Performance Modelling and Analysis of Imaging Service of Earth Observation Satellites

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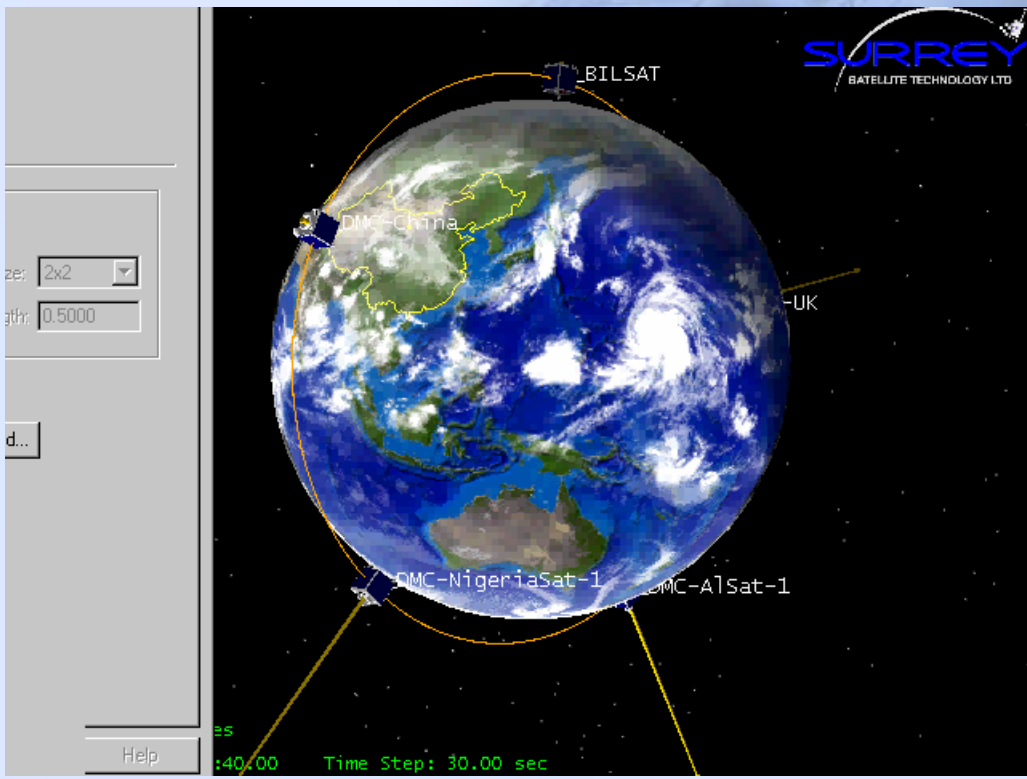
Outline

- Background
- Objectives
- Imaging satellite modelling
- Results
- Conclusions
- Future work

