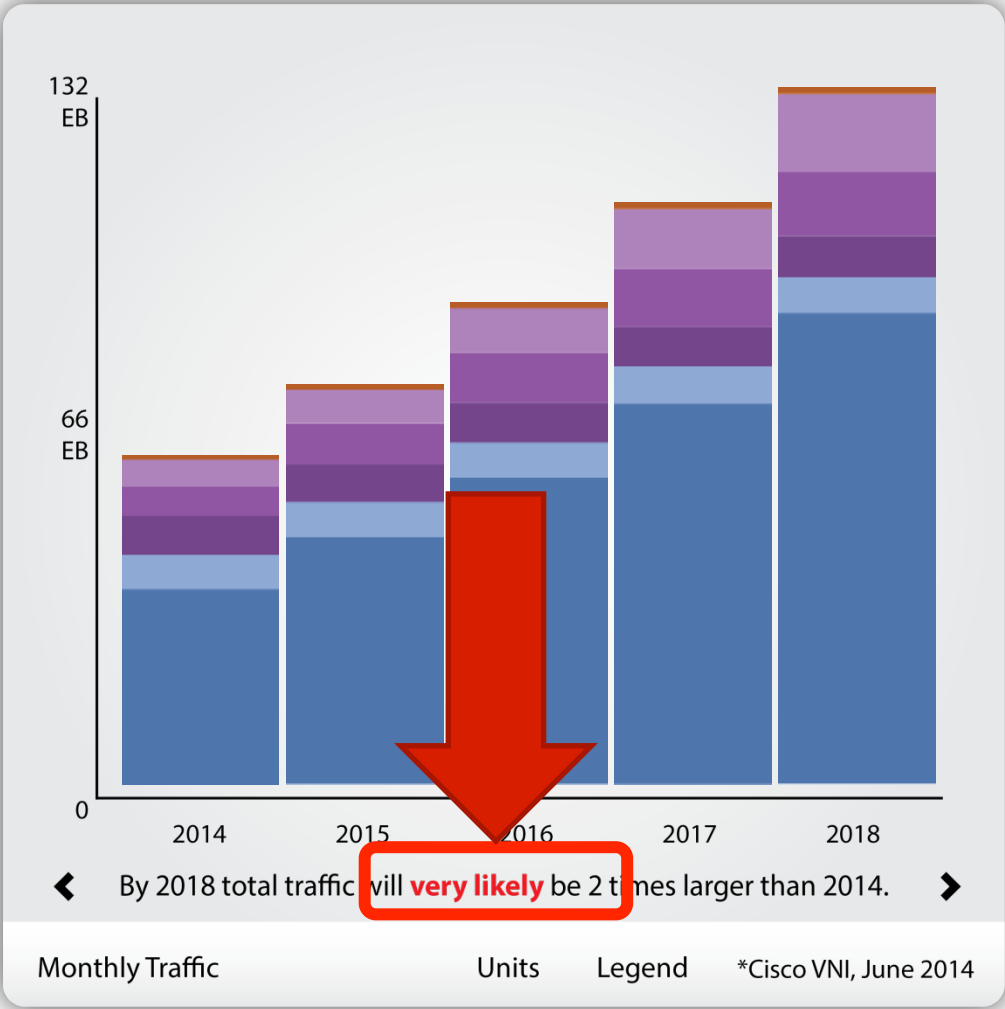
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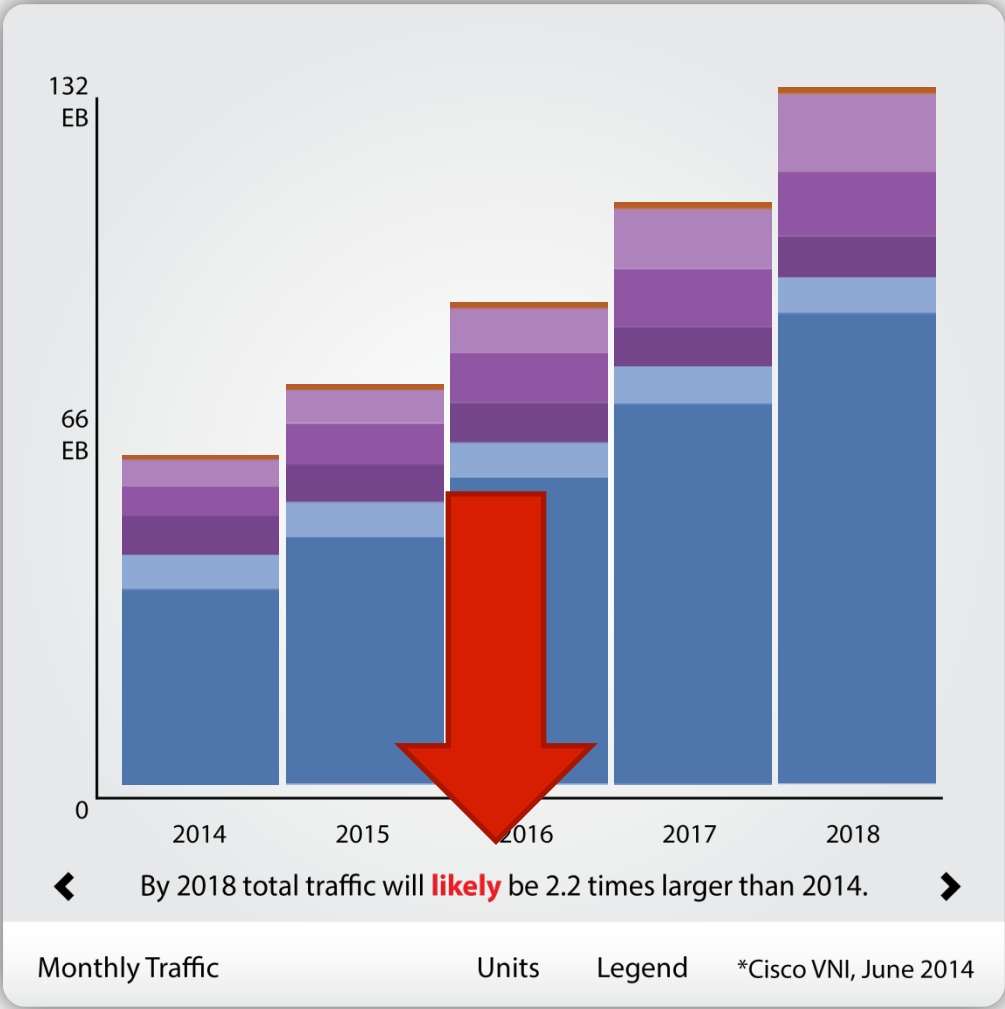
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