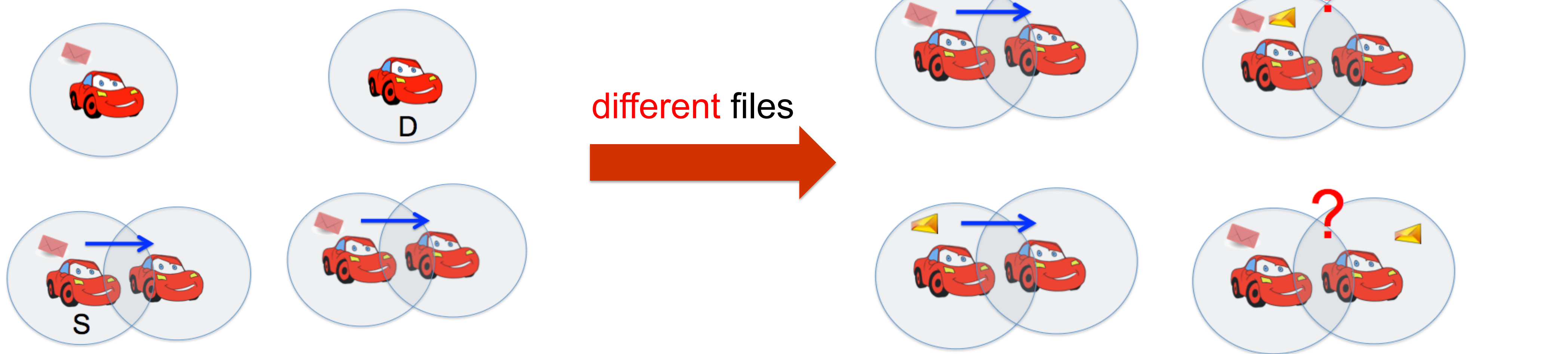


Optimal Control for Epidemic Routing of Files with Different Priorities in DTNs

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Motivation

Epidemic Routing



Problem Formulation

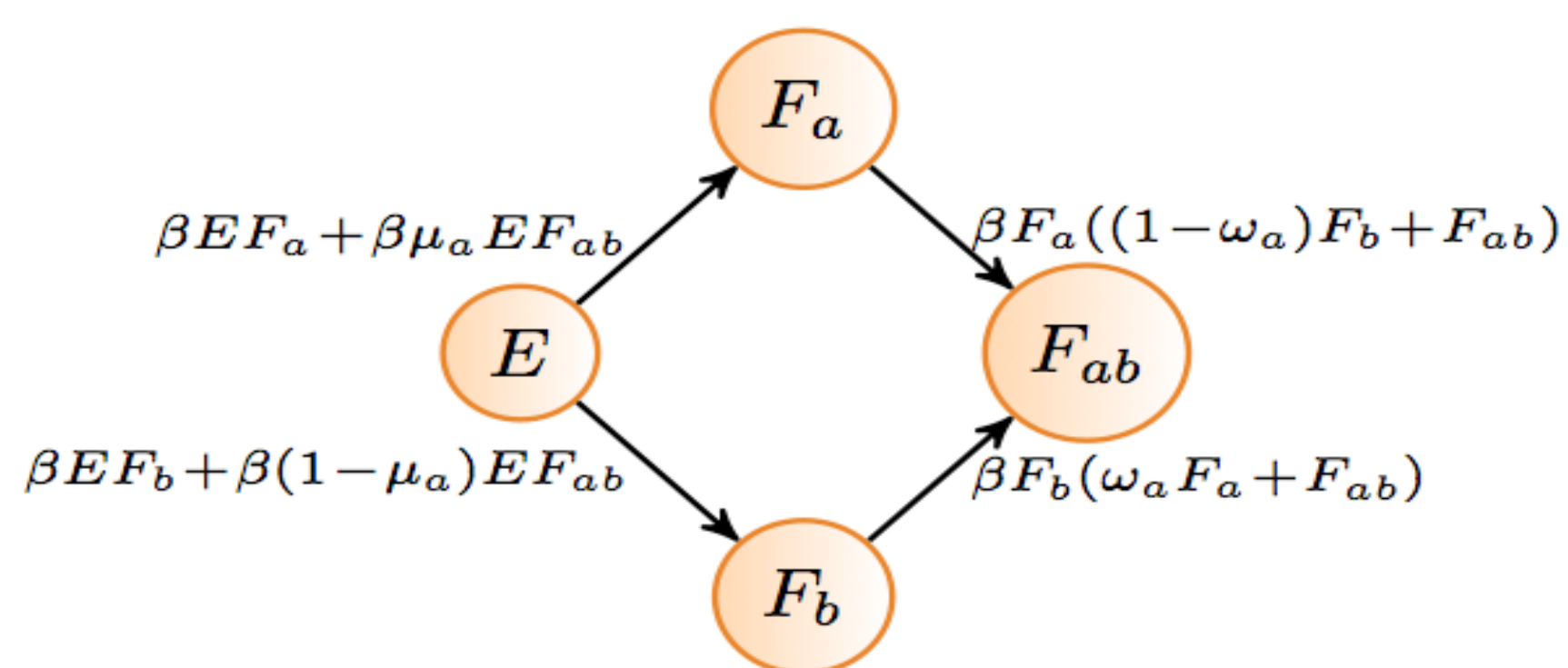


Fig. 1: System Dynamics (Fluid Model)

$E(t), F_a(t), F_b(t), F_{ab}(t)$: fractions of nodes

β : encounter rate

$\mu_a(t)$: probability that a full node transmits file a

$\omega_a(t)$: probability that a single node transmits file a

Goal: properly choose $(\mu_a(t), \omega_a(t))$ in $[0, 1]^2$ over $[0, T]$ to maximize the reward function at time T:

$$R(\mu_a, \omega_a) = W_a F_a(T) + W_b F_b(T) + W_{ab} F_{ab}(T)$$

Nonlinear
Dynamic

Pontryagin's Principle

Base Problem Formulation

$$\begin{aligned} &\text{minimize: } \int_{t_0}^{t_f} \ell(\mathbf{x}(t), \mathbf{u}(t)) dt \\ &\text{subject to: } \dot{\mathbf{x}}(t) = \mathbf{f}(\mathbf{x}(t), \mathbf{u}(t)); \quad \mathbf{x}(t_0) = \mathbf{x}_0, \quad \mathbf{x}(t_f) = \mathbf{x}_f \\ &\quad \mathbf{u} \in \mathcal{U}[t_0, T] \triangleq \{\mathbf{u} \in \hat{\mathcal{C}}[t_0, T]^{n_u} : \mathbf{u}(t) \in U, t_0 \leq t \leq t_f\} \end{aligned}$$

