Drivers For
Control Plane Technology

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Management & Control

- Starting point is service management
- Network management criticism cannot be applied universally
  - Not all systems are the same!
    - Levels of automation vary considerably
  - Processes, planning philosophy, network structure, play a large part
- Require
  - distribution of functionality between control plane and management plane
    - Implementation choice with strong dependence on legacy
      - Component model of ASON
    - Want reuse of some capabilities in existing OSS
    - Delegation of authority
      - there can only be one captain of the ship

Business Drivers

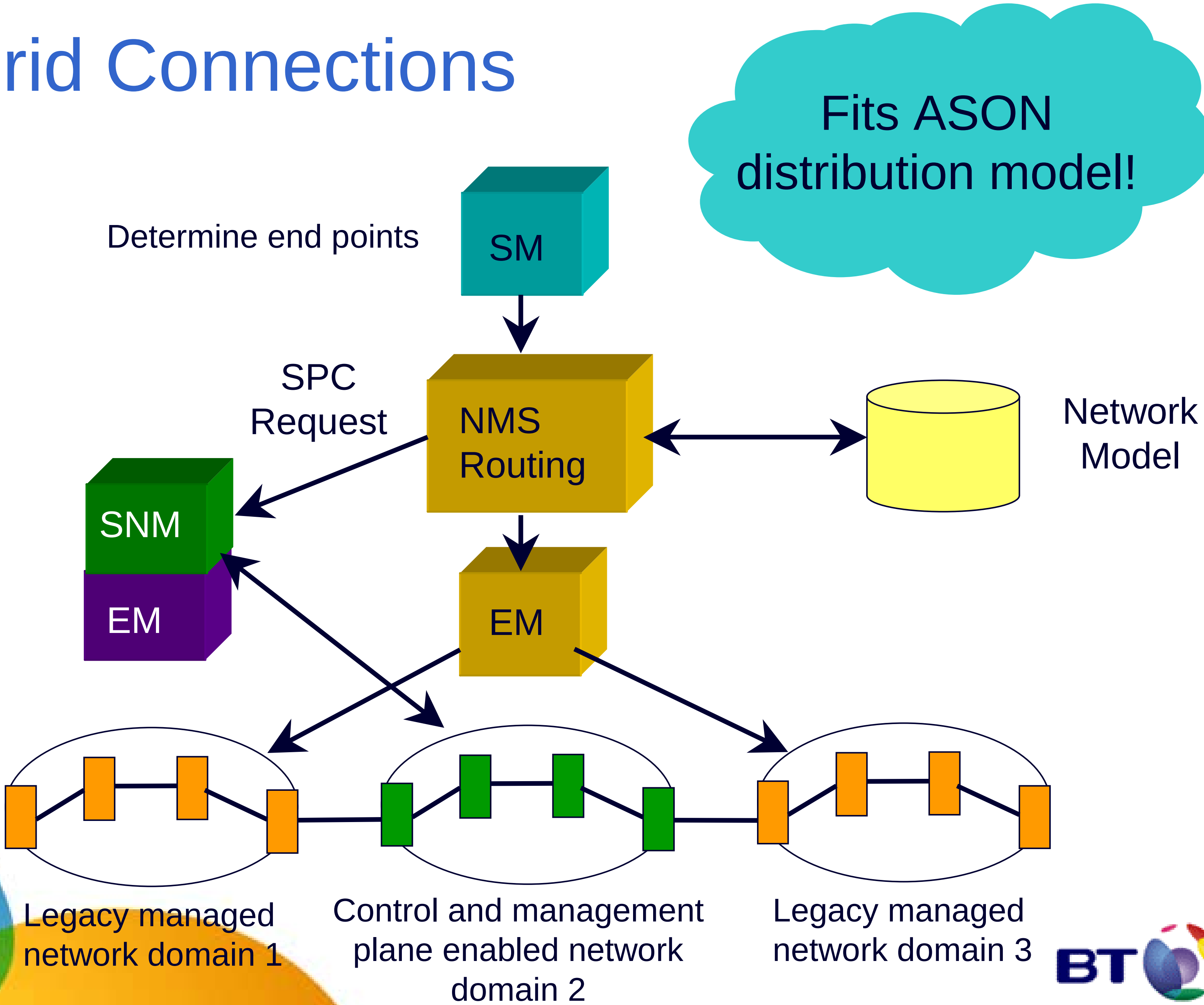
trust the fluffy cloud

- Radically simplified network
- Allow the network to manage restoration - eliminate complex protection options & routing decisions
- OPEX reduction from hands-off operation using the control plane to manage restoration and planned work - radically reduce need for manual intervention *(also achieved by simplifying the network)*
- **CAPEX reduction from shared restoration**
- Simplified product set using control plane restoration
- Simplified planning process with capacity planning & management structure
- Reduction in OSS stack complexity - BUT not replacement

Operational Aspects

- Integration with essential OSS allows:
  - management of the network as a seamless entity with agreed and working interfaces into overall network capacity management and plan and build
  - management of customer service end-end with alarm and performance data
- Manage separation into and out of the control plane cloud but not within it.
- Repair is an offline activity. Restoration of service is not dependent on repair

Hybrid Connections



Soft Permanent Connections

