INSIGHTSIP

Next Generation Bluetooth Solutions

1.Agenda

1) Short Introduction to nRF54 Series chipsets from Nordic Semiconductor, and Insight SIP module solutions for nRF54 devices
   a) ISP2454-MX based in nRF24L15
   b) ISP24XX based on nRF24H20
2) The Modular Advantage
3) Bluetooth 6 and Channel Sounding
4) Application Targets for ISP24 Series devices
5) Migration Issues for transition from ISP nRF52 based modules to next generation

1.Introduction to nRF54 series and Insight SIP solutions

nRF54 family of Semiconductors

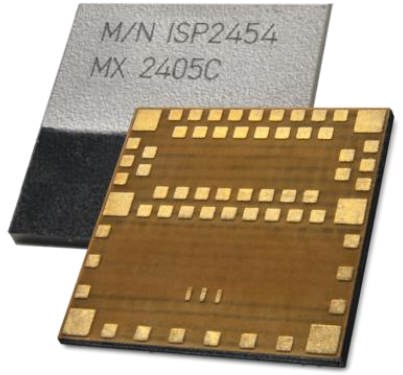
- nRF54L series – “more for less” (cf nRF52 series)
  - Upgraded memory
  - Faster Processor
  - Lower Power

Both enabled by new smaller silicon node

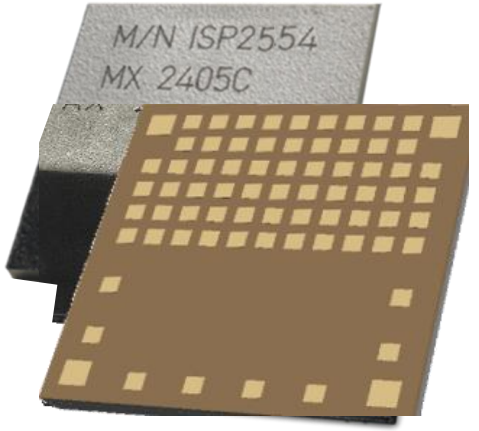
- nRF54H series – “new levels of capability and sophistication”
  - Security – hardware side channel protection
  - Multicore - Separate Radio/Application/Security/Periheral processors
  - Expanded periherals – HS USB, CAN etc

Insight SIP Modules

- ISP2454-LX – based on nRF54L15
  - In ISP standard 8 x 8 x 1mm form factor
  - Pin compatible with ISP15/18/19 series as far as possible
  - Fully “complete” – all crystals, matching, DC-DC support
  - “Just add power”



