Strategies for Traffic-Aware VM Migration

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1. Motivation:

- Reducing amount of communication in datacenters.
- Our approach: use VM migration for co-locating VMs which communicate frequently.
- Can be used to balance load and alleviate hotspots, or even to save energy.

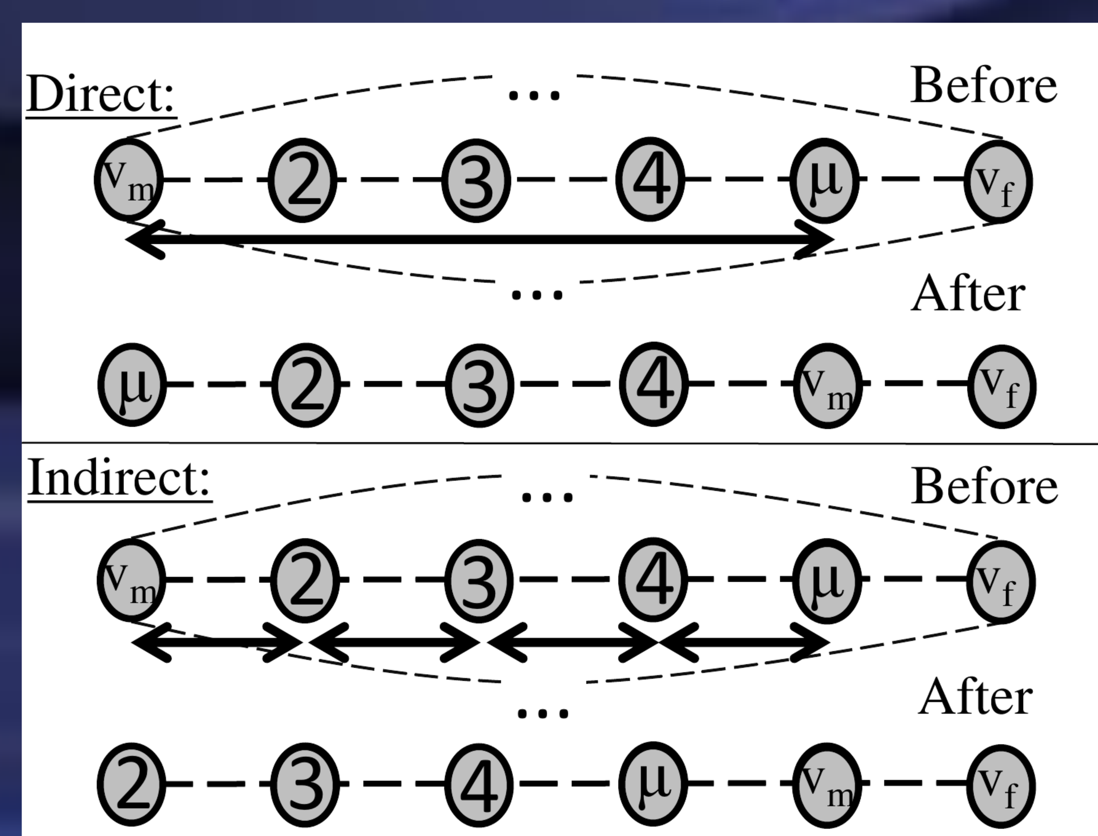
2. Settings:

- A physical **host graph H (the datacenter)**:
  H = (M, L).
  M – physical machines.
  L – physical links.
- A **guest graph G (Collection of tenants):**
  Application i: $G_i=(V_i, E_i, w_i)$.
  V_i – a set of VMs.
  $W_i(e_i)$–frequency of communication
  $G = \cup G_i$