necessary condition

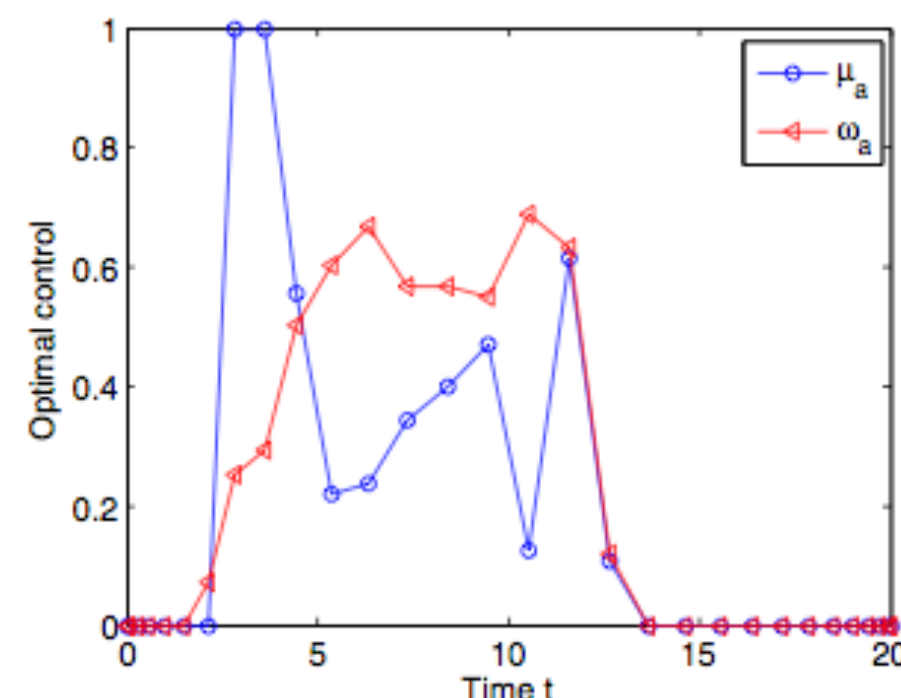
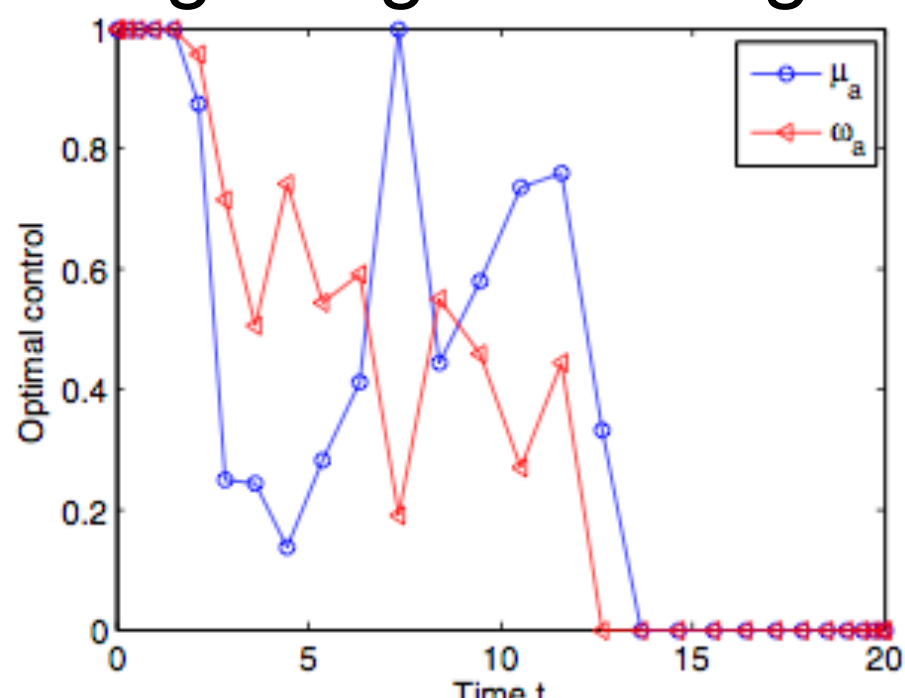
Extremely **powerful** result:

$$\mu^*(t) \in \arg \min_v \{H(\mathbf{x}^*(t), \mathbf{v}, \lambda_0^*, \lambda^*(t)) : \mathbf{v} \in U\}$$

Question: closed-form?
structural properties?

Structural Results

“Bang-Singular-Bang”



Future Work

- Generalize to multiple files network.
- Identify how the optimal policy depends on the initial network conditions.

[1] Shangxing Wang, MHR. Khouzani, Bhaskar Krishnamachari and Fan Bai, “Optimal Control for Epidemic Routing of Two Files with Different Priorities in Delay Tolerant Networks”, submitted to ACC 2015.