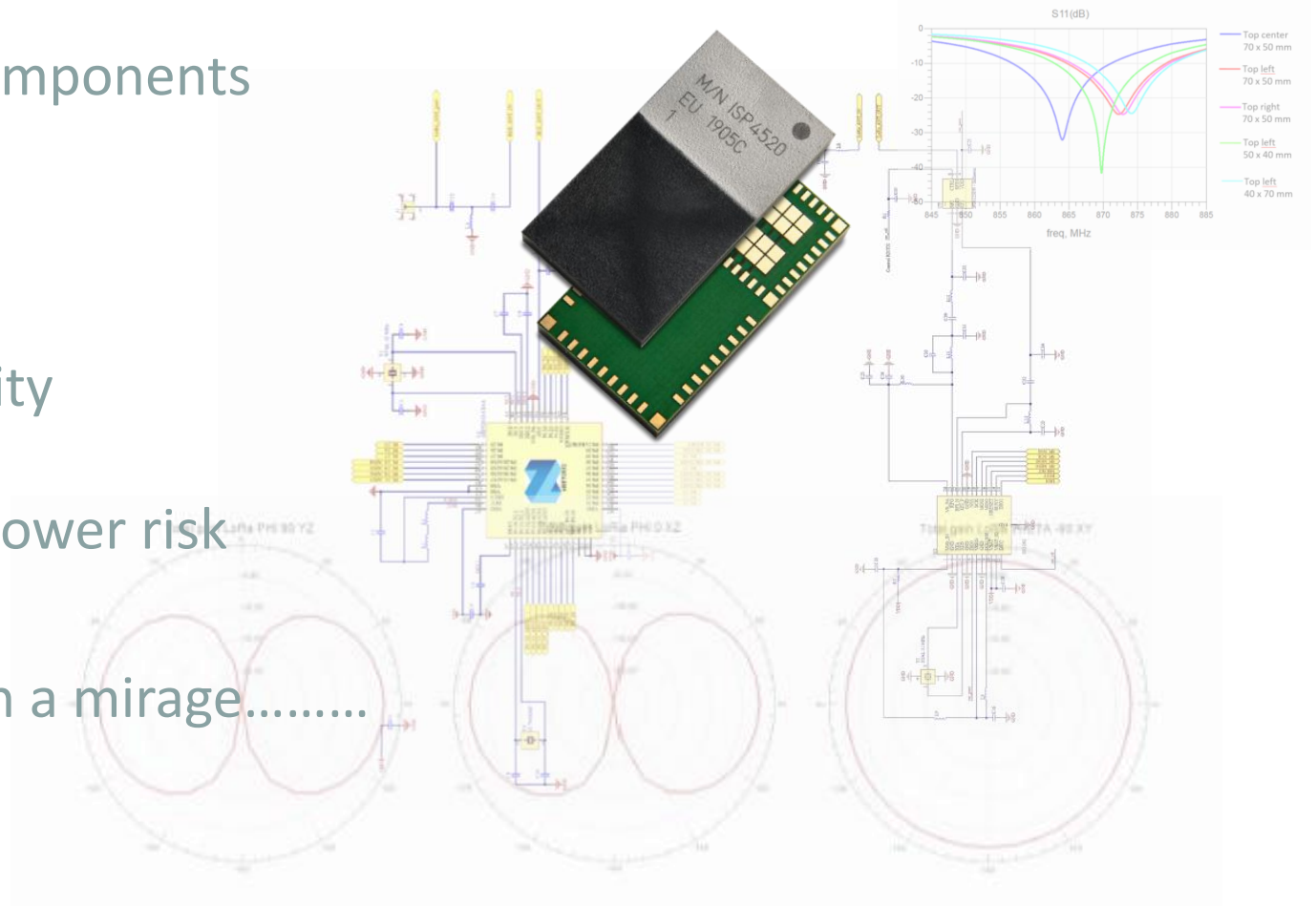
- ISP2554-HU – based on nRF54H20
  - Needs larger footprint due to chip size and I/O count
  - Estimate 10 x 10 mm device
  - Fully “complete” – all crystals, matching, DC-DC support
  - “Just add power”



2. The Modular Advantage

The Modular Approach – The professional's choice

- "***Engineering Approach***" – use proven components
- Benefit from world class RF -expertise
  Better result.
- Improved yield
- Reduced supply chain and build complexity
  Up to 50 components => one fully tested
- Time to Market – Simpler development, lower risk
- Fully Certified – ready to use
- "Lower Cost" of chip-down solution often a mirage……
- H Series chip only in WLCSP



Fully Certified Devices

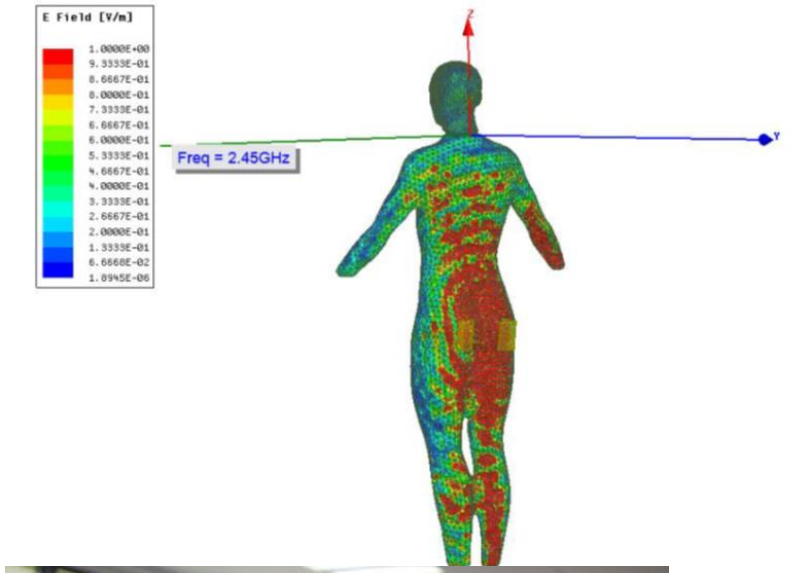
- Certified for Global Markets
- Europe (EU) + UK, US, Japan, Canada for all products
- Additional Certifications on some devices (China, Taiwan, Korea….)
- Time to market saving at least 6 months – certification process notoriously slow, and first time pass not guaranteed.
- Cost /Risk /Management Effort Reduction
- Ongoing update process as standard evolve, products conform to latest regulation