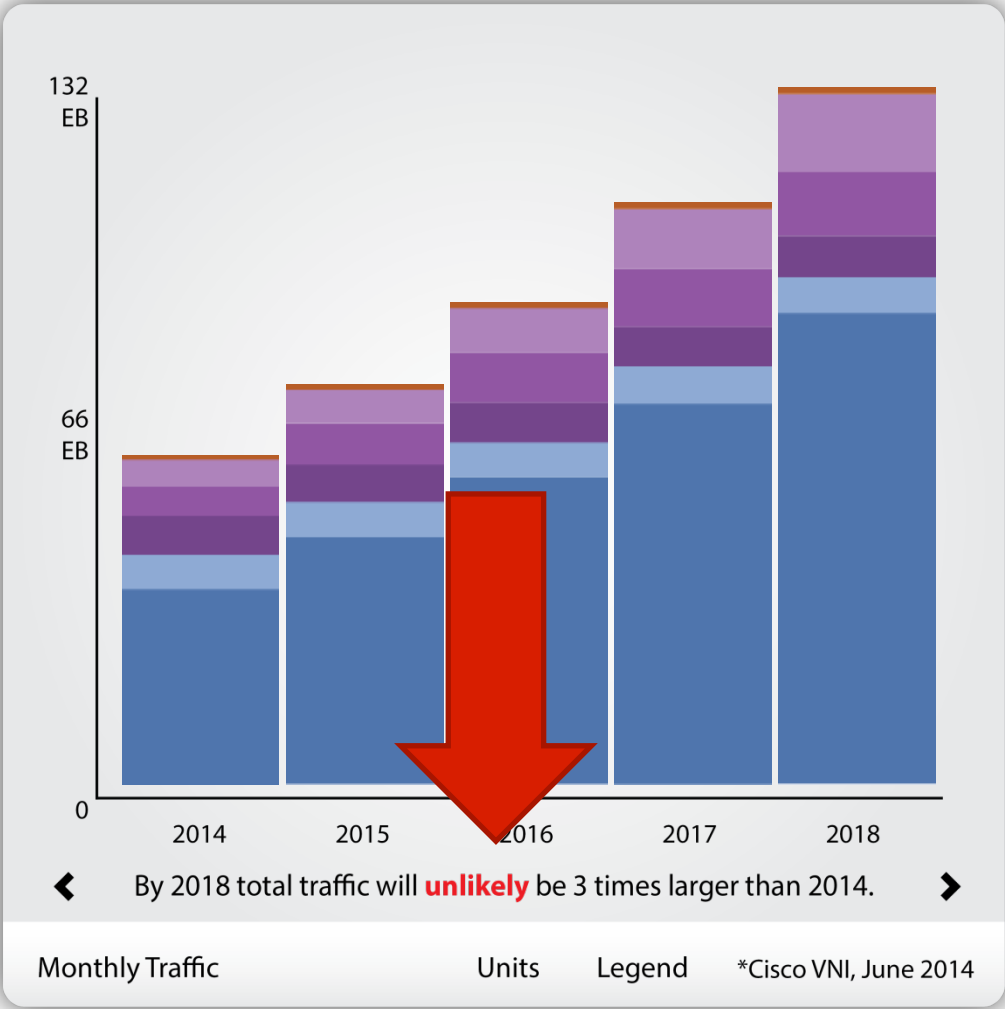
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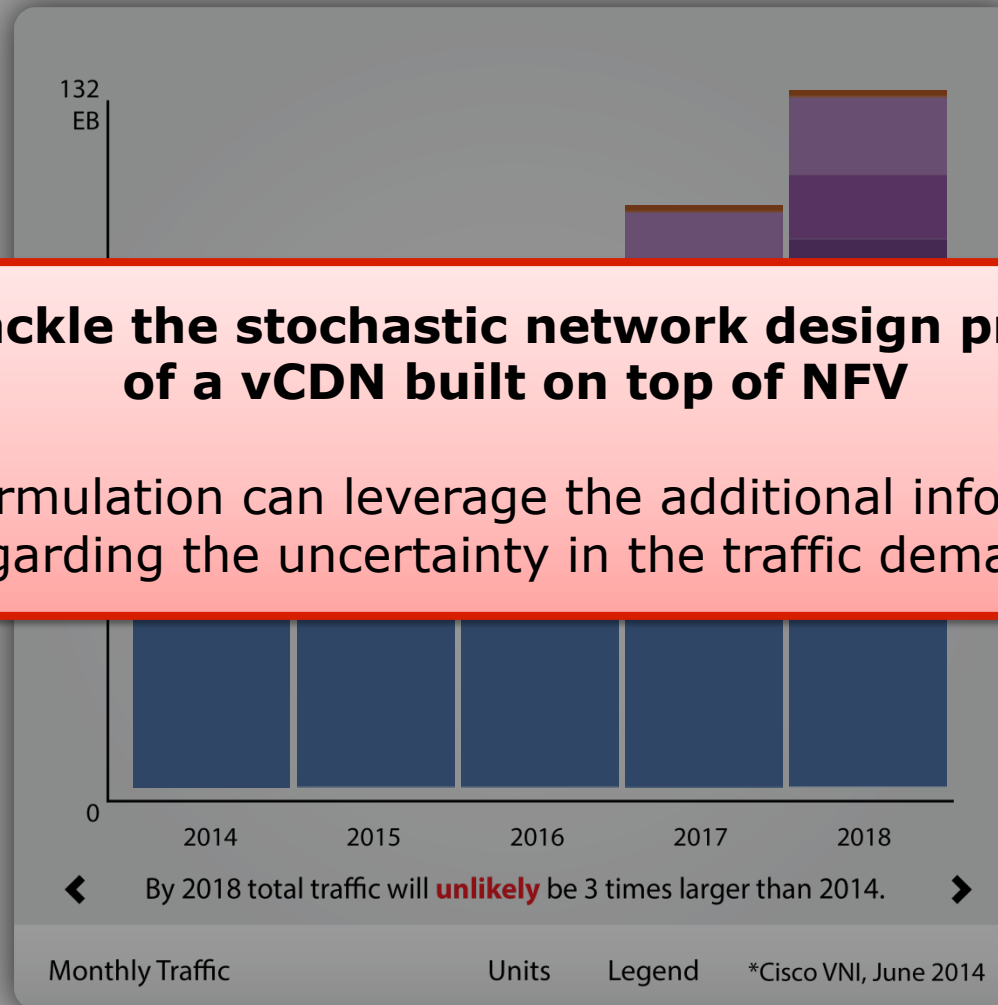
# Traffic Demand Forecasts