Earth Observation Constellation

- DMC
  - Sun-synchronous
  - Daily revisit
  - Commercial

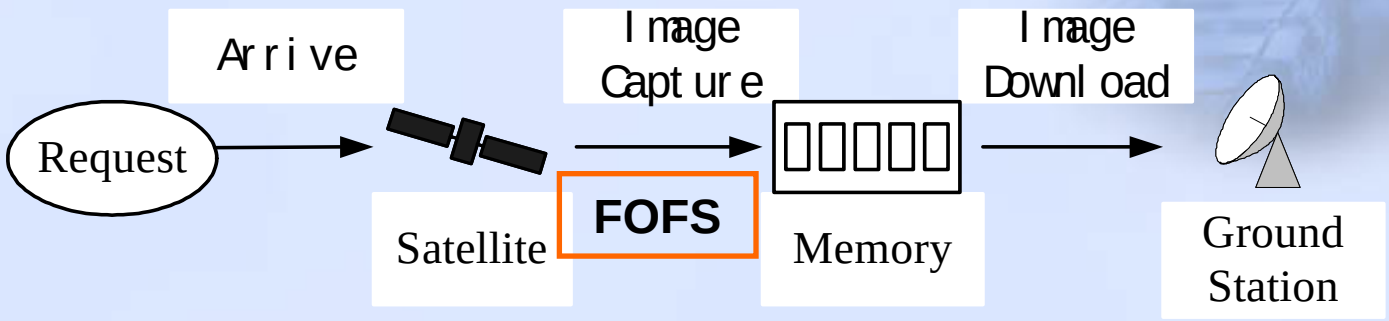


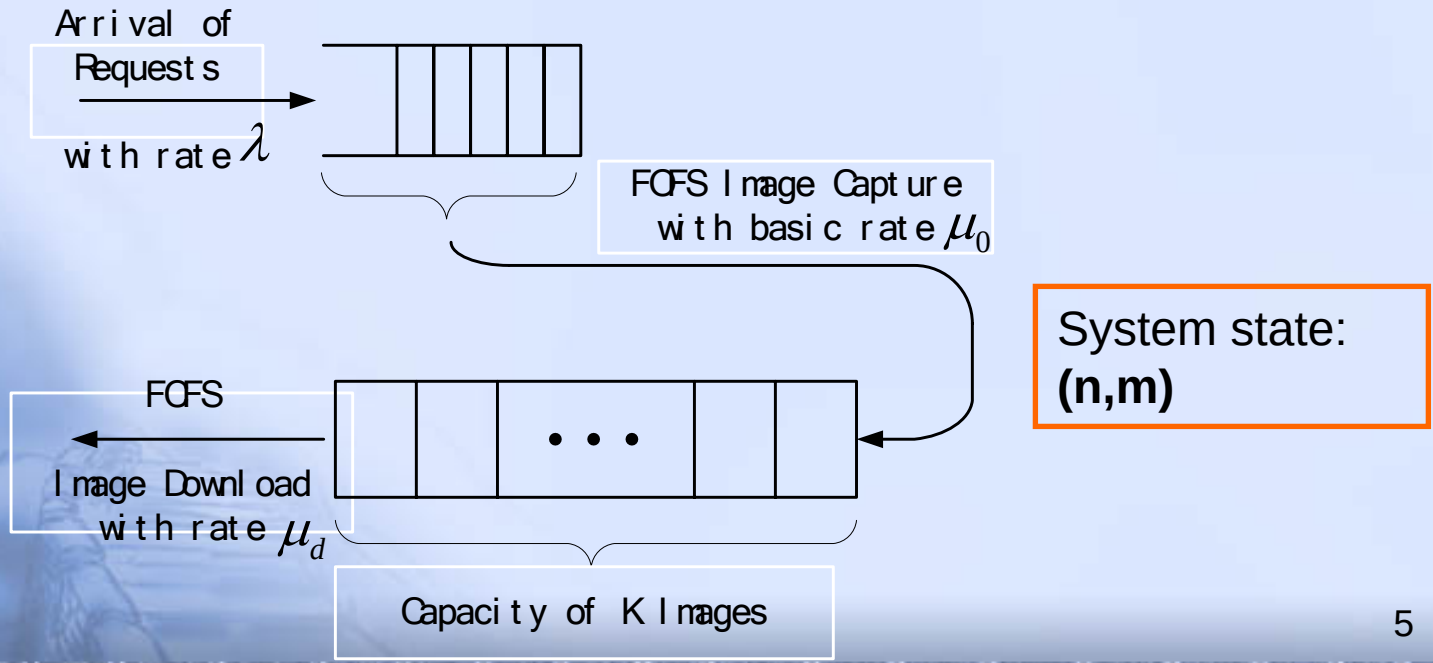
Q: what's the average time requests need to wait?

