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WIRELESS TOKEN RING PROTOCOL – A VIABLE SPECIFICATION

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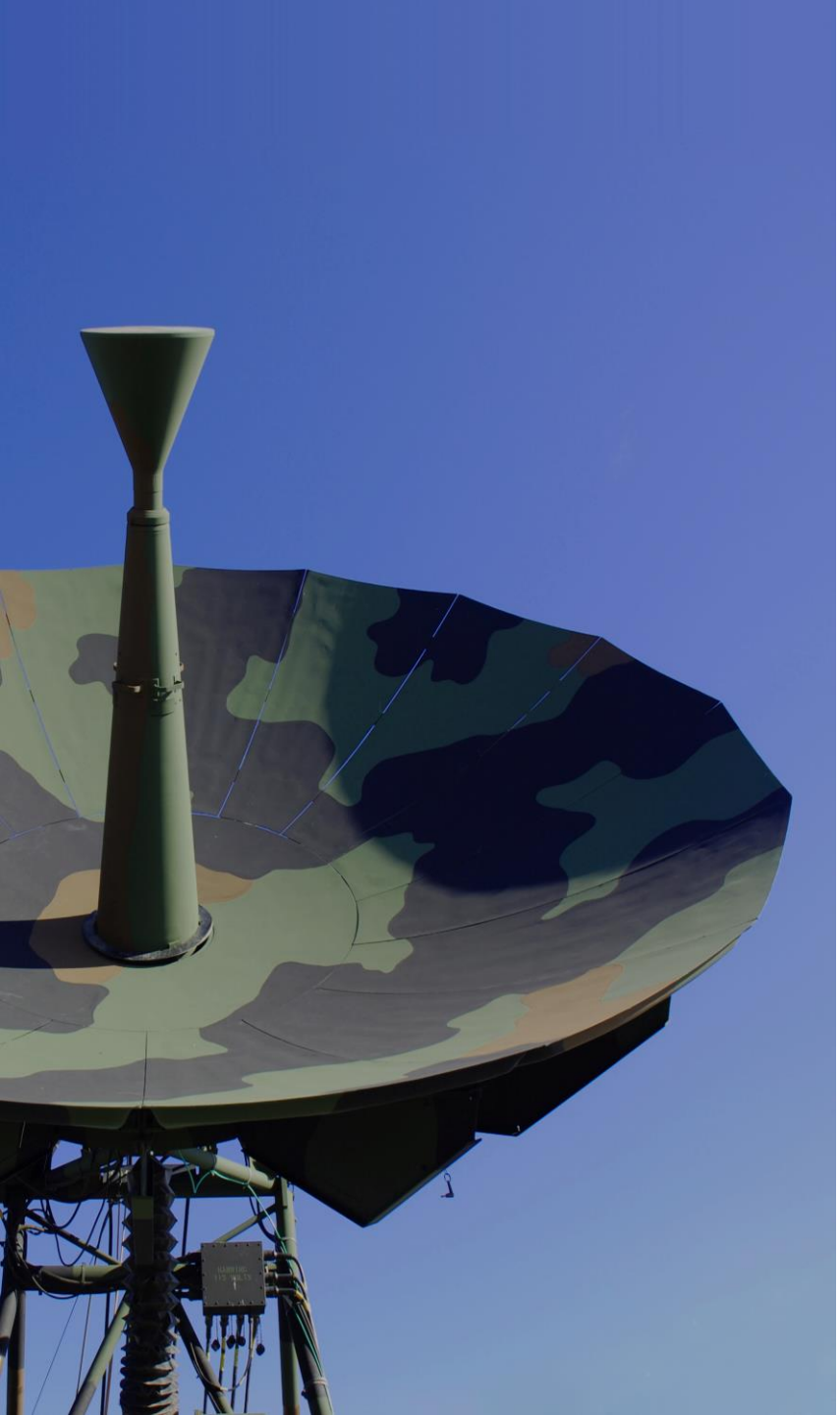

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- A new WTRP Protocol

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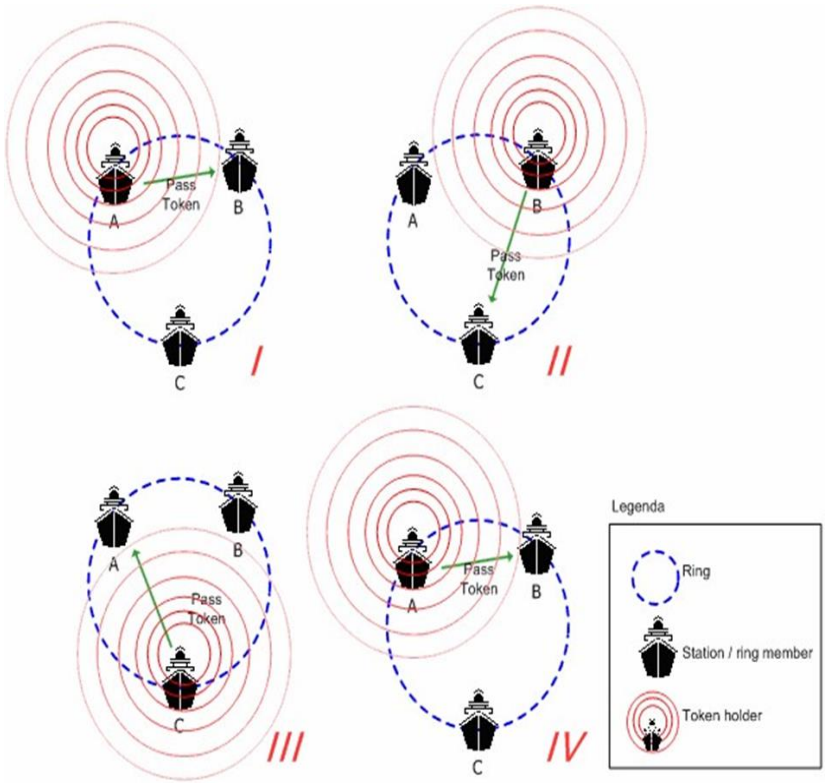
Why Wireless Ring Token Protocol (WTRP)?

