

Accepting More General Telephone Calls  
in Emergency Situations  
by Limiting General Call Holding Time  
under Trunk Reservation Control

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# Background

## ➤ Telephone Network Congestion in Emergency

- Earthquake, Hurricane, Incident on the street etc.
- Calls requesting help, checking on family and friends etc.

**Emergency Calls** : Police, Emergency Responders, Media etc.

**General Calls** : Other users

- Emergency calls should be accepted

- As many general calls as possible should be accepted
- Natural voice relieves the callers' family and friends even if their holding time is short

Accepting more general calls  
while emergency calls are still accepted

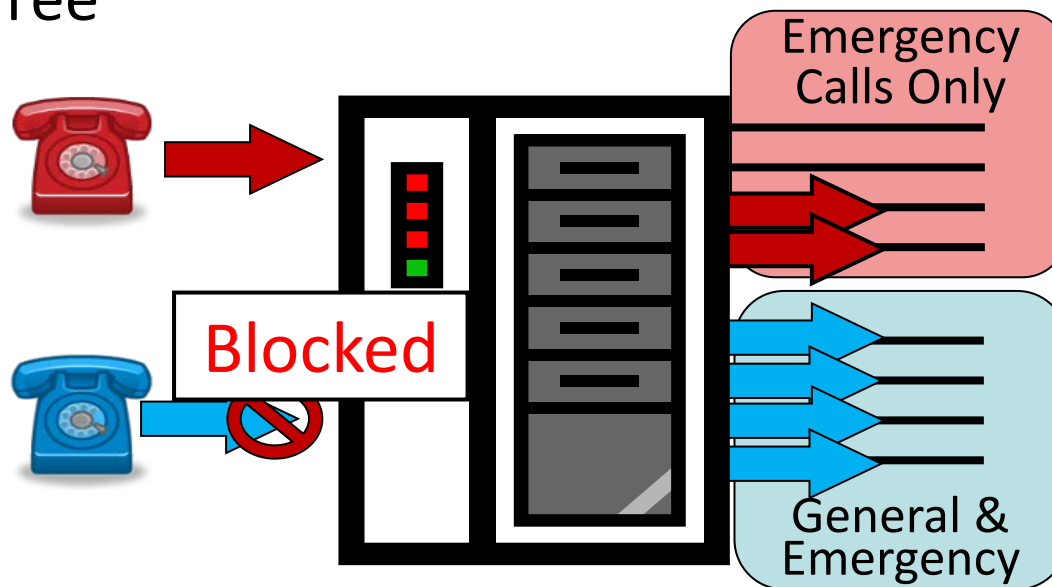
# Strategy (1/2)

In a real telephone network...



## Reserved Lines

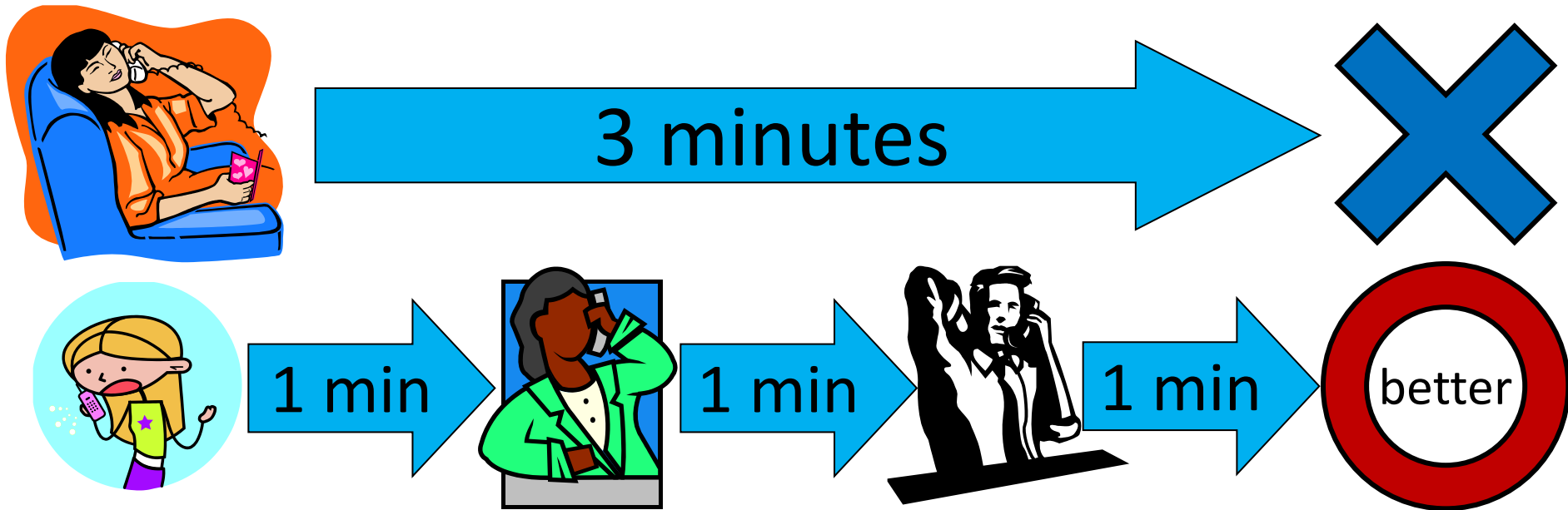
- » Certain number of emergency calls are accepted
- » General calls may be blocked though reserved lines are still free