Objectives

- Modelling imaging satellites with Queueing theory
- Use queuing models to analyse system performance systematically
- Investigate system parameters' effects on the service performance
- Optimise system configuration

Imaging Satellite System Modelling





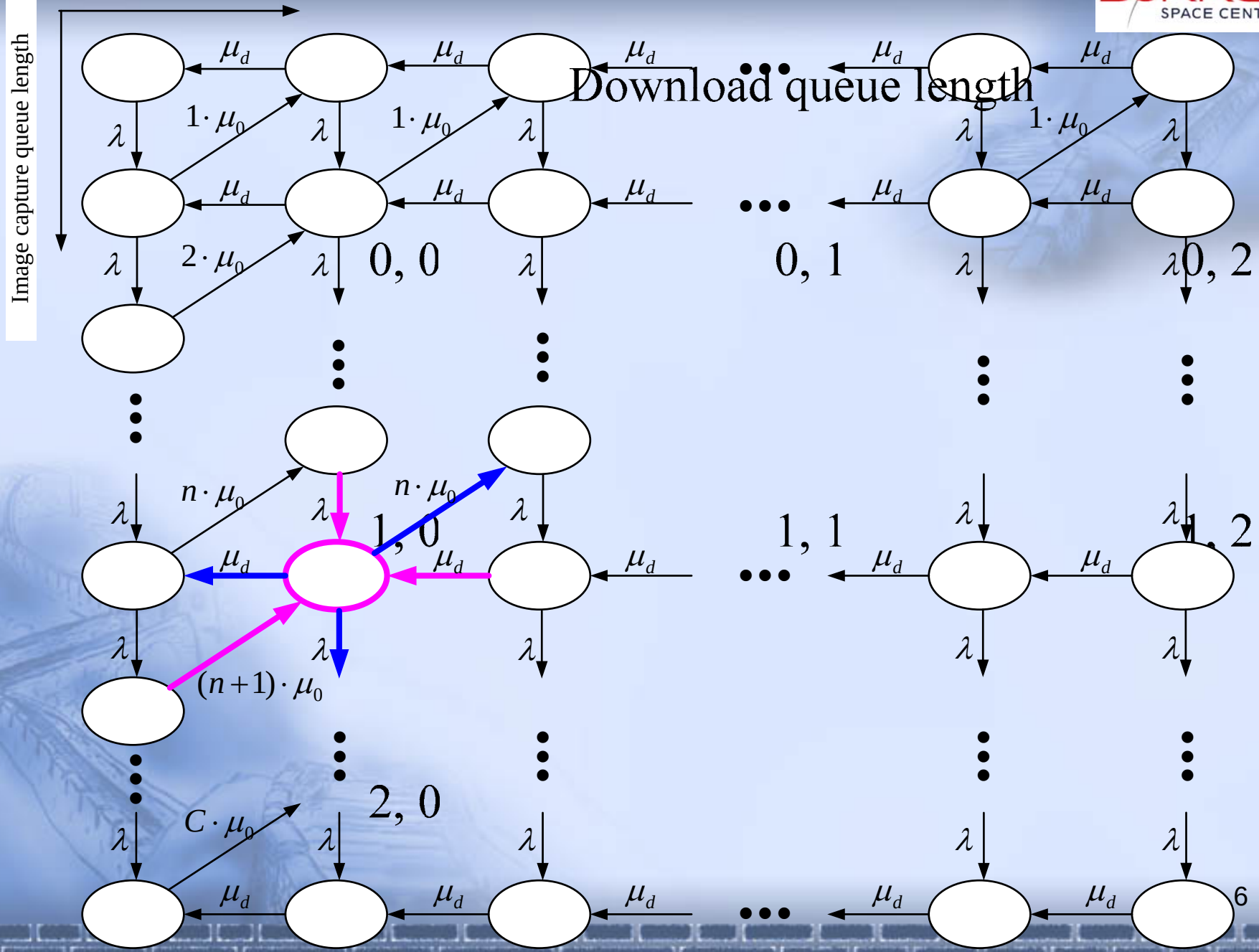
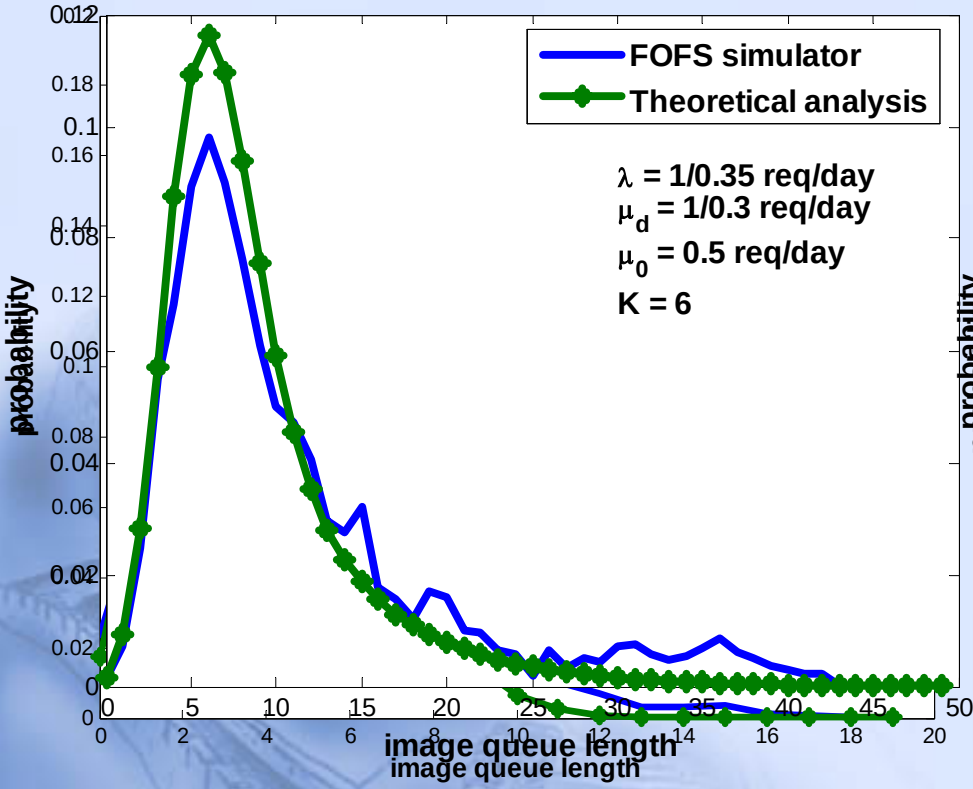
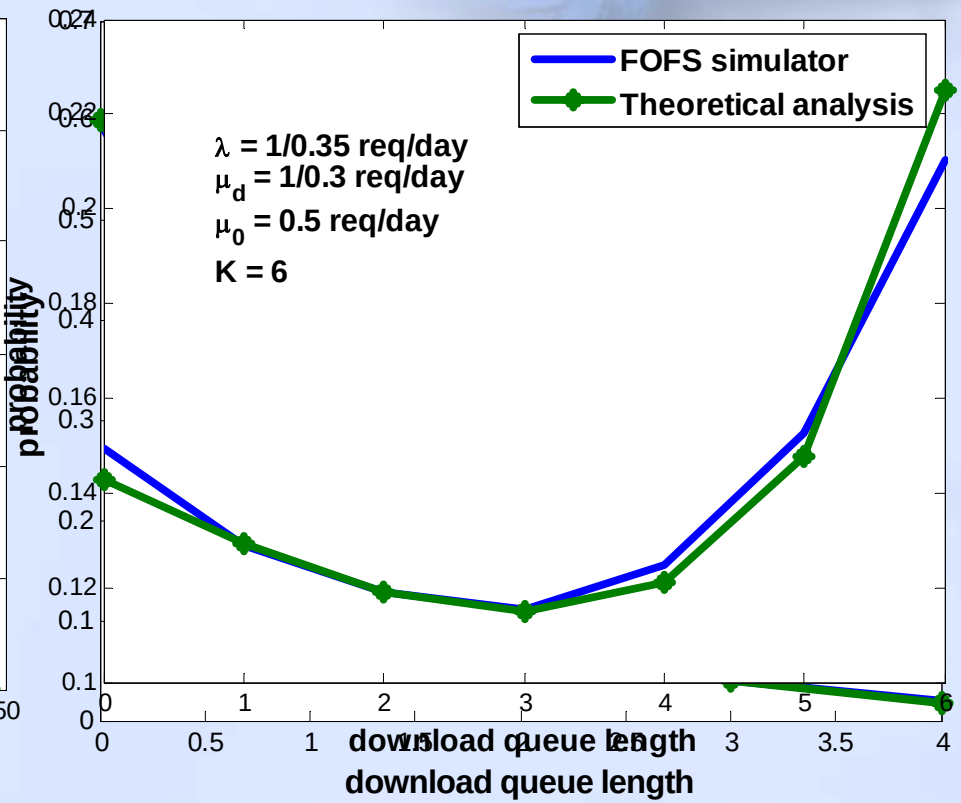