# Traffic Demand Forecasts



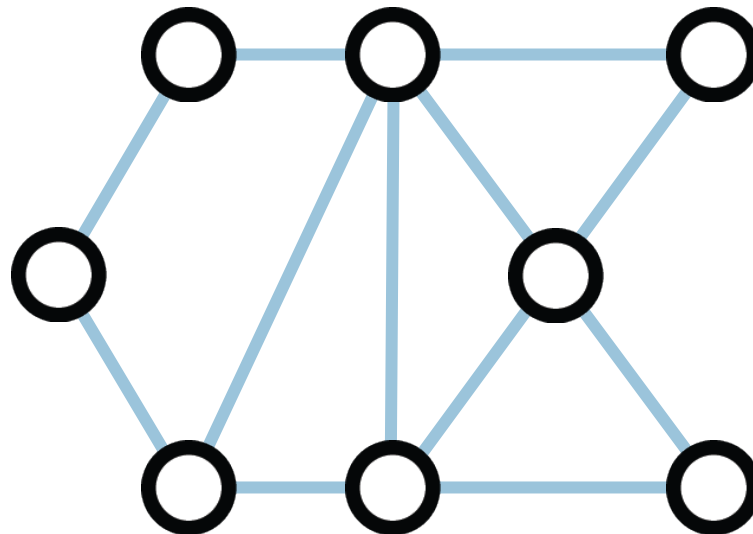
# Traffic Demand Forecasts





# System Model

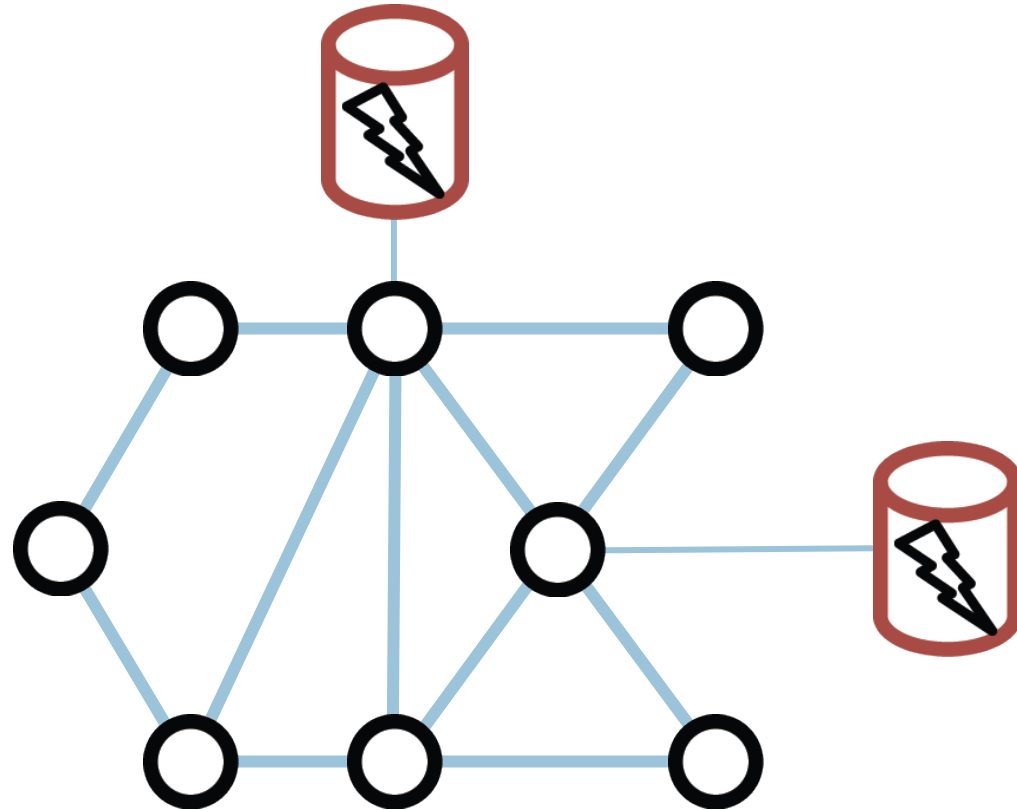
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Network Routers