Strategy: **Less telephone lines should be reserved**

# Strategy (2/2)

> To accept more general calls ...



Strategy: **More short-period calls should be accepted**

# Key Idea

If there's no reservation...

➤ Trunk reservation control: practical CAC method

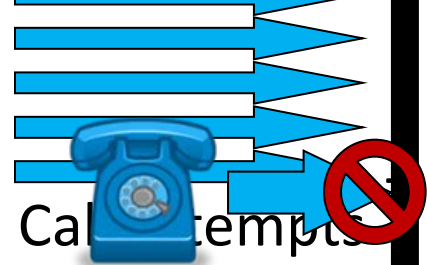
➤➤ Emergency calls may be blocked

➤➤ Emergency Admission Control (EAC) is needed

Emergency Calls



General Calls



➤➤ Accept the required number of emergency calls

➤➤ Reduce general call-blocking rate

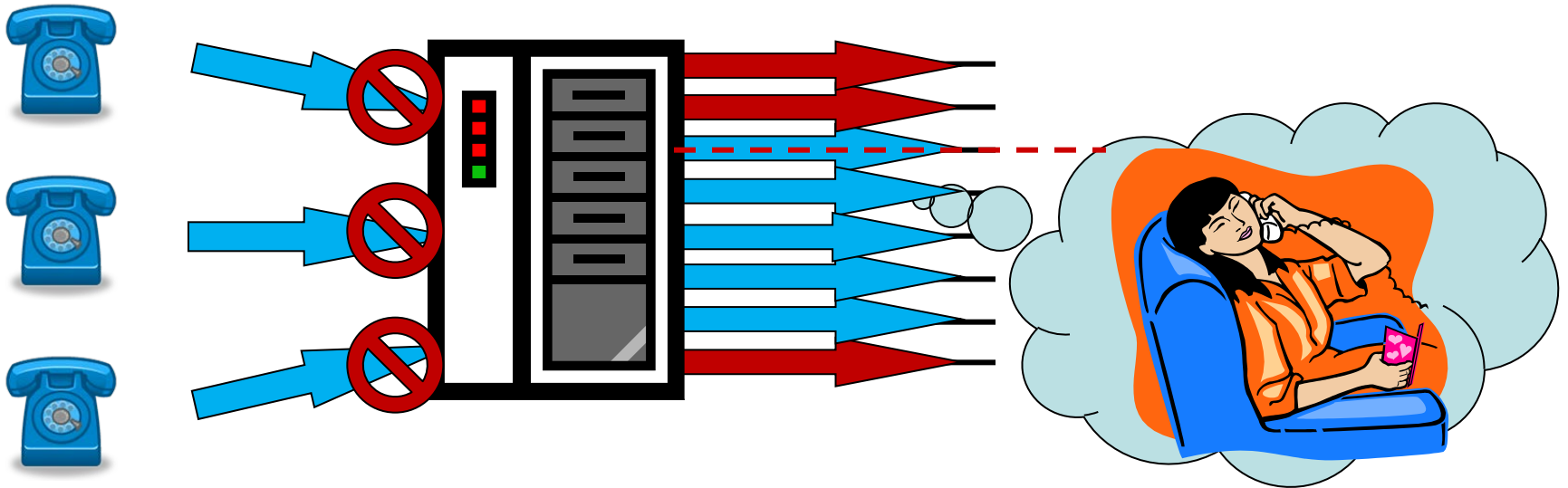
Telephone Lines

Threshold