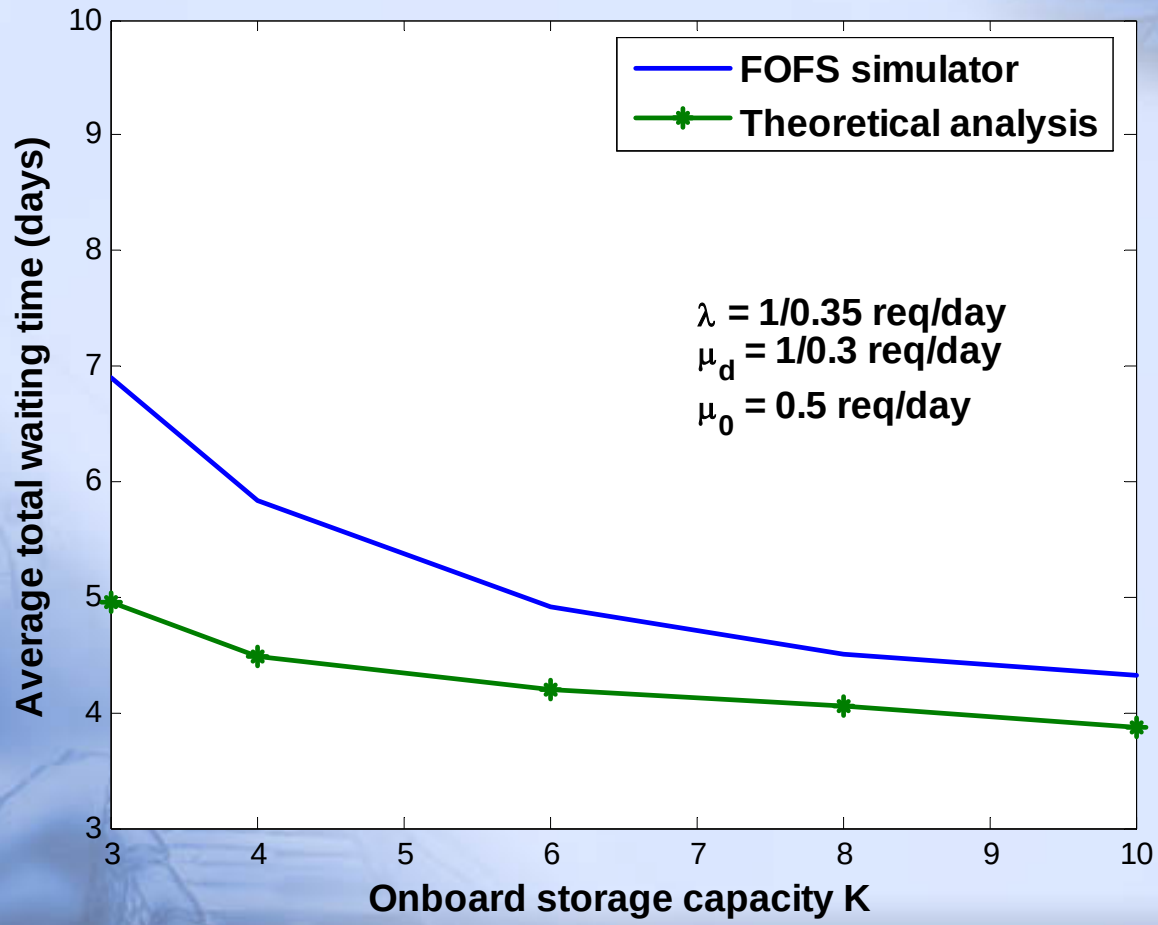
Image capture queue length
Download queue length
μ_d
λ
$1 \cdot \mu_0$
$2 \cdot \mu_0$
$n \cdot \mu_0$
$(n+1) \cdot \mu_0$
$C \cdot \mu_0$
0, 0
0, 1
0, 2
1, 0
1, 1
1, 2
2, 0

