# 스케일 프리 ICN 코어 네트워크에서 클러스터링 기반 콘텐츠 관리

하산 캄룰, 정성호

한국외국어대학교 정보통신공학과

# Clustering-based Content Management in the Scale-Free ICN Core Network

Kamrul Hasan and Seong-Ho Jeong, Dept. of ICE, HUFS
kamrul@hufs.ac.kr, shjeong@hufs.ac.kr

## Abstract

Information-centric networking (ICN) is a paradigm shift for the modern Internet architecture. For ICN, information is retrieved based on the name of the information, rather than the positions of the information. While ICN is well acquainted with its various features, such as in-network information caching, unique naming, built-in information protection, there are some ICN drawbacks, such as Interest flooding, poor cache management, and proper content handling, which reduces ICN's performance. We propose a clustering framework within this paper for efficient content management in the scale-free ICN core network to address the solution of the ICN's current drawbacks. We illustrate how the cluster eliminates Interest flooding in the scale-free core network and improves ICN's performance during content retrieval, and how the network manages the newly generated node in the cluster-based ICN network dynamically. Within the scale-free network, we applied the principle of network science to make the core ICN network more efficient and robust.

## I. Introduction

If the core network in the Internet handles the information caching and Interests efficiently, the end-user receives the necessary content from nearby caching devices within a short amount of time. We also took the ICN core network into account. The well-known disadvantages of the current ICN can be overcome if we can manage the ICN core network efficiently. The ICN core network was assumed to be a scale-free network in this paper. A power-law degree distribution by Equation (1) follows the scale-free network to create the network.

$$P(k) = k^{-\alpha} \cdots\cdots\cdots (1)$$

We developed our BA-algorithm-based scale-free network[1] for the variable number of nodes and $\alpha$ values. BA-algorithm also follows the power-law distribution of each node identified by m as well as the degree distribution.
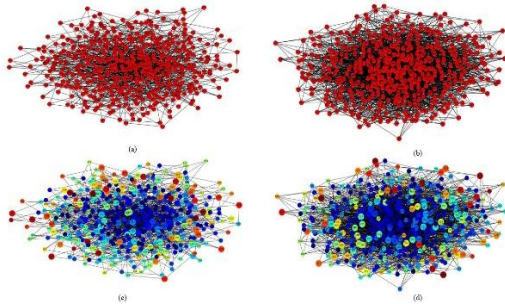


Figure 1: Cluster and cluster-head in the scale-free network using BA-Algorithm for 500 nodes (a) Scale-free network for m = 3, (b) Scale-free network for m = 6, (c) Cluster and cluster-head in the scale-free network for m = 3, and (d) Cluster and cluster-head in the scale-free network for m = 6

## II. Clustering mechanism in the scale-free network

Figure 1 (a) and (b) show the scale-free network for varying degrees of centrality within each node. The clustering algorithms are implemented to render the clusters and cluster heads inside the generated scale-free network. After using the algorithms in every scale-free network, each cluster was returned by a series of groups and their representatives depending on the degree of centrality of each node. Figure 1 (c) and (d) display the clusters and heads of the clusters depending on the various colours and the more large nodes. A newly added node automatically joins the nearby cluster because of less degree of centrality. The detailed analysis of clustering results based on the total number of clusters and nodes per cluster is shown in Figure 2. The single-node clusters are not considered as a cluster, and they are merged into the neighbour cluster.
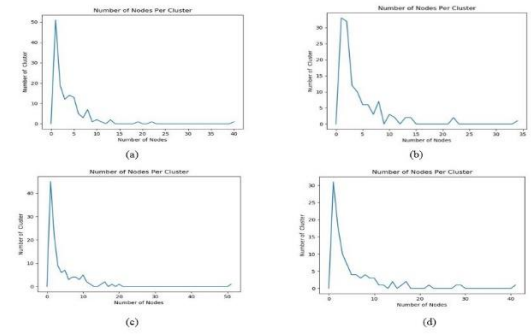


Figure 2: Number of nodes per clusters for 500 nodes (a) when m = 3.0, (b) when m =4.0, (c) when m = 5.0, and (d) when m = 6.0

All the cluster nodes and cluster heads are responsible for managing the incoming Interest Packets and Data packets. As a consequence, the issue of Interest flooding is solved, and the cluster head manages the process of information caching inside the cluster as well as linked cluster heads effectively. The cluster head also maintains the collaborative caching management within a cluster.

## III. Concluding Remarks

This paper primarily explained the clustering and coordination mechanism inside the scale-free ICN core network to resolve the existing drawbacks of ICN. The new network structure design of the Internet is considered as a scale-free network, and this definition is ideally adapted for the current ICN core network.

### Acknowledgement

### References

[1] Albert, Réka; Barabási, Albert-László (2002). "Statistical mechanics of complex networks" (PDF). Reviews of Modern Physics. 74 (47): 47-97.