NEIGHBOUR REPLICA AFFIRMATIVE ADAPTIVE FAILURE DETECTION AND AUTONOMOUS RECOVERY

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged

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ABSTRACT

High availability is an important property for current distributed systems. The trends of current distributed systems such as grid computing and cloud computing are the delivery of computing as a service rather than a product. Thus, current distributed systems rely more on the highly available systems. The potential to fail-stop failure in distributed computing systems is a significant disruptive factor for high availability distributed system. Hence, a new failure detection approach in a distributed system called Affirmative Adaptive Failure Detection (AAFD) is introduced. AAFD utilises heartbeat for node monitoring. Subsequently, Neighbour Replica Failure Recovery(NRFR) is proposed for autonomous recovery in distributed systems. AAFD can be classified as an adaptive failure detector, since it can adapt to the unpredictable network conditions and CPU loads. NRFR utilises the advantages of the neighbour replica distributed technique (NRDT) and combines with weighted priority selection in order to achieve high availability, since automatic failure recovery through continuous monitoring approach is essential in current high availability distributed system. The environment is continuously monitored by AAFD while auto-reconfiguring environment for automating failure recovery is managed by NRFR. The NRFR and AAFD are evaluated through virtualisation implementation. The results showed that the AAFD is 30% better than other detection techniques. While for recovery performance, the NRFR outperformed the others only with an exception to recovery in two distributed technique (TRDT). Subsequently, a realistic logical structure is modelled in complex and interdependent distributed environment for NRDT and TRDT. The model prediction showed that NRDT availability is 38.8% better than TRDT. Thus, the model proved that NRDT is the ideal replication environment for practical failure recovery in complex distributed systems. Hence, with the ability to minimise the Mean Time To Repair (MTTR) significantly and maximise Mean Time Between Failure (MTBF), this research has accomplished the goal to provide high availability self sustainable distributed system.

ABSTRAK

Kebolehsediaan yang tinggi ialah satu ciri penting untuk sistem teragih semasa. Kecenderungan sistem-sistem teragih masakini seperti *grid computing* dan *cloud computing* ialah penyedian pengkomputeran sebagai satu perkhidmatan berbanding sebagai satu produk. Oleh itu, sistem teragih semasa sangat memerlukan sistem yang mempunyai kebolehsediaan yang tinggi. Potensi untuk gagal-berhenti dalam sistem pengkomputeran teragih adalah faktor yang memyebabkan gangguan kepada kebolehsediaan yang tinggi. Oleh itu, tesis ini mencadangkan pengesanan kegagalan yang afirmatif serta adaptif (AADF). AAFD menggunakan *heartbeat* untuk pemantauan nod. Seterusnya pemulihan kegagalan replika kejiranan (NRFR) dicadangkan untuk pemulihan secara autonomi. Oleh kerana AAFD dapat mengadaptasi dengan ketidaktentuan rangkaian dan CPU, ia boleh diklasifikasikan sebagai pengesan kegagalan yang adaptif. NRFR menggunakan kelebihan teknik replika kejiranan teragih (NRDT) dan menggabungkan pemilihan keutamaan berdasarkan pemberat. Seterusnya AAFD dan NRFR dinilai melalui pelaksanaan *virtualisation*. Hasil keputusan menunjukkan, secara puratanya AAFD adalah 30% lebih baik dari teknik-teknik yang lain. Manakala bagi prestasi pemulihan, NRFR mengatasi yang lain kecuali untuk pemulihan didalam teknik replika berdua (TRDT). Seterusnya, struktur logik yang realistik dan praktikal bagi kebolehsediaan tinggi dalam persekitaran teragih yang komplek dan saling bergantungan dimodelkan untuk NRDT dan TRDT. Model ini membuktikan bahawa kebolehsediaan NRDT adalah 38.8% lebih baik. Oleh yang demikian, model ini membuktikan NRDT adalah pilihan terbaik untuk memulihkan kegagalan di dalam sistem teragih yang komplek. Oleh itu, dengan kebolehan meminimumkan Mean Time To Repair (MTTR) dan memaksimumkan Mean Time Between Failure (MTBF), kajian ini mencapai matlamat untuk menyediakan sistem teragih yang mampan dan kebolehsediaan tinggi.