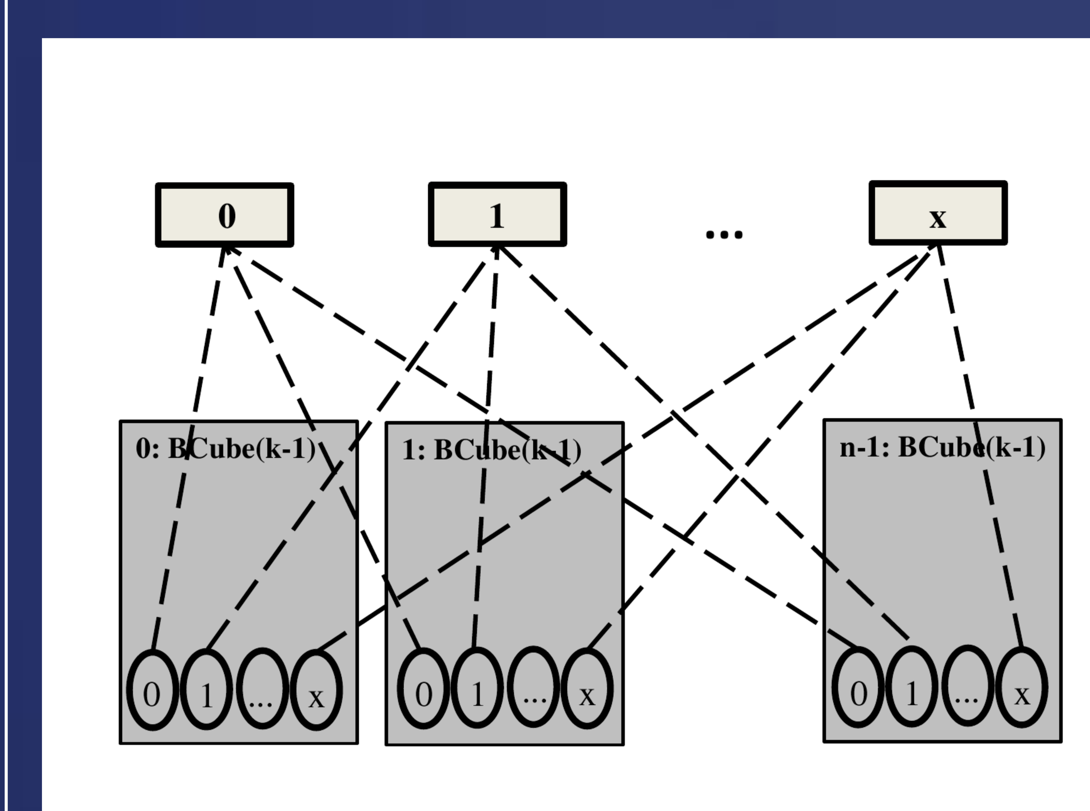
2. Model:

- $\sigma = \{\sigma_1 \dots \sigma_n\}$ a sequence of communication requests.
- **Mapping function:**
  For u ∈ V, $\lambda_t(u)$ **–** the physical machine that hosts u at time t.
- ALG – migration algorithm can change the location of the VM.
- For $u, v \in V$, $d(u,v)$ – shortest path between $\lambda(u)$ and $\lambda(v)$.
- *Amortized Cost*: (H, ALG, σ)
  $= \frac{1}{|\sigma|} \sum_{t=1,(u,v)\in\sigma_t} d_t(u,v)$

Direct Vs Indirect:



BCube Architecture:



4. Desination-Swap Algorithms:

- After communication request (u,v) – make u, v neighbors.
- Select "migrated VM" according to amortized cost.
- Select a "Destination" for migration.
- Destination Methods:
  - Random.
  - BestNeighbor.
  - MeetMiddle.
- Swapping Methods:
  - Direct.
  - Indirect.

5. Main Results:

- Random-Direct **Converges to Best solution** under a "matching" guest graph.
- Simulation shows **great improvement** for using BestNeighbor algorithm over simple random placement.
- Quick convergence time.