Appropriate Threshold

# Problem

- General Call Holding Time Limitation
  - » Long-period talk by some general call users
  - » This may occur under trunk reservation control
  - » General call users should reduce their holding time



# Purpose of Study

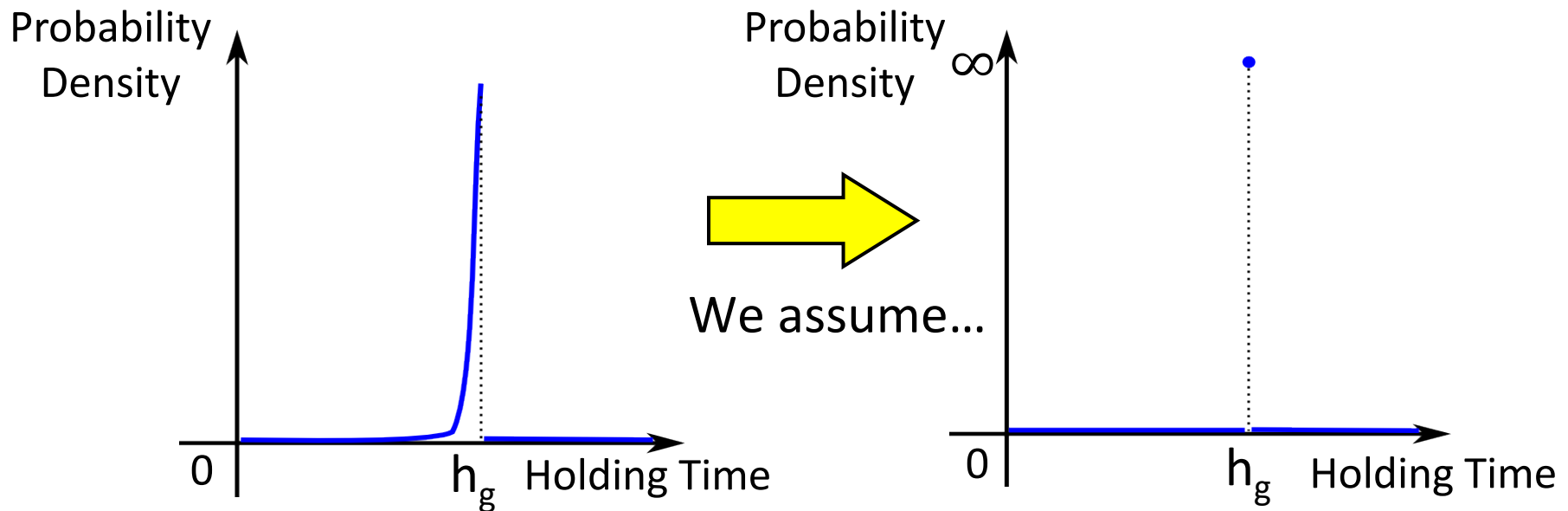
- A method for limiting the general call holding time under trunk reservation control
- » Threshold  
Holding time limit } are set considering traffic situations
- » Accept more general calls while still accepting the required number of emergency calls

As a basic study ...

