

Modelling BitTorrent with PEPA

Ashok Argent-Katwala

Department of Computing

Imperial College London

`http://aesop.doc.ic.ac.uk/`

June 11, 2004

1 Aim

To understand how BitTorrent works.

To gauge the performance cost of adding new features.

To improve client interfaces.

2 BitTorrent

A very popular peer-to-peer application, especially good for '0-day' releases. Often no (interesting) steady-state.

Terminology:

- pieces
- tracker
- seeds
- 'leeches'
- choking
- optimistic unchoking

3 Modelling goals

Represent each peer identically. Be able to add more peers simply.

4 Naive model

```
Piece_i = (transfer, down_i).GotPiece;  
GotPiece_i = (transfer, up_i).GotPiece;
```

```
Peer = (Piece_1 || ... || Piece_n);  
Seed = (GotPiece_1 || ... || GotPiece_n);  
System = (Peer <L> ... <L> Peer <L> Seed);
```

```
L = {transfer}
```

```
System
```

5 Huge model

```
Piece_i_j = (transfer_1_i, down_i).GotPiece_i_j  
            + (transfer_2_i, down_i).GotPiece_i_j  
            + ... i
```

```
GotPiece_i_j = (transfer_i_1, up_i).GotPiece_i_j  
               + (transfer_i_2, up_i).GotPiece_i_j  
               + ... i
```

```
Peer_i = (Piece_i_1 || ... || Piece_i_n);  
System = (Peer_1<L> ... <L> Peer_n<L> Seed);  
L = {transfer_1_1, transfer_1_2 ...}
```

6 Smaller model

$$\begin{aligned} \text{Peer}_{i_j} = & (\text{transfer}_{1_i}, \text{down}) . \text{Peer}_{i_{j+1}} \\ & + (\text{transfer}_{2_i}, \text{down}) . \text{Peer}_{i_{j+1}} \\ & + \dots \\ & + (\text{transfer}_{i_1}, \text{up} . \alpha_i) . \text{Peer}_{i_j} \\ & + (\text{transfer}_{i_2}, \text{up} . \alpha_i) . \text{Peer}_{i_j} \\ & + \dots ; \end{aligned}$$
$$\begin{aligned} \text{System} = & (\text{Peer}_{1_0} \langle L \rangle \dots \langle L \rangle \text{Peer}_{n_0} \\ & \langle L \rangle \text{Peer}_{n+1_n}) ; \end{aligned}$$
$$L = \{ \text{transfer}_{1_1}, \dots \}$$

7 Extras

- Arrivals, departures and aborting
- Tracker
- Choking

8 Links

`<http://logicwand.com/darktorrent/>`

`<http://www.notcon04.com/>`

`<http://aesop.doc.ic.ac.uk/>`