# System Model

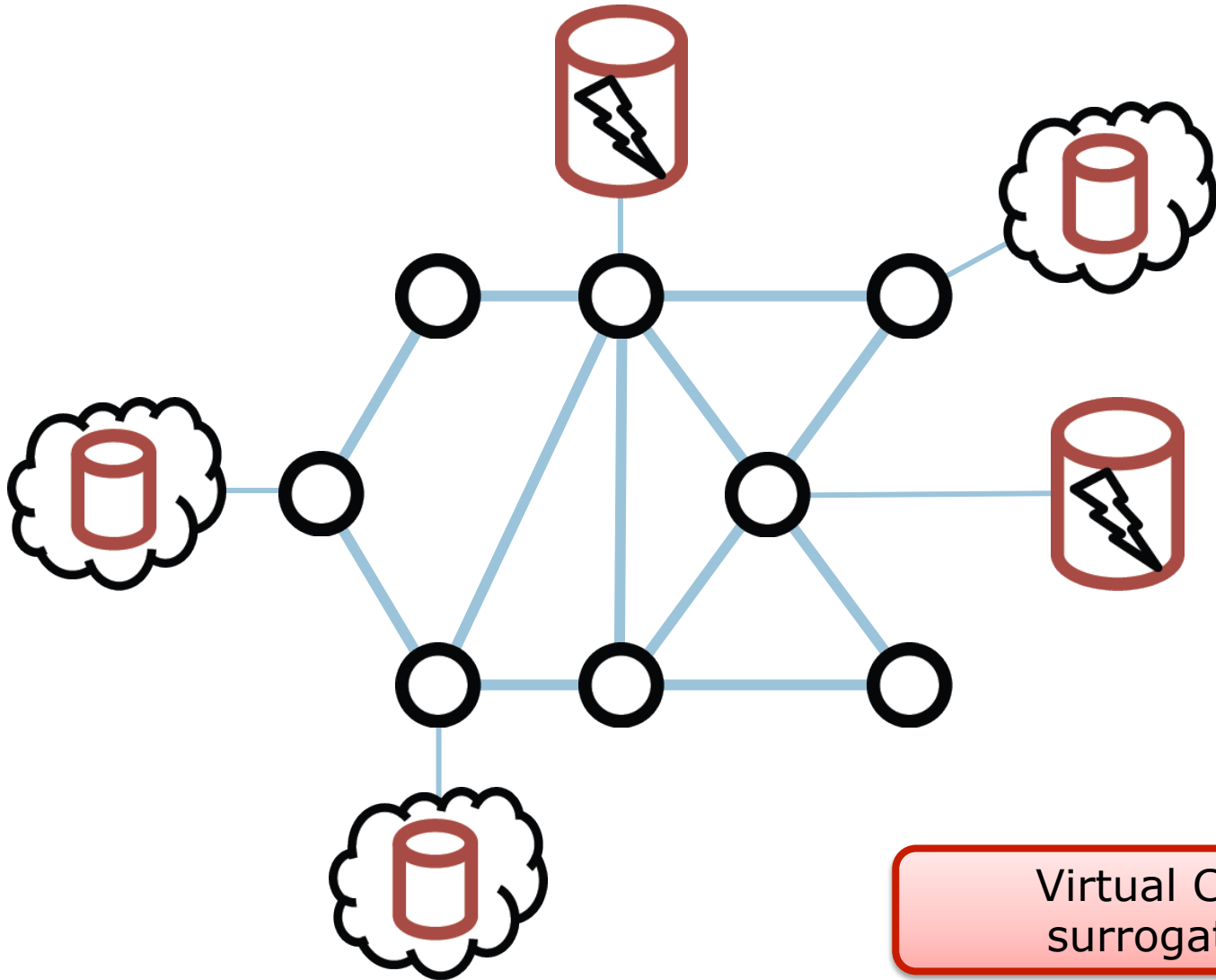
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Candidate Physical  
CDN surrogates

