GBSD Optimization Scheme (Input F, Input K, Output U_i)

- **Inputs:**
  - **F**: The expectation of the global metric to optimize.
  - **K**: The total number of different messages within the network.
- **Output: U_i**: The utility of message i.
- **Objective:** At each contact, maximize the gain $\Delta(F)$ on the global metric **F**

$$F = \sum_{i=0}^{K(t)} f_i$$

Where f_i is the per-message metric value (ex: message delivery probability or delivery delay)

• In the case of congestion (limited transfer opportunity) a DTN node should take the drop (replication) decision leading to the best gain for **F**. To find this decision, we differentiate **F** with respect to n_i, (number of copies of the message i), and then discretize and replace dn_i by $\Delta(n_i)$ to obtain:

$$\Delta(F) = \sum_{i=0}^{K(t)} \frac{\partial f_i}{\partial n_i} \Delta(n_i) = \sum_{i=0}^{K(t)} U_i \Delta(n_i) \quad \text{and} \quad U_i = \frac{\partial f_i}{\partial n_i}$$

$$\begin{cases} \Delta(n_i) = -1 & \text{If we drop an already existing message i from the buffer} \\ \Delta(n_i) = 0 & \text{If no action for message i is taken} \\ \Delta(n_i) = +1 & \text{If we replicate message i during a contact (scheduling), or if we store a newly received message i (buffer management)} \end{cases}$$

• Based on this, a DTN node should (i) replicate messages in the order of decreasing U_i (ii) drop the message with the lowest U_i when buffer is full