Results

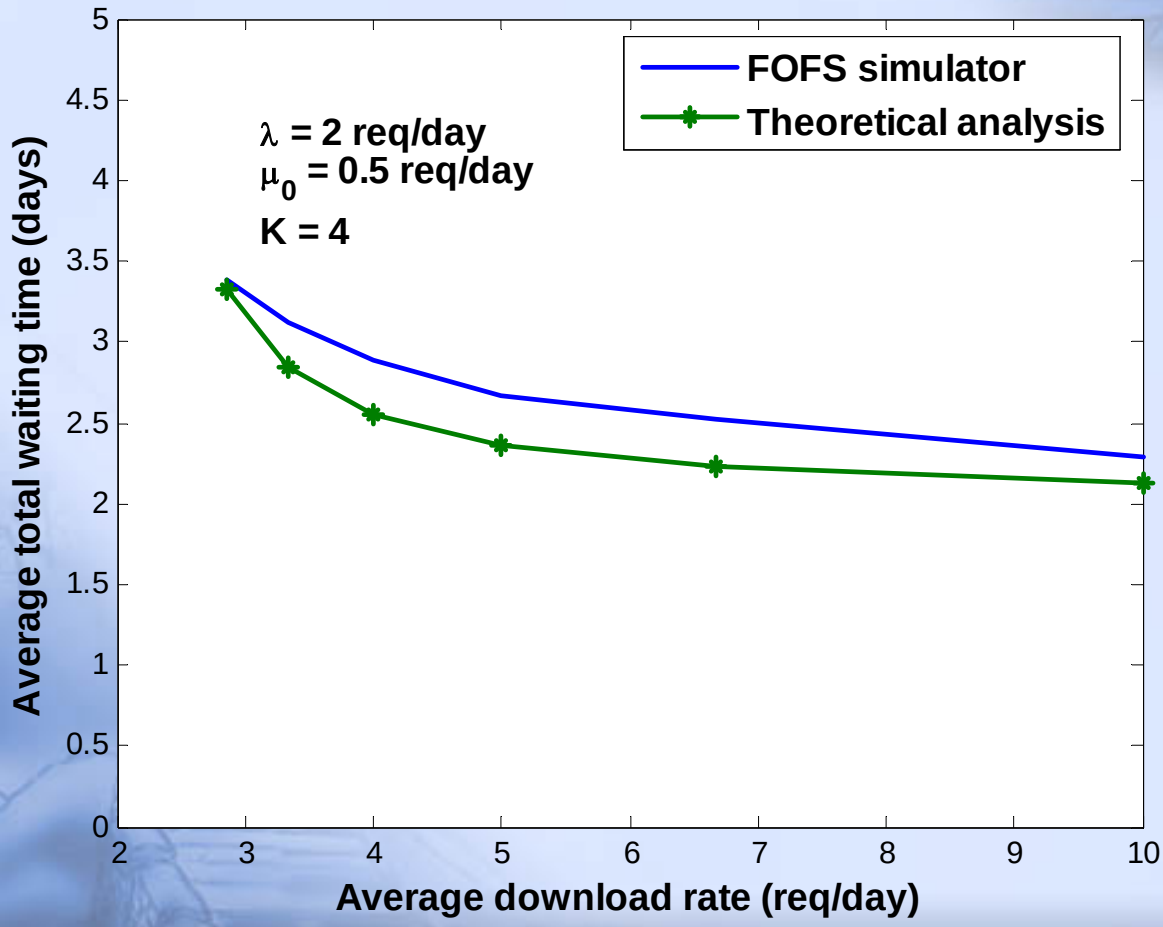

FOFS simulator
Theoretical analysis
λ = 1/0.35 req/day
μd = 1/0.3 req/day
μ0 = 0.5 req/day
K = 6
probability
image queue length


FOFS simulator
Theoretical analysis
λ = 1/0.35 req/day
μd = 1/0.3 req/day
μ0 = 0.5 req/day
K = 6
probability
download queue length