6. Simulation Results:

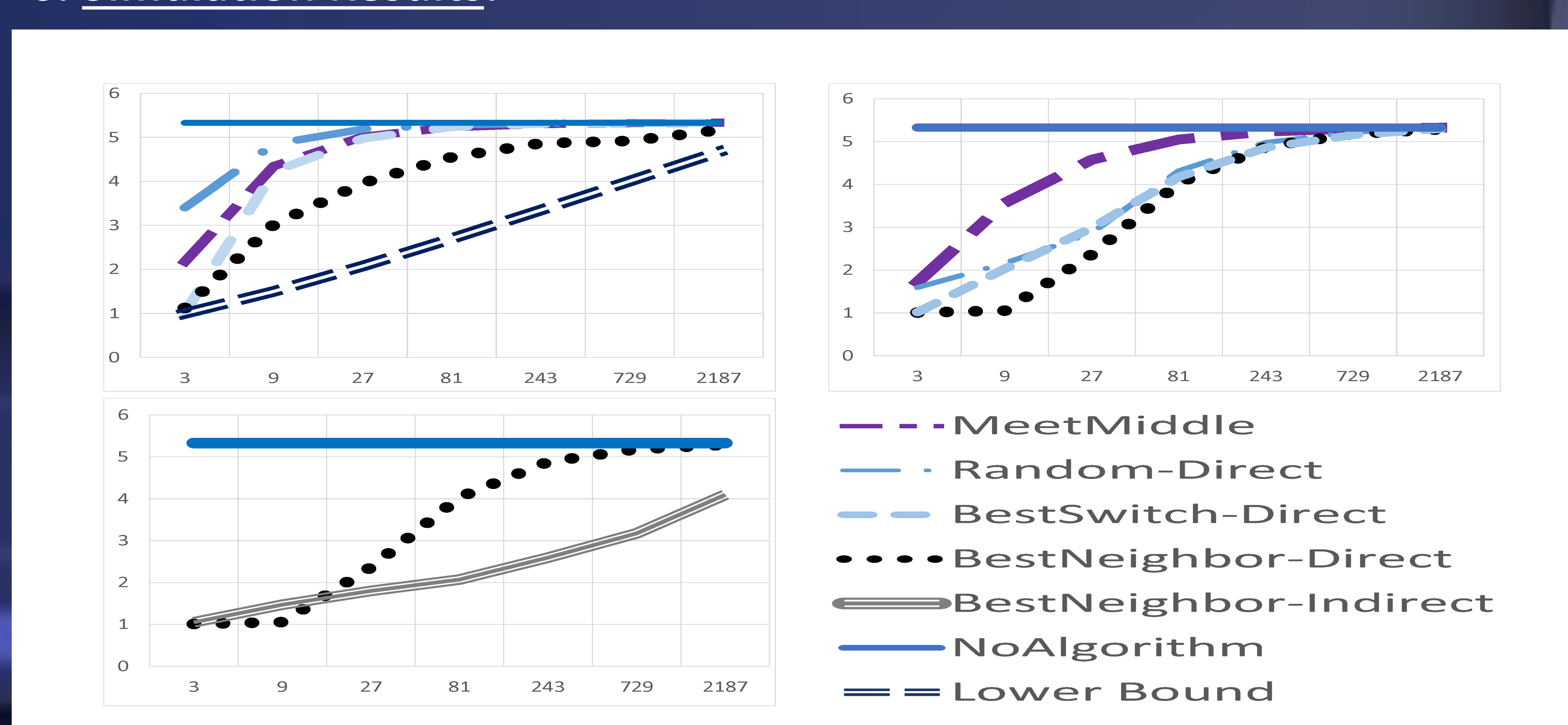


Fig. 2. Amortized communication cost as a function of the (tenant) guest graph size after 3m requests for host graph BCube(3,7) and for *upper left:* all-to-all communication $G^{(K_x)}$, *upper right:* one-to-all communication $G^{(S_x)}$, *bottom left:* $G^{(S_x)}$, Direct VS Indirect swaps for BestNeighbor