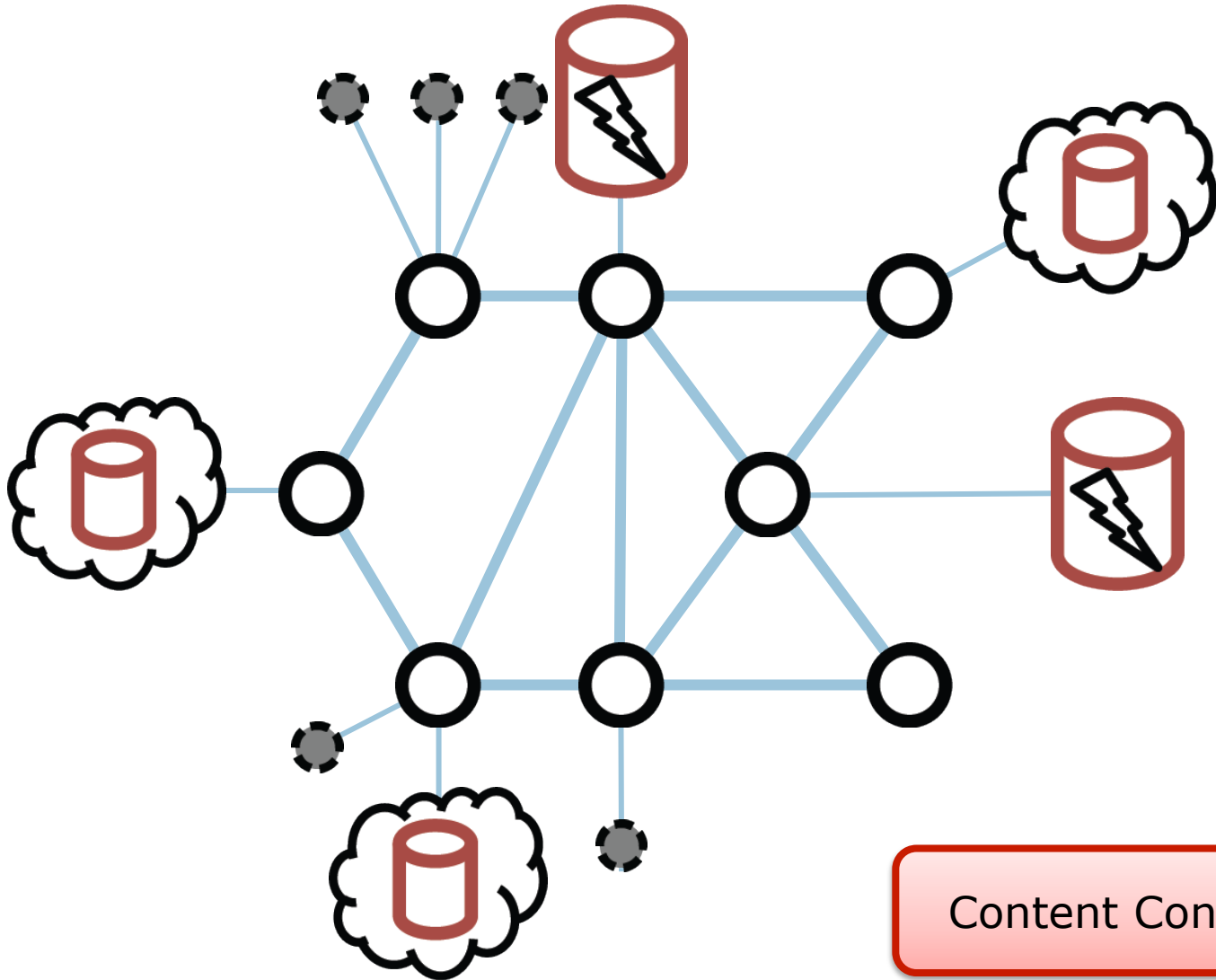
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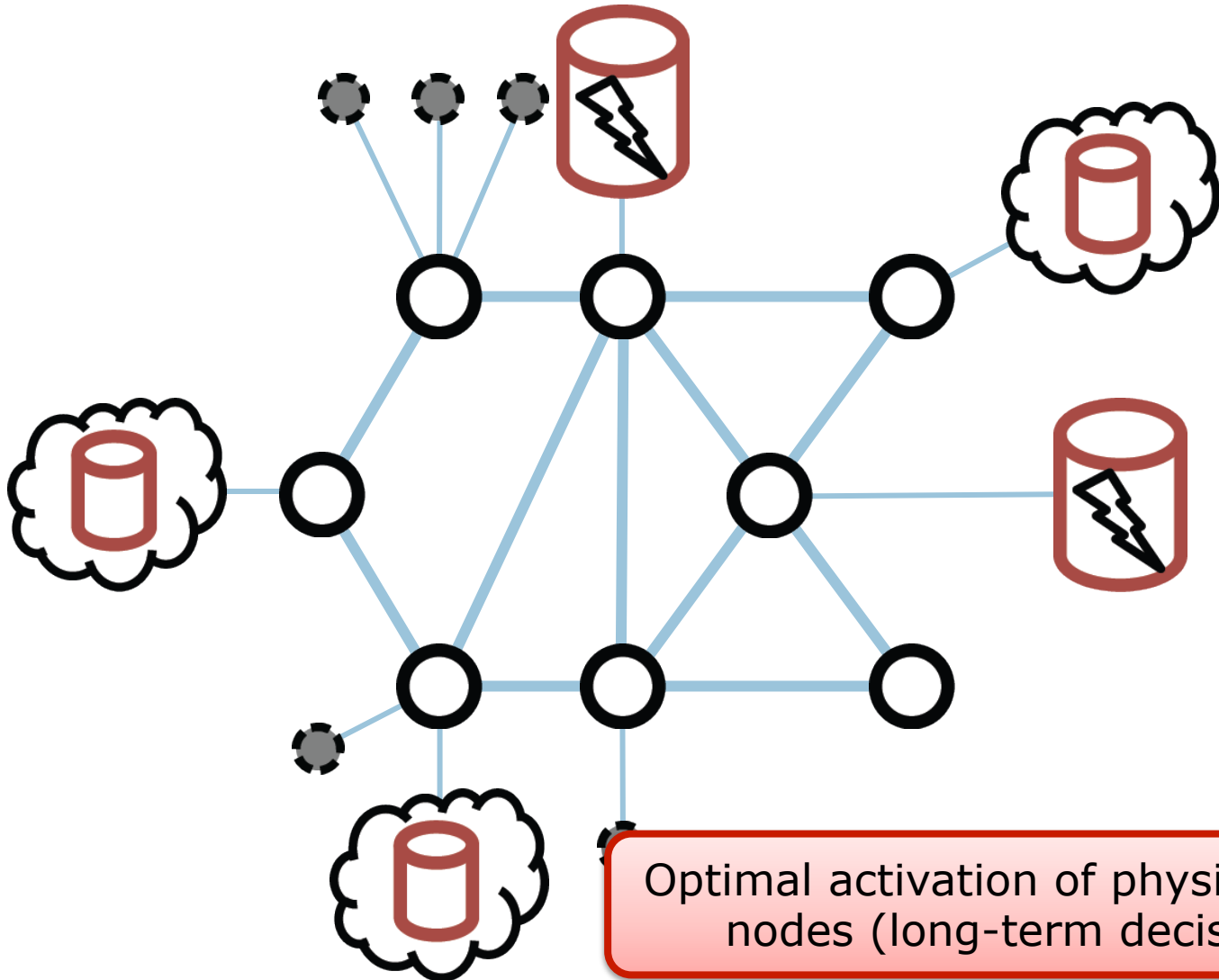