- Connections setup by network operator using signalling
  - similar to many installed ATM networks
- Managed connection characteristics
  - time to allow for order placement by customer, service management and network management processes
  - establishment of connection
  - testing of performance prior to handover to customer
  - wrap-up time
- Minimises impact on OSS

Dynamic/Switched Services

- Examples that have been proposed in literature
  - Distributed storage area networks
  - LAN extension
  - Disaster Recovery
  - Outside broadcast for major sporting events
  - Layer 1 virtual private networks
  - Real-time traffic engineering
- How well can they be supported
  - Erlang models provide a good indication

Classical Performance Requirements

- Traditional performance requirement for the Phone Network is simply defined by the percentage of calls blocked in a single hour
  - assumes Poisson arrivals and negative exp holding times, infinite sources
- Adopting above for a transport network leads us no further
  - Phone network is scale invariant: passing to a system with longer holding times has no effect on network sizing or cost
  - Phone network is independent of the 1-hour assumption, this merely serves to define the duration (the busy hour) over which the reference traffic is measure
- Scaling up the holding time in above way would however lead to relaxation times that would be unacceptable to the customer.

New Service Criteria

- We suggest that any network which offers single high bandwidth connections should be designed and dimensioned not on the basis of the percentage of calls blocked, but rather on a delay basis. A suggested service description might be:
- A request for a connection will be successful immediately on at least S% of occasions; of those not immediately successful, T% will be satisfied with a delay of not more than t.