Relationship between call-blocking rate and traffic situations under trunk reservation control

# Model Setting (1/2)

- » Model the telephone exchange using queuing theory
- » If General Call Holding Time Limit  $h_g$  is **short** ...
- » General Call Holding Time Distribution:

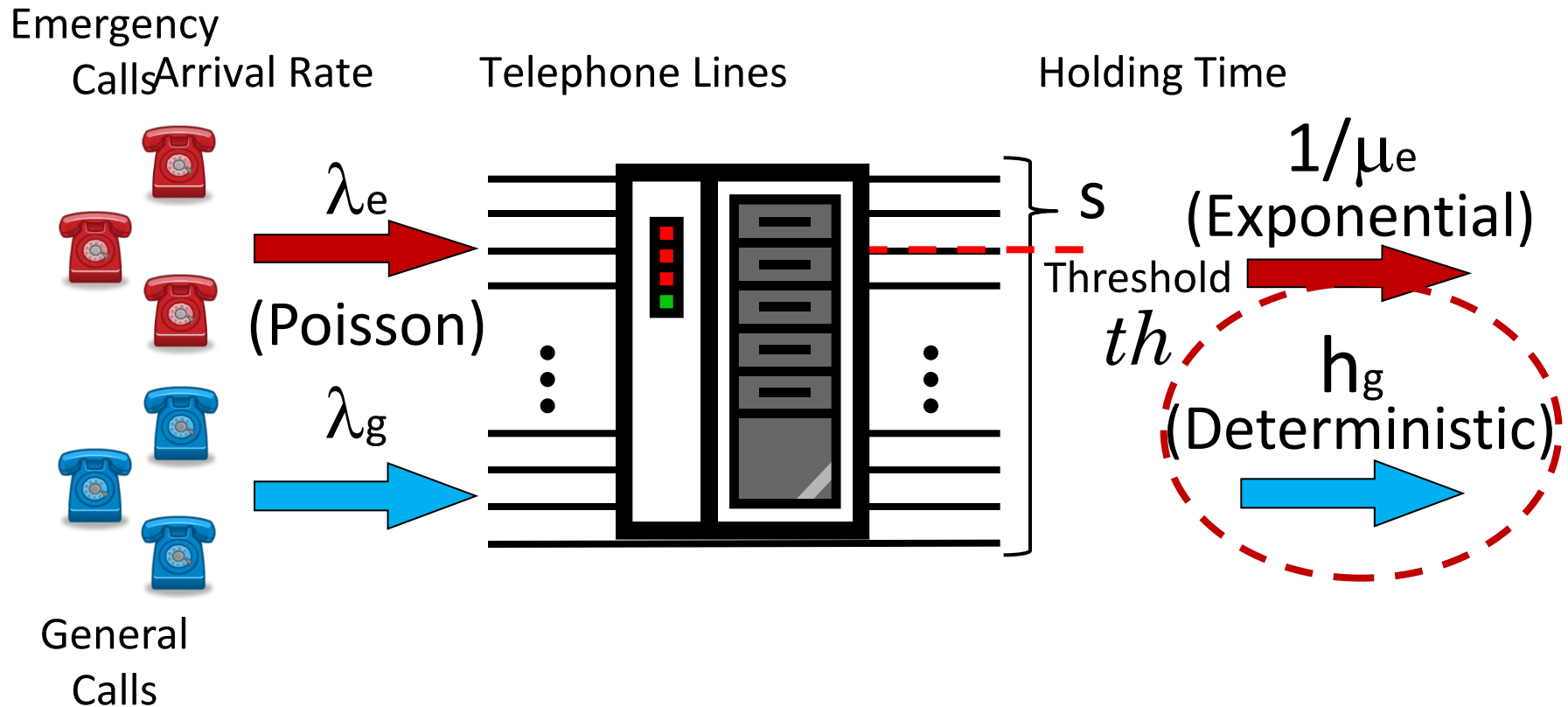


Approximated as the fixed value  
 **$h_g$**  (Deterministic Distribution)