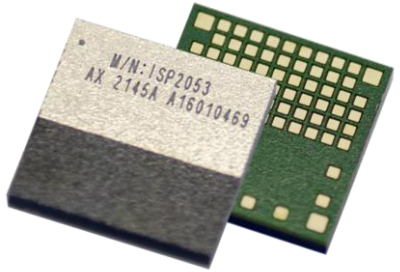
Certification is getting more complex…

- For “simple” BLE modules, certification relatively limited.
- New multiprotocol devices add complexity
- Radio scheme for Thread is different to BLE, needs separate certification
- Matter certification (not a module level) requires Thread
- ANT+ also has its own channel scheme.
- New requirements on OTA update – obligatory to be able to fix security issues

Additional Support on RF issues

- Modules are about making life ***easy*** – support "***included in the package***"
- Detailed Product Support Documentation – Data Sheets and App Notes
- Working software examples and hardware demos
- Layout reviews offered – avoid classic RF "bear traps"
- Detailed simulation studies for "edge cases" - non-obvious problems, challenging environments
- Access to real experts – focused team, no "tiers" to navigate





3. Bluetooth 6 Update

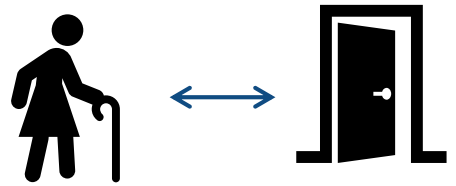
Key features of Bluetooth 6.

- Bluetooth Channel Sounding – new distance measurement technique
- Decision-Based Advertising Filtering and Monitoring Advertisers - Improves advertising efficiency
- ISOAL Enhancement – Increases reliability and reduces latency for Isochronous transmission (streaming)
- LL Extended Feature Set – This feature allows devices to exchange link layer features that they support.
- Frame Space Update – Time between frames was previously fixed – now is negotiable, optimizing data throughput.

Channel Sounding Overview.

Two different methods of determining distance:-

1. Time of Flight measurement



2. Phase-based Ranging – measure phase differences across different channels

Note: BT6 Spec only defines these two basic methods. No definition of how to combine them

Many options in channel selection, repetition, etc

=> “Toolbox” rather than solution.

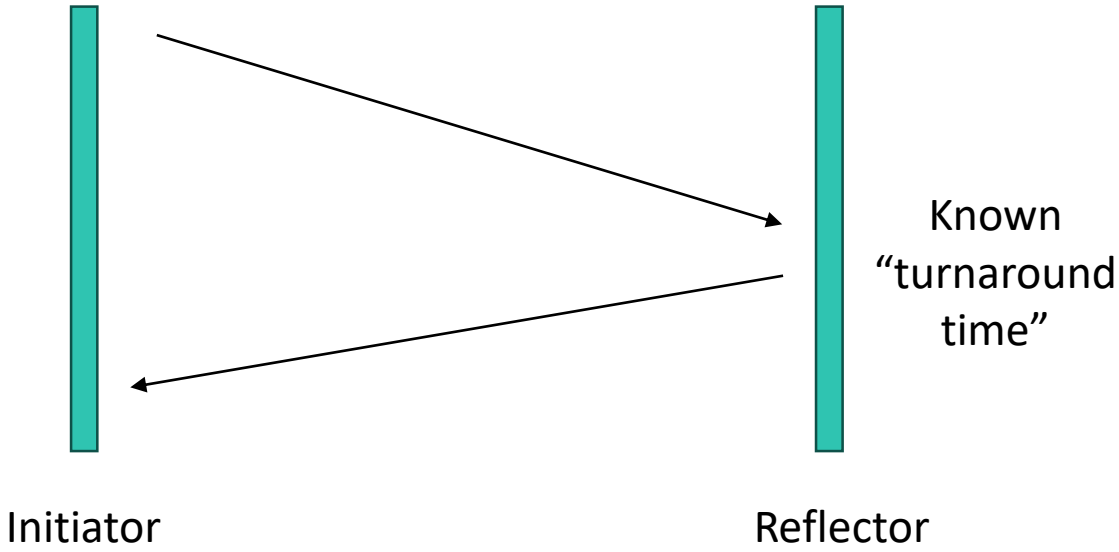
Bluetooth Channel Sounding – Time of Flight