Delay System

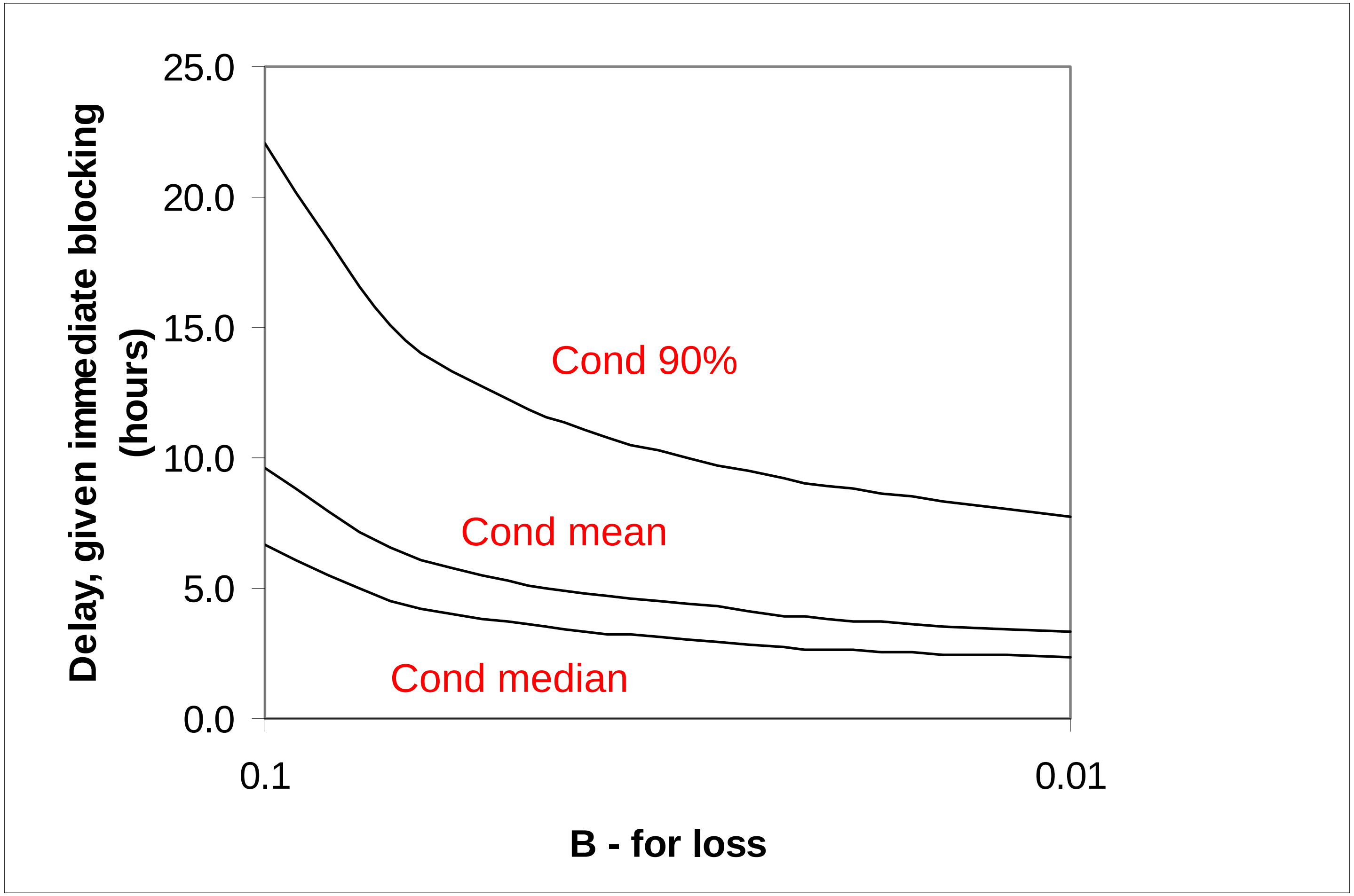
- Enqueued, FCFS
- M/M/N queue model
- N: discrete circuits, A: offered traffic, H: Holding time
- Classical Erlang Theory
- Conditional mean delay = H/(N-A)
- Conditional median delay - 0.69H/(N-A)
- Conditional 90th Percentile delay = 2.3H(N-A)

$$P(queueing) = C_N(A) = \frac{NE_N(A)}{N - A(1 - E_N(A))} = \frac{NB}{N - A(1 - B)}$$