# Model Setting (2/2)

$M_1M_2/MD/s/s,th$  loss system

» Set Holding Time Limit to General Calls

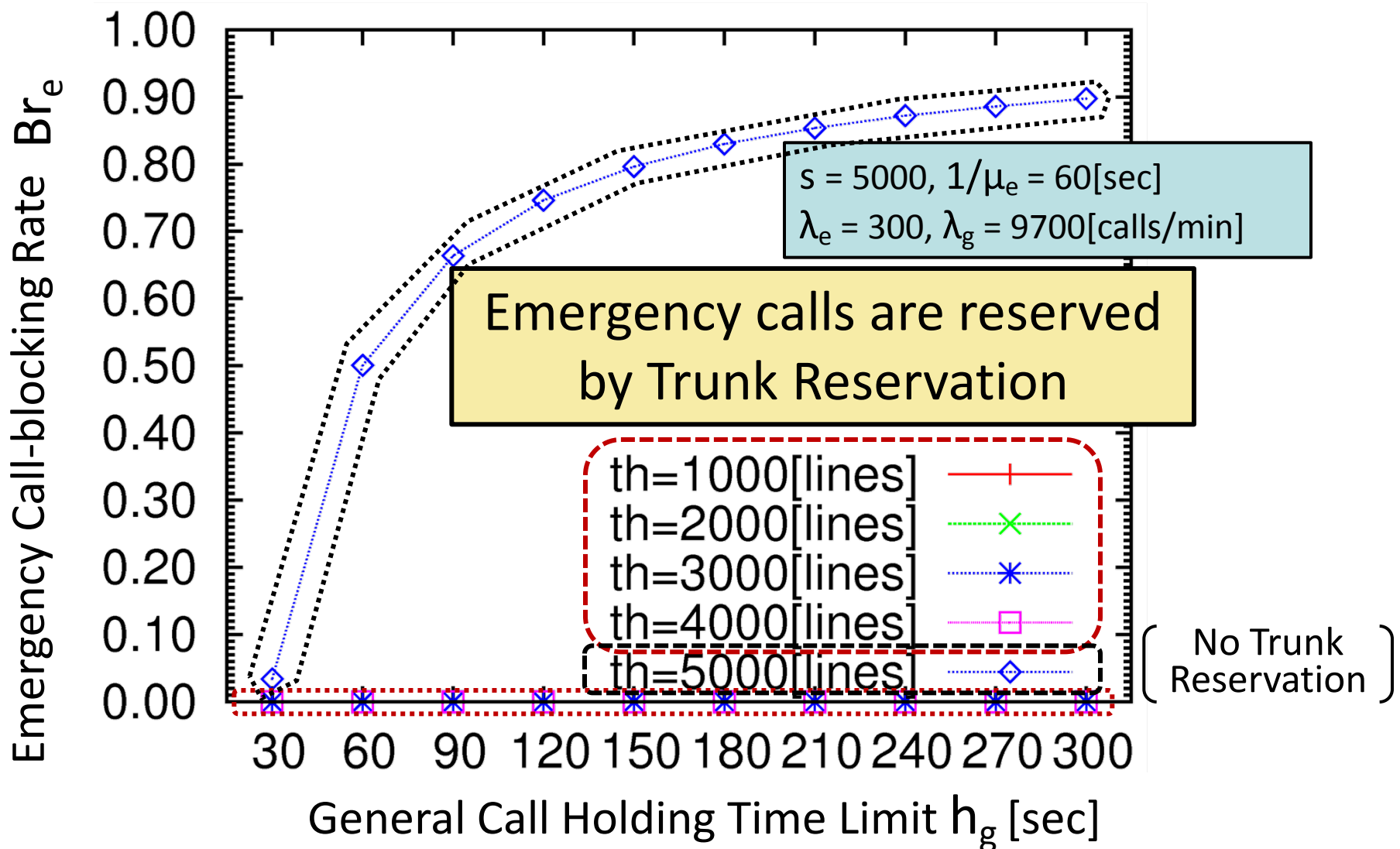


# Computer Simulation

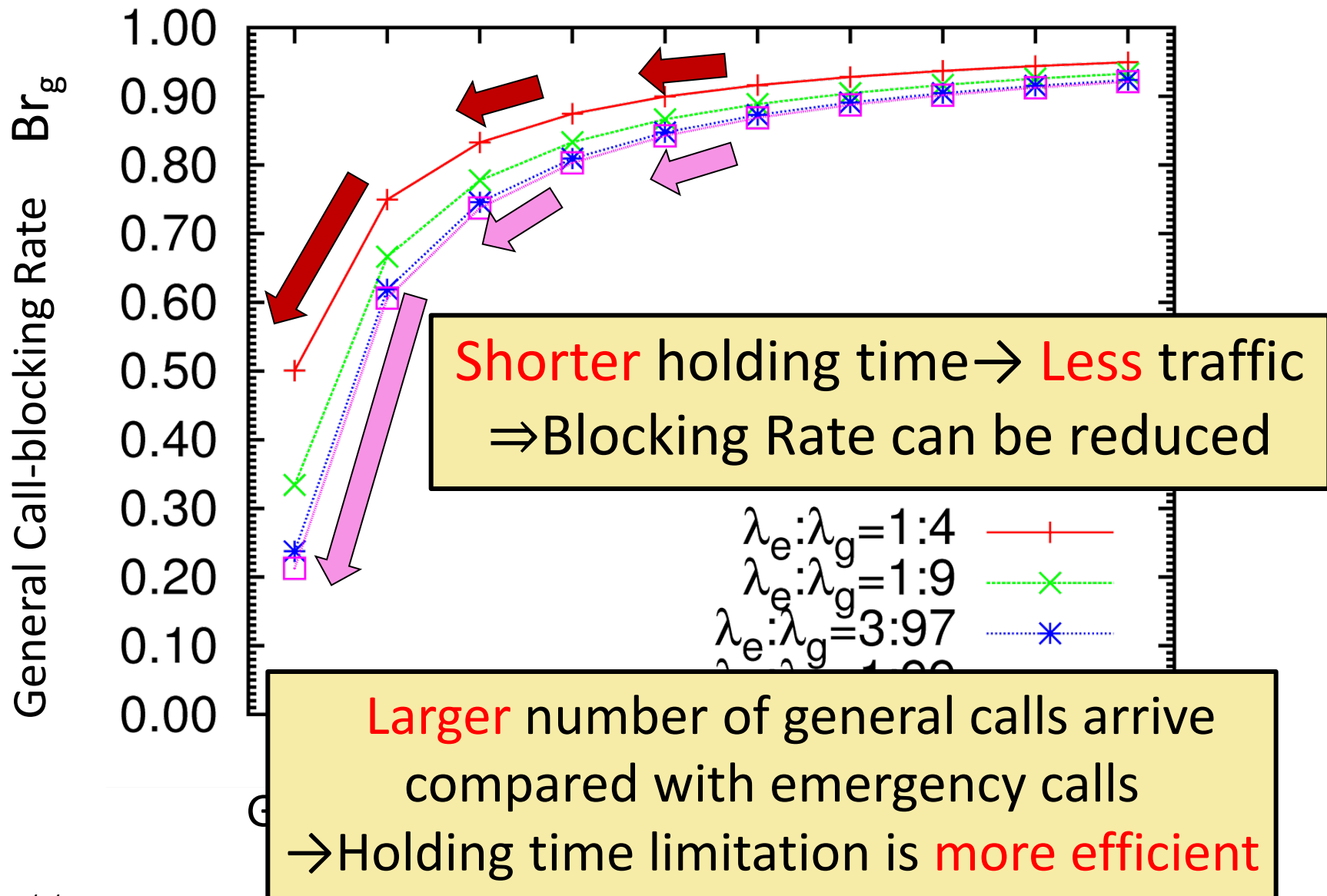
## Parameter Settings:

Number of Lines(s)	1000,2000,3000,4000,5000 [lines]
Threshold(th)	$s \times 0.1, s \times 0.2, \dots, s \times 0.9, s$
Sum of Arrival Rates ( $\lambda_e + \lambda_g$ )	2500, 5000, 7500, 10000 [calls/min]
Ratio of Arrival Rates ( $\lambda_e : \lambda_g$ )	1:4, 1:9, 3:97, 1:99
Mean Holding Time of Emergency Calls( $1/\mu_e$ )	60, 120, 180[sec]
General Call Holding Time Limit ( $h_g$ )	30, 60, 90, 120, 150, 180, 210, 240, 270, 300 [sec]
Simulation Time	360000[sec]