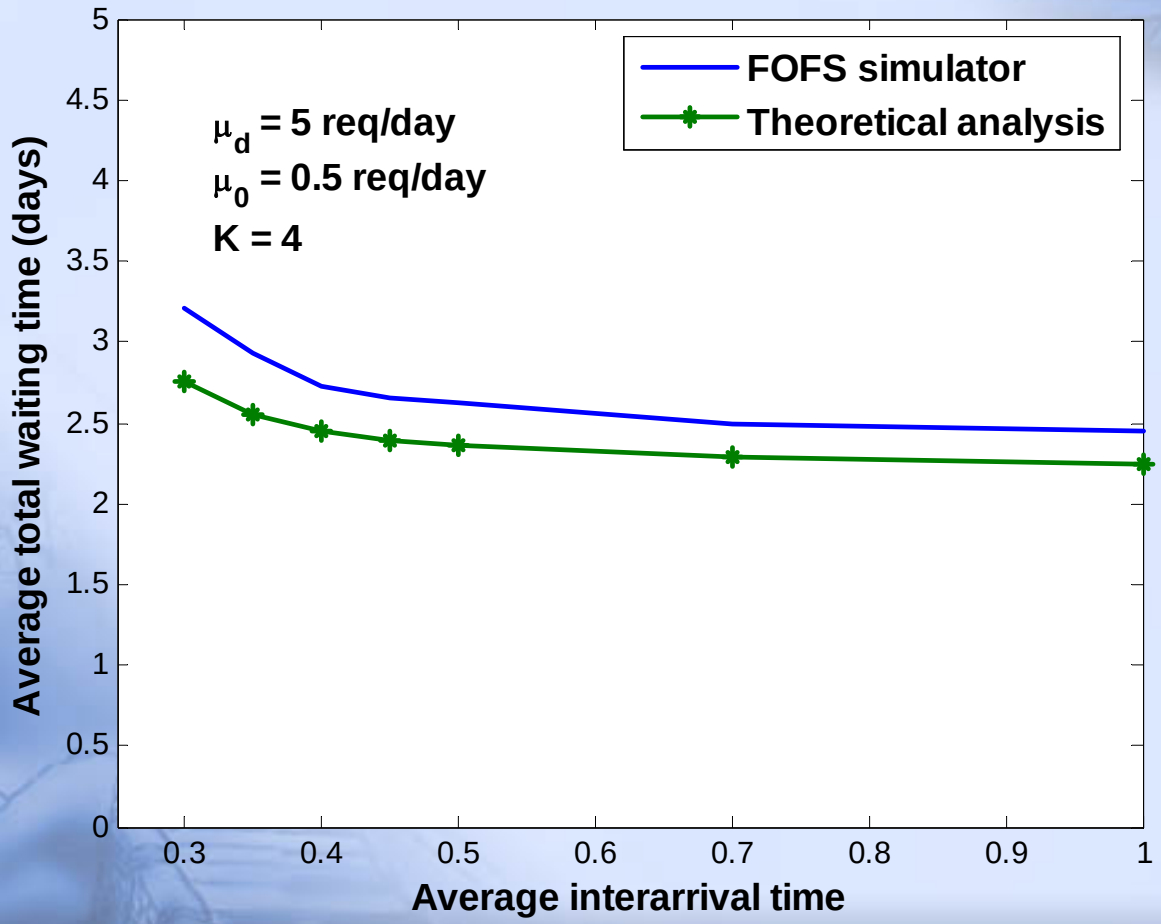
Effects of memory capacity



Effects of average download rate



Effects of arrival rate



Conclusions

- The proposed model is able to represent the imaging service process of earth observation satellite.
- The onboard memory capacity, the download rate, and the request arrival rate, all have effects on the system performance.
- It will be useful to apply the model help with system configuration optimisation.

Future Work

- More realistic assumptions
  - General distributed download service
  - Non-universal distributed location of arrival requests
- Failure analysis
- Constellation analysis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Abuja_Nigeria
Size:
2x2
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0.5000
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Help
Time Step: 10.00 sec
Thank you