- Token passed around “ring”
  - Controls which node can transmit
- Best option for multi-node shared channel HF networks under high load
- Particularly targeted at Naval Task Group communication with surface wave
- Supports “partial connectivity”
  - For example “three ships in a line”
  - Important capability as surface wave, although BLoS, has limited reach
  - CSMA and TDMA cannot do this



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Experience with Ed3 Annex L (the good)

- Based on experience implementing WTRP
- The model and state machine are sound
- Token passing is VERY robust
  - Rumours of issues with losing token (which Isode has repeated) are more likely an implementation issue than a protocol problem

Experience with Ed3 Annex L (the bad)

- The protocol is problematic
  - Many errors in the specification
  - The protocol relating to partial connectivity cannot work
  - The Ergen (original model) has been extended with a Transmit Order List, and details of the specification are muddled between the two approaches
  - The protocol attempts to shoe-horn the PDUs into Management D_PDU. This is a mess and violates two basic STANAG 5066 extensibility principles
  - Interoperable deployment seems unlikely
- If full connectivity is assumed:
  - Compliant protocol can be used (essentially ignore the contents and just follow state machine)
  - If this was the target, a much simpler protocol could be used
  - This seems like a dead end
- Conclusion: Ed3 Annex L is not fit for purpose

A Way Forward

- “HF Wireless Token Ring Protocol” (S5066-EP12)
  - Written as drop-in replacement for Annex L
  - At first glance looks very similar
  - Protocol quite different
- Protocol change took opportunity to address two things
  - Smaller PDUs
    - Ed3 PDUs are too large and grow as square of number of nodes
  - Link Quality
    - Enables “best ring” to be built using best links
    - Enables variable speed. This is really important for (target) surface wave, as you want to slow down as you move further apart

State Machine

- One high level change: Drop RELAY state
  - Ed3 design means that a node will only transmit once per ring cycle
    - This was sensible for the original Ergen specification
  - Change means that node transmits user data whenever it gets token
  - Consider three ships in a line (where two ends cannot communicate directly), with two end nodes communicating indirectly through the middle ship
    - You want middle ship to transmit each time to optimize this communication
- Work to ensure clarity and correctness of specification
  - In parallel with implementation
  - Ongoing fine tuning
  - State diagram in specification automatically derived from Isode state machine

Token Passing

- Token encoded using standard EOW
  - Engineering Order Wire, included in every D_PDU to transfer control information
- Enables token to be sent multiple times, with no protocol overhead
  - Facilitated robust token transfer
- No WTRP protocol overhead when ring is stable

Messages

- WTRP messages use Extended D_PDUs (S5066-EP10)
- Status messages “passed around the ring”
  - Nodes will listen to all transmissions
  - After complete cycle (all nodes have messages) status update only sent when things change
- A simplified overview of the key messages is given in next three slides

Transmit Order List

- Transmit Order List (TOL)
  - Directed Graph specifying the ring
  - Nodes may appear multiple times in the TOL to address “disconnected connectivity”
  - TOL is circulated as a message
- Any node can change TOL to address broken connectivity
  - Unable to transmit to next node
  - Node joining or leaving
- Any node can optimize TOL to improve ring order
  - Only when TOL has been stable for a ring cycle

Receive Table

- Nodes record reception quality from every node on the ring (that they can hear) in Receive Table
  - Link quality is recorded as maximum recommended Transmit Speed using the same encoding as “Data Rate Selection in STANAG 5066 for Autobaud Waveforms” (S5066-EP4)
- Receive Tables are circulated round the ring as TABLE messages
  - So each node will have a complete set of (up to date) Receive Tables
- Any node can use the Receive Tables to calculate an optimal ring structure / TOL
  - The general problem is NP Complete (like Travelling Salesman problem)
- Each node can determine best speed to transmit to every other node
  - When data is transmitted to several nodes, the speed suitable for the poorest link is the maximum to use
- Unreachable nodes addressed by “STANAG 5066 Routing Sublayer” (S5066-EP13)
  - Next Talk

Ring Formation and Merging

- Procedures for Ring Formation and growth are same as Ed3
  - Floating -> Self Ring -> Ring Member
  - Uses INVITE and JOIN messages
  - Nodes take turns to send INVITES (important for partial connectivity)
- Allows multiple nodes to join ring at same time (Ed3 was one at a time)
  - Gives faster initial ring creation
- Specified mechanisms for ring merging
  - Need to take care with rings that can only just hear each other

Conclusions

- STANAG 5066 Ed3 WTRP (Annex L) is not viable
- S5066-EP12 provides a drop-in replacement that can be used in STANAG 5066 Ed4

Any Questions?