Fiber optics have narrowed the gap between an ISP’s total web traffic and bandwidth provided by high capacity links. Now, datacenters connected to ISPs via fiber links can quickly deliver web content to the ISP’s users without placing edge servers within the ISP. Due to economies of scale, these datacenters can host web content efficiently, making it cheaper to set up a content delivery network (CDN) that caches content to reduce delivery times. Increasingly, CDNs must do more than reduce response times to attract customers; They also have to keep prices low and invest in new features that add value to their service.

We propose a new value-added feature for CDNs: Carbon offsetting. Carbon offsets represent a unit of work that voids 1g of carbon emission. By buying carbon offsets, CDNs can void emissions caused by traffic that they intercept, including emissions spent getting content from source servers. These green CDNs would add value because the growing carbon footprint of the web is concerning. If datacenters worldwide were treated as a country, they would rank among the top 30 carbon emitters. Rounding through MantisMail, offsetting 295g CO2e per day (about 1 mile in an econ. car). While email is personal, caching email alone causes more than 1M metric tonnes of carbon emission each year [1, 2], even though email is less than 1% of Internet traffic.

**Research Challenge 1:** To offset the emissions caused by retrieving content from source servers, green CDNs must estimate the carbon needs of servers and network links they do not control. Prior studies have estimated carbon needs for specific workloads, but most of these studies confound the contributions of applications, hardware, and environment. Our approach captures each independently, allowing us to predict the effects of Moore’s Law and growing renewable energy penetration.

**Research Challenge 2:** The simplest design for a green CDN is 1) cache content on a cluster of servers, 2) size the cluster based on hit rate and bandwidth costs, 3) estimate emissions, and 4) buy offsets as needed. But carbon offsetting increases costs, affecting the best cluster size for a green CDN. Further, these costs vary over time with energy prices and renewable energy production.

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\begin{align*}
\text{Min: } & \lambda P_{\text{co}2e} [E_{\text{source}} \times M(N)] + \lambda P_B + P_{\text{srvr}} \times N \\
\text{Subject to: } & \mu N \geq \lambda
\end{align*}
\]