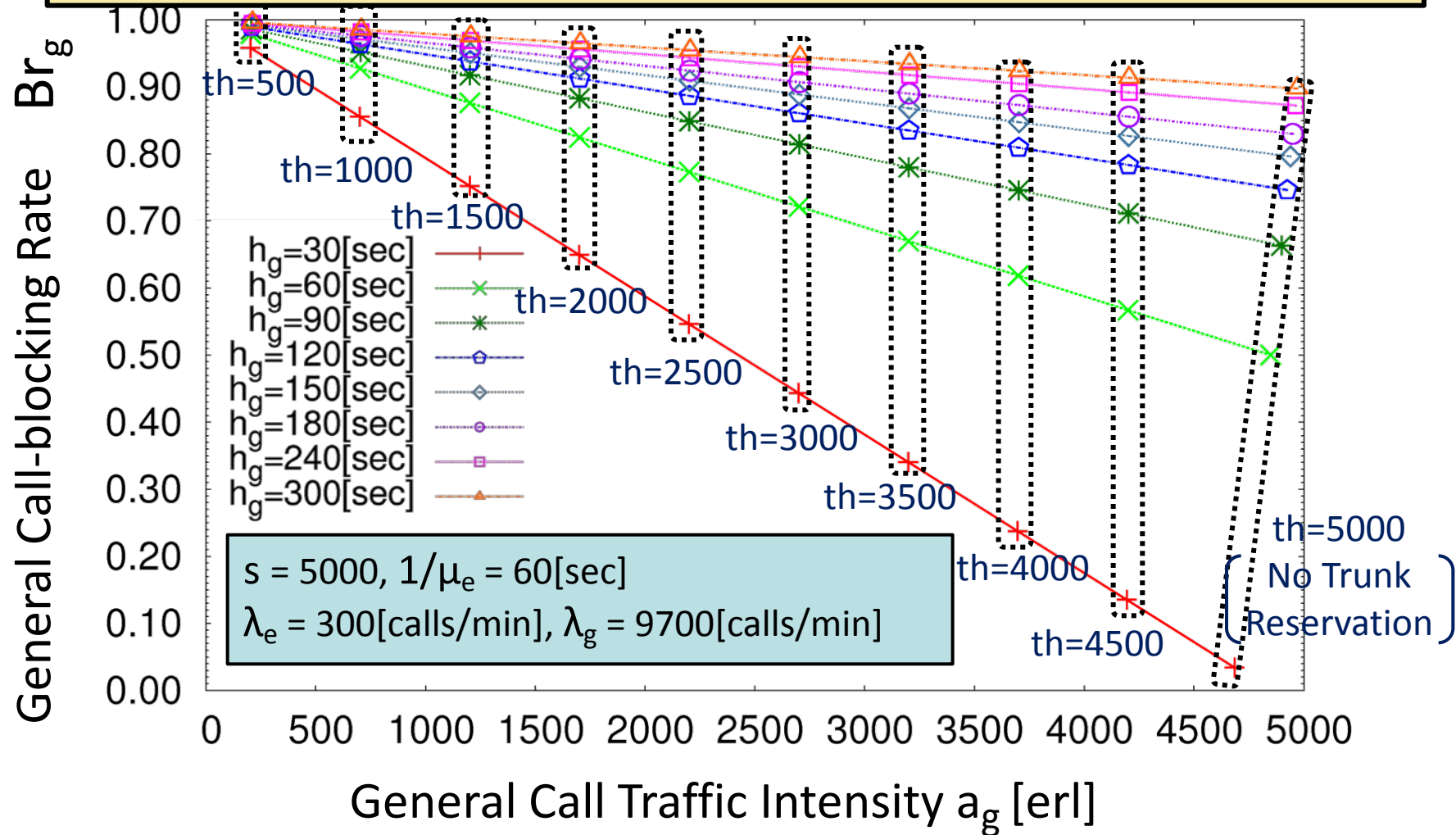
# Accepting Emergency Calls



# Call-blocking Rate vs Arrival Rate



About the same  $a_g$  is accepted by th  
 $\Rightarrow$  upper limit of traffic intensity can be estimated



# Summary and Future Work

## Summary

- » We proposed general call holding time limitation under trunk reservation control
- » Modeled the telephone exchange as an  $M_1M_2/MD/s/s,th$  loss system
- » Calculated blocking rates of emergency calls and general calls by computer simulation

## Future Work

- » A method to set appropriate general call holding time limit and threshold
- » Emergency congestion control on SDN-based IP network