GOAL
To provide network connectivity in hard-to-reach areas using a nanosatellite constellation

PROBLEM STATEMENT
How would nanosatellites schedule their message delivery effectively and efficiently considering nanosatellite limitations in terms of size, power onboard data storage, energy capacity and contact time windows?

OPTIMIZATION MODELS
Nanosat Scheduling Decision Making for Single-hop Architecture
- Optimization model (P1) is a binary linear program that minimizes priority weighted delivery completion time
- Optimization model (P2) is a standard linear program with a very special structure that minimizes priority weighted mean busy times
- Optimization model (P2) has an equivalent minimum cost network flow representation, and thus the integer optimal solution is guaranteed with integer input parameters

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\text{(P1) Weighted completion time model}
\begin{align*}
\min & \quad \sum_{j=1}^{J} w_j C_j \\
\text{subject to} & \quad C_j \geq \tau_{k+1} u_{jk} \quad \text{for} \quad j = 1, \ldots, J, k = 0, \ldots, K - 1 \\
& \quad \sum_{j=1}^{J} u_{jk} \leq 1 \quad \text{for} \quad k = 0, \ldots, K - 1 \\
& \quad \sum_{j=1}^{J} u_{jk} = s_j \quad \text{for} \quad j = 1, \ldots, J \\
& \quad e_{k+1} = e_k + \delta_k - \sum_{j=1}^{J} u_{jk} - h_k \\
& \quad \text{for} \quad k = 0, \ldots, K - 1 \quad \text{and} \quad e_0 \text{ is given} \\
& \quad e_{\text{min}} \leq e_k \leq e_{\text{max}} \quad \text{for} \quad k = 0, \ldots, K \\
& \quad h_k \geq 0 \quad \text{for} \quad k = 0, \ldots, K - 1 \\
& \quad C_j \geq 0 \quad \text{for} \quad j = 0, \ldots, J \\
& \quad u_{jk} \in \{0,1\} \quad \text{for} \quad j = 1, \ldots, J, k = 0, \ldots, K - 1
\end{align*}
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\text{(P2) Weighted mean busy time model}
\begin{align*}
\min & \quad \sum_{j=1}^{J} \sum_{k=0}^{K-1} w_j \left( \frac{\tau_k + 1}{2} \right) u_{jk} \\
\text{subject to} & \quad \sum_{j=1}^{J} u_{jk} \leq 1 \quad \text{for} \quad k = 0, \ldots, K - 1 \\
& \quad \sum_{k=0}^{K-1} u_{jk} = s_j \quad \text{for} \quad j = 1, \ldots, J \\
& \quad e_{k+1} = e_k + \delta_k - \sum_{j=1}^{J} u_{jk} - h_k \\
& \quad \text{for} \quad k = 0, \ldots, K - 1 \quad \text{and} \quad e_0 \text{ is given} \\
& \quad e_{\text{min}} \leq e_k \leq e_{\text{max}} \quad \text{for} \quad k = 0, \ldots, K \\
& \quad h_k \geq 0 \quad \text{for} \quad k = 0, \ldots, K - 1 \\
& \quad 0 \leq u_{jk} \leq 1 \quad \text{for} \quad j = 1, \ldots, J, k = 0, \ldots, K - 1
\end{align*}
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NUMERICAL RESULTS
Weighted mean busy time strategy (P2) outperforms highest priority first strategy by 3 hours in total delivery time