Available Technology for the Demo Application of the SNPK

Features of a simple Demo Application

Following features have to be provided by the application:

- Sensor data gathering to one sink
- Multi hop ability
- Low power
- TinyOS2 (TOS2) implementation
- Able to run on Tmote Sky
- simple event synchronisation (timestamping)

There are more desirable items for further versions:

- Runtime-configurable
- Status queries (Routing tables, buffer fill level, battery level, ...)
- Data sanity checks
- Network reprogramming
- Multi sink

Layer Overview

Layer	TOS2	Sensor-scope	Delta	Nico/ Pascal	SCP MAC	X-MAC
App.	TOS2 Oscilloscope	?	Boomerang Delta			
Network	TOS2 Multihop Collection (TEP119) CTP TEP123	TOS2 Single Hop	MultihopLQI NetSync	TOS1 Dozer Collection Multihop		
MAC	TOS2 LPL	TOS2 Simple LPL	SP	TOS1 Dozer Local TDMA	SCP MAC TOS1	X-MAC Mantis OS
Phy	CC2420 CC1000	XE1205	CC2420	XE1205	Packetising Radio (e.g. CC2420)	Packetising Radio (e.g. CC2420)

The Candidates

TOS2-NET

This candidate is composed of two components: The Collection implementation based on TEP199 and a low power listening MAC protocol.
Collection provides a best-effort, multihop delivery of packets to one of a network's tree roots. It is an anycast protocol. The available implementation in the TOS2 repository acts as a discussion base of the corresponding TEP.
The low power listening implementation for the CC2420 stack is not yet tested thoroughly. As the CC2420 does not support long preambles, the wake-up signal is simulated by repeating messages often enough. In the long term, the maximal expected duty cycle of a sender node is one half.

Pros:

- Already TinyOS2 code
- Suites most of the requested features for the demo application
- Contribution to TOS2 can be done for a existing project
- LPL does not need exact synchronisation and is therefore suitable for applications with temperature fluctuations (e.g. outdoor applications)

Cons:

- To remain compatible to TEP119, the implementation has to be updated frequently

- The simple LPL implementation has a high duty cycle compared to other low power implementations
- No real world test results available

SensorScope

SensorScope has a running data gathering implementation in a 1-hop network. According to the project page (http://sensorscope.epfl.ch/), there is a simple low power listening implementation for the Tmote Sky but not for the TinyNode.

Pros:

- Already TinyOS2 code
- LPL does not need exact synchronisation and is therefore suitable for applications with temperature fluctuations (e.g. outdoor applications)

Cons:

- Only single hop
- Only experimental low power duty cycling

Delta

This is Moteiv's data collection multihop application. It uses the Sensor Protocol (SP) which acts as universal glue between the network and the link layer.
The obtained sensor data can be displayed with a java program. Sampling period can be changed at runtime.

Pros:

- Well known working demo that suites most of the requested features

Cons:

- Code must be migrated to TinyOS2
- Global duty cycling causes bigger overhead
- Outdoor applications need special attention because of larger clock drifts

Dozer

Dozer is designed to gather periodic data with ultra low power consumption. The MAC layer locally synchronises nodes for TDMA. To set up the synchronisation, a tree is necessary.

Pros:

- Very low duty cycle
- For MAC protocol, only local synchronisation is needed
- Suites most of the requested features for the demo application
- Existing proof of concept

Cons:

- Protocols must be implemented from scratch for TinyOS2 (T1 code is not public)
- Outdoor applications need special attention because of larger clock drifts
- Was only tested on TinyNode

MAC Protocols for Packet based Radios

Many MAC protocols for wireless sensor networks need the ability to send a long preamble in order to wake up nodes. The packet based CC2420 of Tmote Sky has a very limited preamble configuration freedom, so other strategies are needed. The two considered protocols have been designed with this limit in mind.
SCP MAC has been implemented in TinyOS1 (source code available). Parts of the network need to be synchronised, so the nodes all sample the channel at about the same time. Only short wakeup tones are required. To avoid collisions, a 2-phase contention is implemented.
X-MAC adapts LPL to packetising radios and adds some improvements against overhearing and excessive preamble length. An implementation is available for Mantis OS.

Pros:

- Lower duty cycle than standard LPL
- Is implementable on a packet based radio (e.g. CC2420)

Cons:

- Code must be migrated/rewritten to TinyOS2
- For a the whole application, the upper layers have to be added and new functions need to be implemented for routing support

Decision Matrix

	TOS2	Sensor-scope	Delta	Dozer	SCP MAC	X-MAC
TOS2	+	+	-	-		
Data gathering	+	+	+	+		
Multihop	+	-	+	+		
Low power	+	0	+	+	+	+
Implementation for CC2420	+	NA	+	0	0	0
Event sync	0	NA	0	0		
Duty cycle	0	NA	0	+	+	0

Reference:

0: neutral valuation
-
+
NA

The most promising candidate is TOS2. Another MAC implementation should be considered with this solution to reduce power consumption even more. MAC candidates are SCP-MAC or a Dozer-Style implementation.