Weekly Report (2009-11-15)

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1. Order Constraint Minimum Length Link Scheduling

Last report, I have analyzed the scheduling results on several cases. However, the most difficult part: $1 < T < n$ and *multihop* case is still under research. Recall that before submission of Infocom'10, I mentioned a possible research topic: order constraint minimum length link scheduling. Current link scheduling works are mainly based on "independent" links with little constraints. Lu et al. firstly propose the minimum length link scheduling with consecutive constraints in [6]. Each link is associated with different weight of workload, e.g. link i requires l_i timeslots to schedule. Thus, once link i is scheduled, it should be scheduled continuous for the following $l_i - 1$ timeslots.

We may be able to revise the problem into an Order Constraint Minimum Length Link Scheduling (OC-MLLS) problem, which may server as a sub-problem to our current research. We add dependence among links. For example, link i cannot be scheduled until E_i, which is a link set, has been scheduled. Of course, we should eliminated dead-lock in this problem. Here is a preliminary definition of OC-MLLS.

Given with graph $G(V, E)$, V is the node set with n arbitrarily distributed nodes and E is the link set. For each link $e_i \in E$, a sub-set of E, which is E_i, should be scheduled before its scheduling. We need to derive a schedule $S = S_1, ..., S_T$, which fulfills the following constraints, such that T is minimized.

1) $\bigcup_{t=0}^{T-1} S_t = E$.
2) $\forall i \neq j$, $S_i \cap S_j = \emptyset$.
3) $e_i \in S_t \Rightarrow E_i \subseteq \bigcup_{j=1}^{t-1} S_j$.

Note that we put no limitation on primary interference. If two or more than two links share the same receiver and they are all ready to be scheduled, interference cancellation may be applied.

2. Paper Study

Although applying successive interference cancellation sounds an effective solution to the minimum-latency data aggregation in wireless sensor network, some reviewer may argue that wireless sensor nodes are not powerful enough to implement interference cancellation. So I read some literatures on interference cancellation in wireless mesh networks, which have more powerful wireless devices and similar uplink aggregation-like applications.

Simeone et al. [4] make analysis on the capacity of linear two-hop mesh networks, in which each device can be connected to base-station in two hops: local device to relay and relay to base-station. A decode-and-forward relaying mechanism is proposed by exploiting the possible relevant inter-cell channel gains and rate splitting with successive interference cancellation.

[5] makes effect on the revision to MAC layer to implement interference cancellation in 802.11 protocols. Only design mechanisms are presented with little technical details.

OFDM is most widely used 802.1x protocol in mesh networks. The orthogonality among different carriers in OFDM tries to only have the innercarrier interference by eliminating the intercarrier interference. However, frequency offset, which is a time-varying factor of the channel, will distort the orthogonality and cause intercarrier interference. [1] and [2] are both aimed to address on this issue. [1] proposes self-cancellation scheme mainly focusing on the modulation and demodulation. Each symbol will be modulated onto a group of adjacent subcarriers with weighted coefficients at the transmitter. And the receiver will linearly combine the signals to retrieve the data. The weighted coefficients are the key to the solution. On the other hand, [2] designs a mechanism which iteratively cancel the interference and estimate the channel coefficients. Different from traditional pilot-symbols-based estimator, the novel estimator in this work is decision-directed.

[3] also addresses on the interference cancellation in OFDM systems. A two-stage hybrid interference cancellation and equalization framework is proposed for the uplink. The first stage makes use of spatial reuse and the second stage focuses on the frequency domain.

References

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