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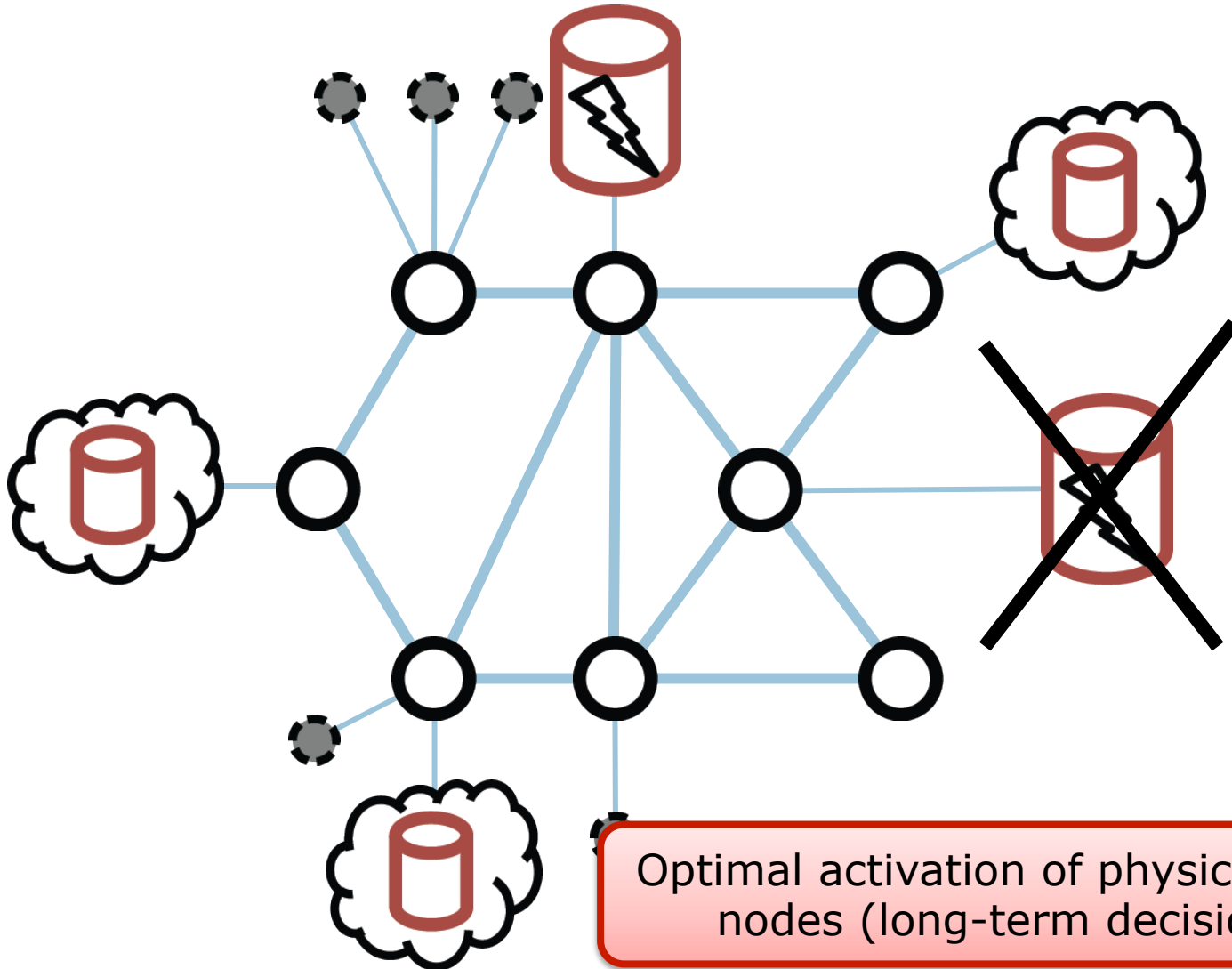
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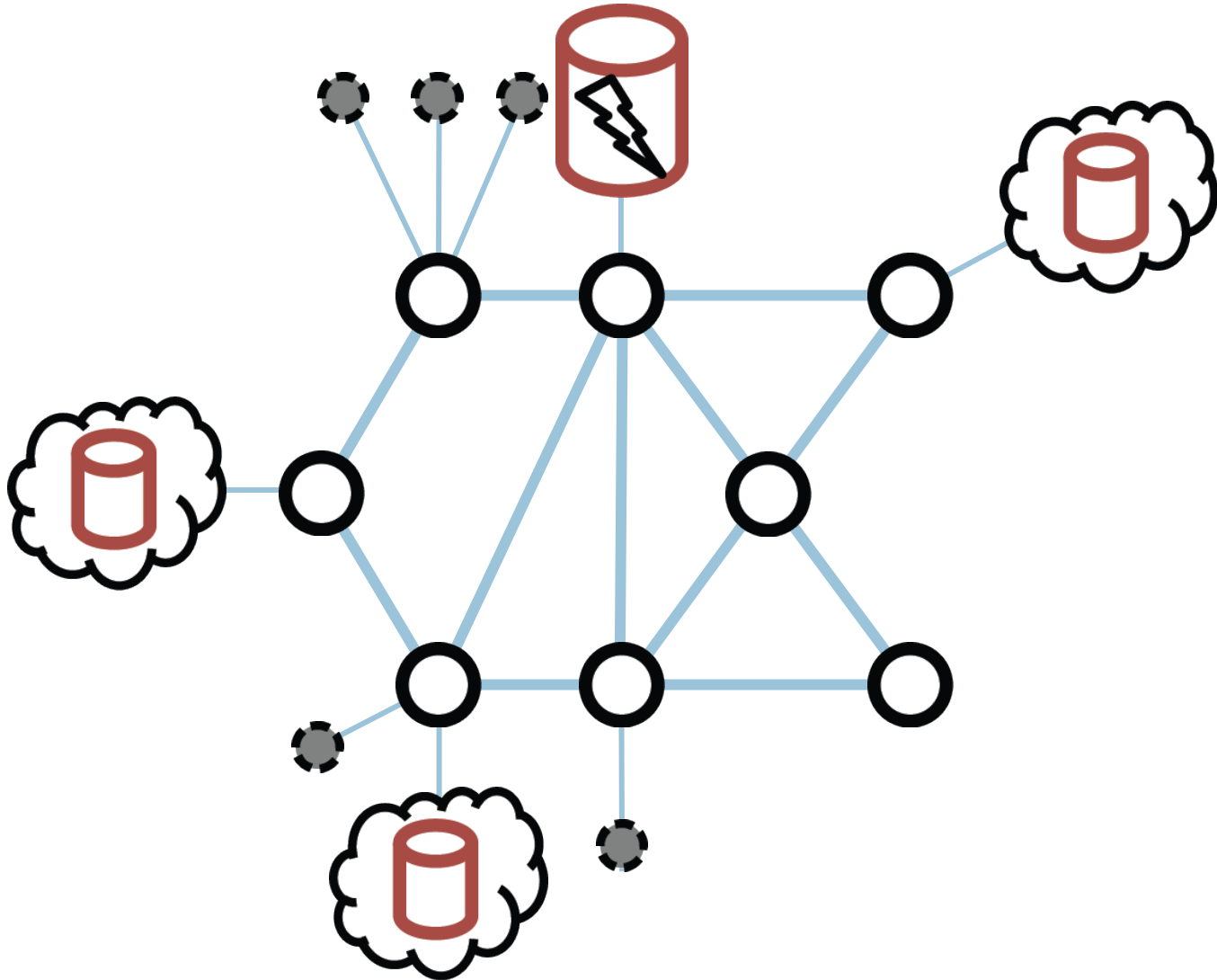