Principle:-

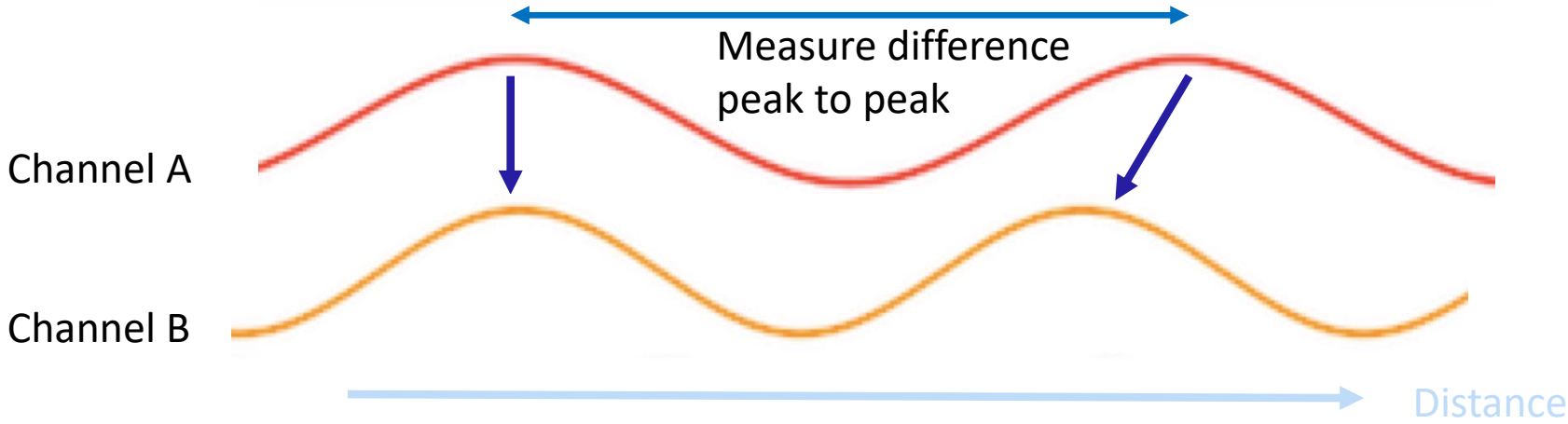
- Establish Secure Connection
- Send Packet from Initator to Reflector
- Return packet from Reflector with known delay
- Convert round trip time into distance

Issues:-

- Limited precision with narrow band signal
- Relies on precise device timing
- Reflections??



Bluetooth Channel Sounding – Phase based measurement



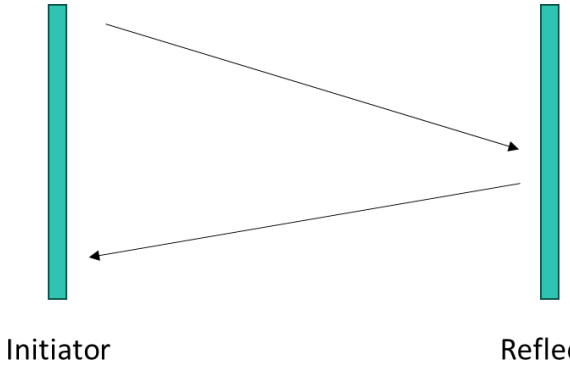
Principle:-

- Send two pulses on different channels (frequencies)
- Phase difference varies with distance
- Can use multiple channel combinations