$$P(service < time\, t) = P(0) + (1 - P(0))(1 - e^{-(N-A)t})$$

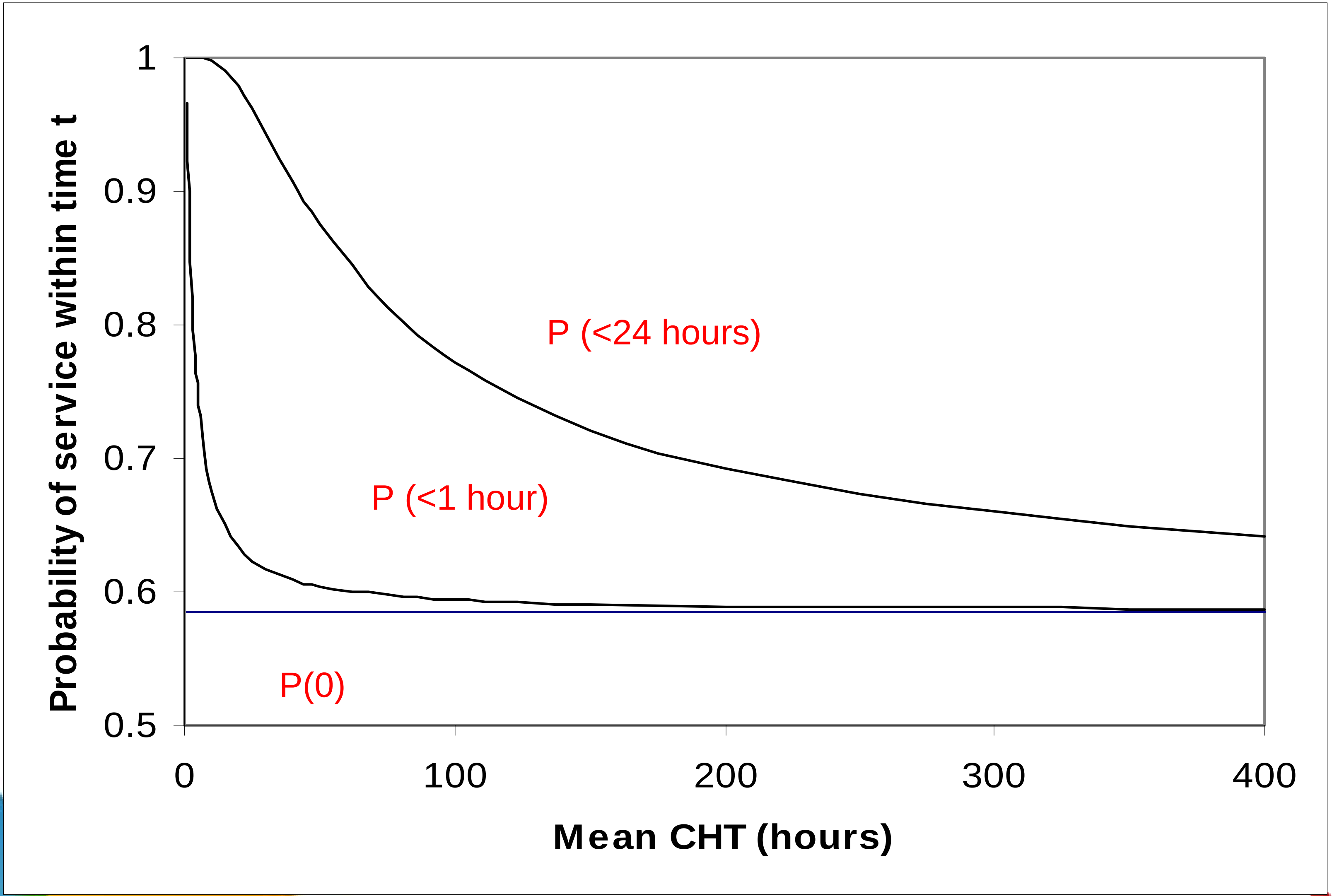
P(0) - Probability of immediate service

Example



N=16, CHT=24 hours, 0.01< B < 0.1

Example



N=16, B=0.1, A=13.5

Conclusions

- Major driver is soft permanent connections
- Strong interaction with network management required
  - control plane only solutions inadequate
  - offline tools and many OSS functions required
  - hybrid connections required to work with installed base
- Studies suggest it may not be commercially viable to offer a switched service for long-holding times: the expected delays for initially blocked calls are likely to be intolerable to users
- ASON tutorial
  - A. McGuire, G. Newsome, L. Ong, J. Sadler, S. Shew and E.Varma: "Architecting the Automatically Switched Transport Network: ITU-T Control Plane Recommendation Framework", Chapter 16, Optical Network Standards, Edited by K. Kazi