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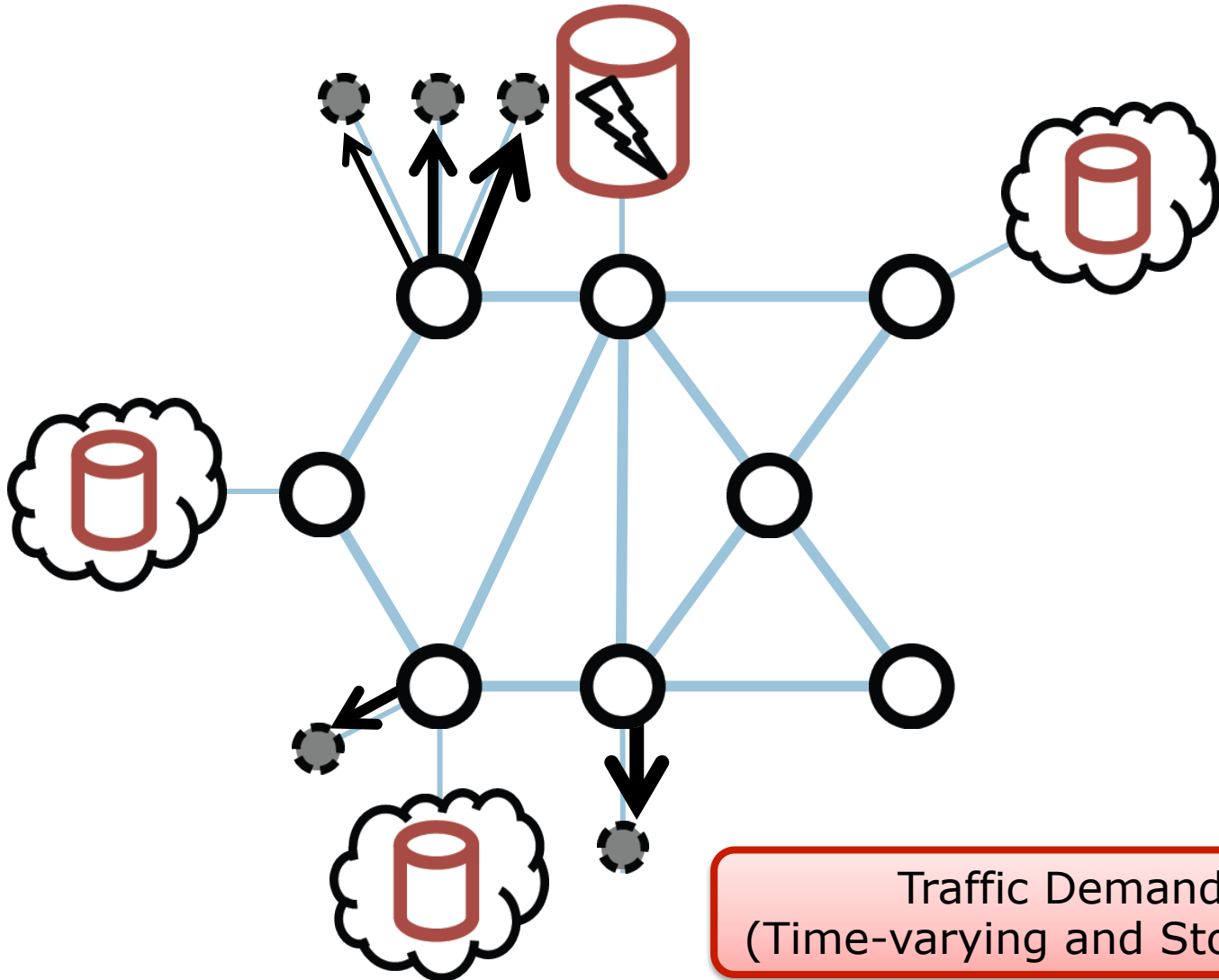


# System Model

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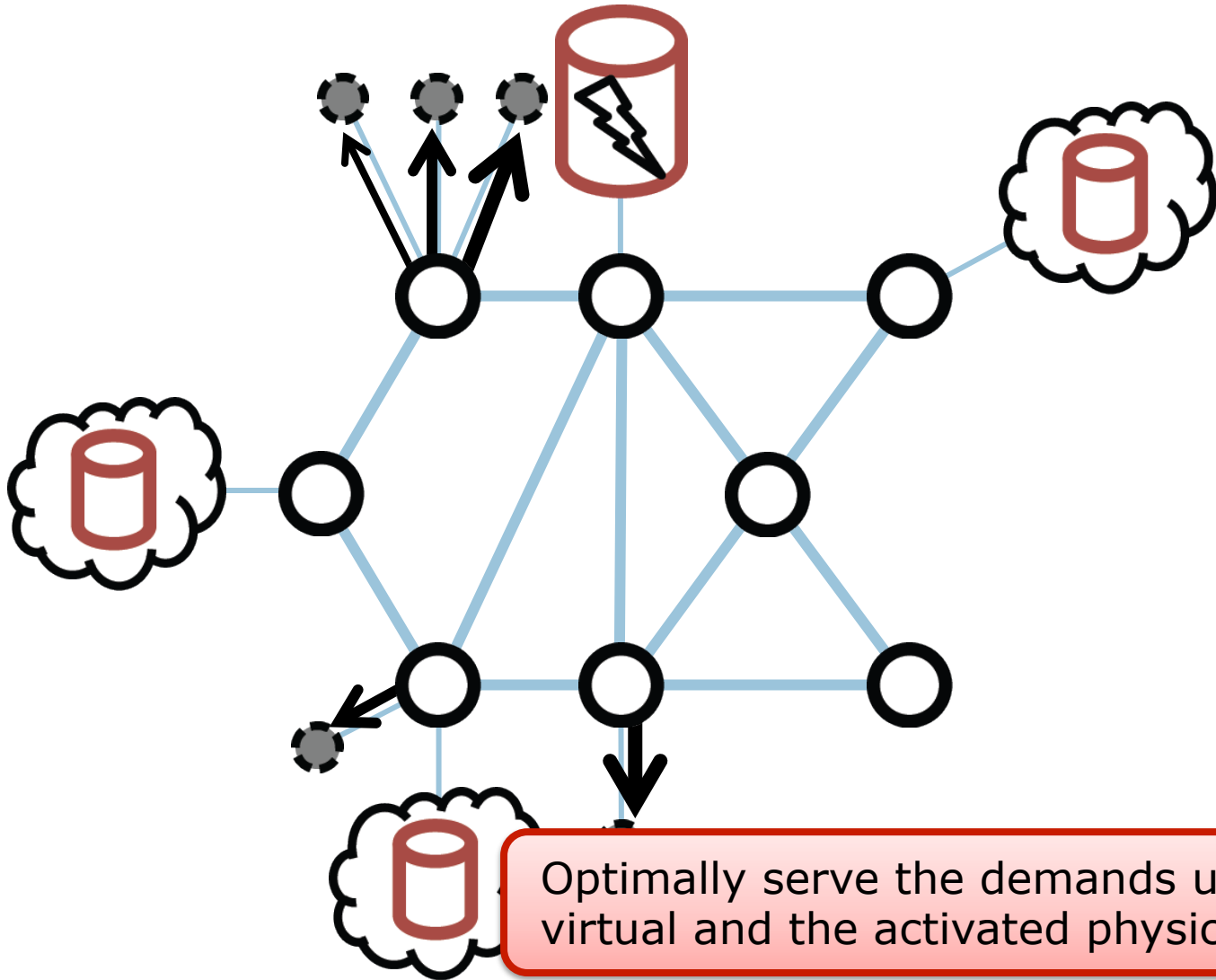
# System Model



Traffic Demands  
(Time-varying and Stochastic)

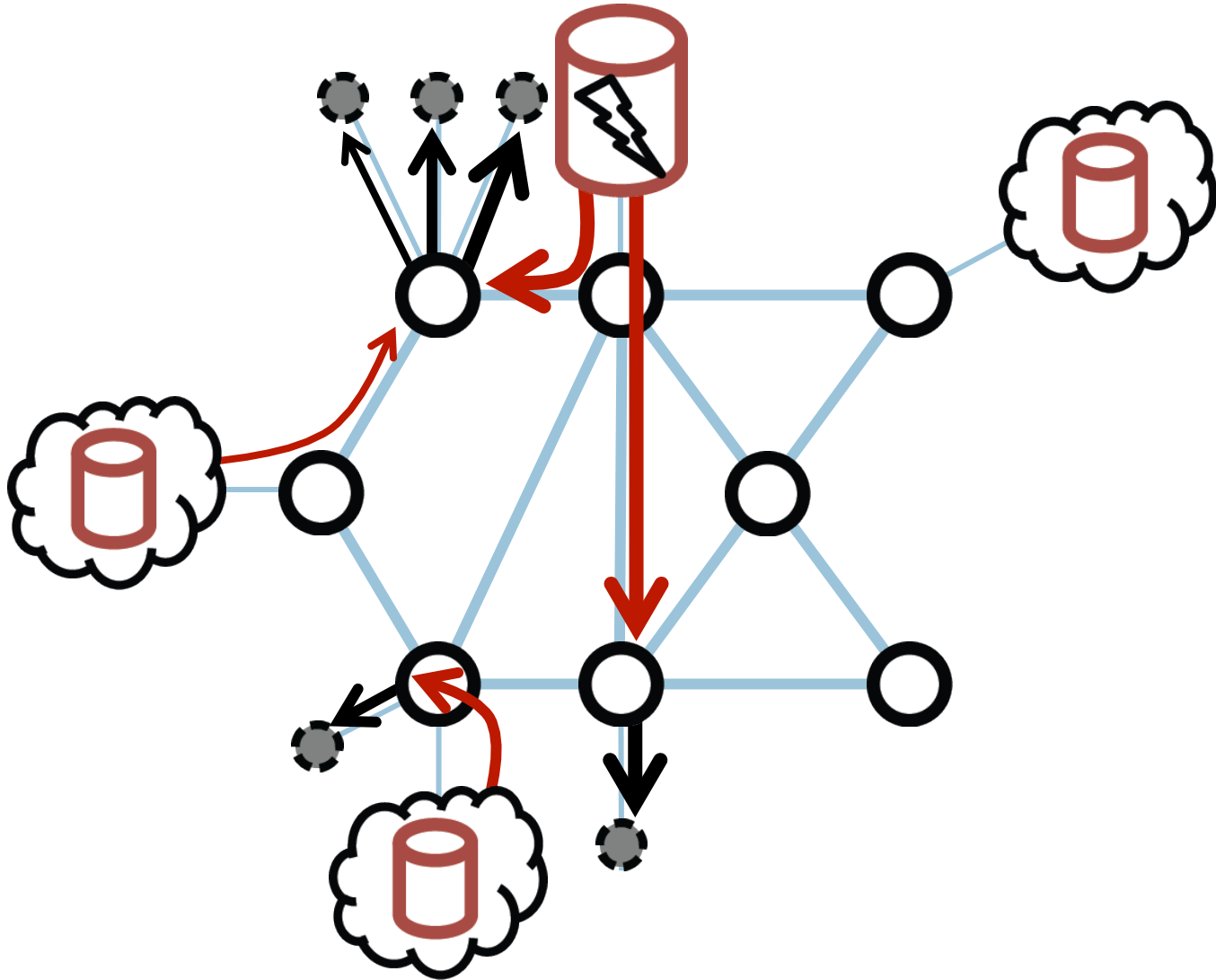


# System Model



# System Model

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# Stochastic Planning for vCDN

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- The aim of the Provider is to perform 2 choices:
  - 1) Select *whether* and *where* physical CDN nodes should be installed in the network topology
  - 2) Select the optimal *request routing*, given the installed