Issues:-

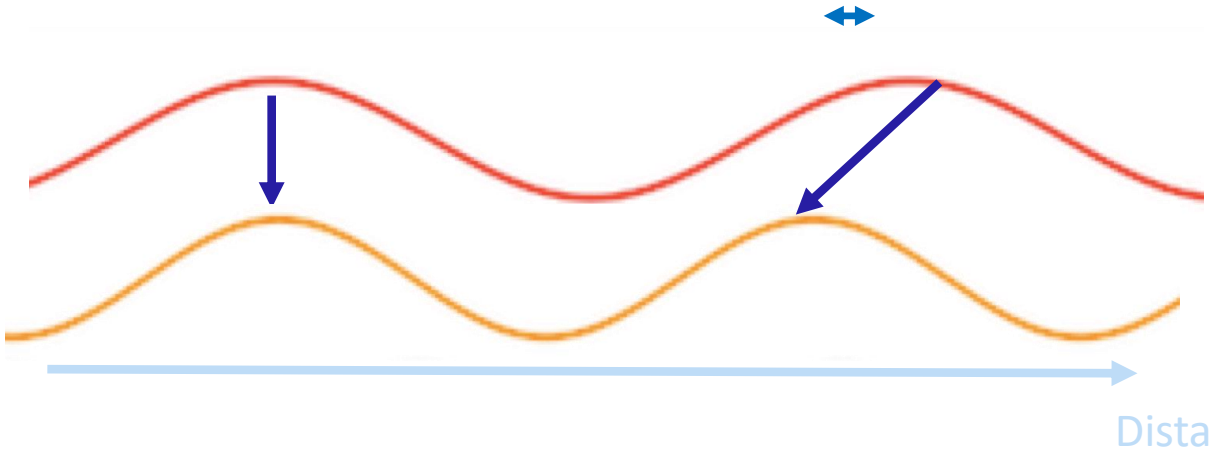
- Detecting small differences, doesn't eliminate the reflection issue with narrow band
- Phase difference doesn't give unique solution – can be resolved, but only with more signals

Bluetooth Channel Sounding – Conclusions



Channel A

Channel B



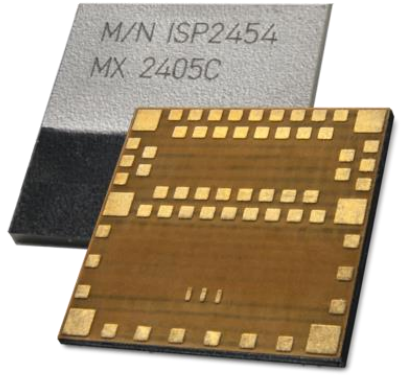
- Accuracy of c. 0.5m reported
- Depends on quality of stacks and software, many options available
- Multiple antenna options supposedly aid accuracy, but add complexity
- Environmental impact to be determined
- Complex solution

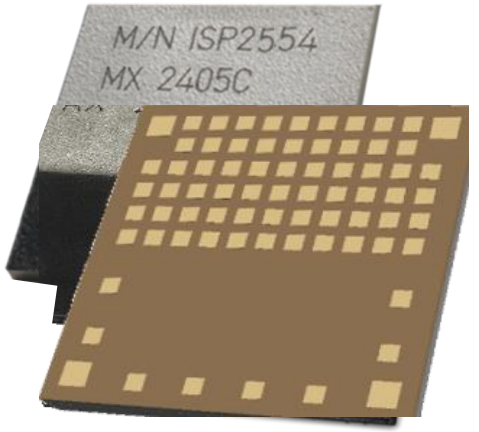
Will it work, and how well – to be determined !!!!!

4. Application Targets for Next Generation Bluetooth Devices

ISP nRF54 based modules – what are they good for?

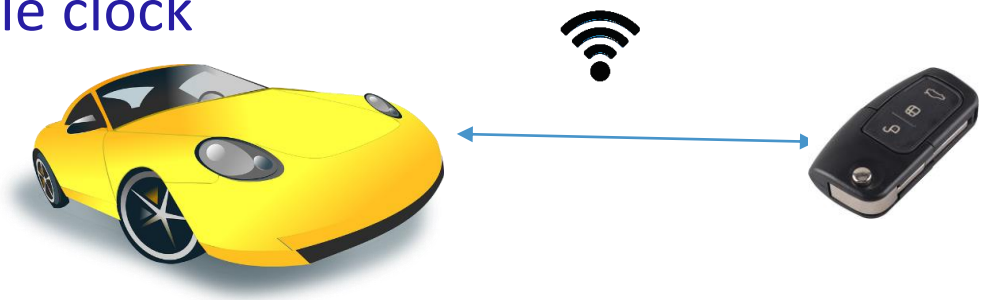
- ISP2454-LX
  - (Almost!) anything you can do with an nRF52 devices
  - But – faster, cheaper, more capacity
  - More RAM/Flash, for sophisticated applications and software stacks
  - Increased OTA upgrade capability
  - Security – TrustZone
- ISP2554-HU
  - High security applications
  - Edge computing – AI front end
  - Advanced Wearables



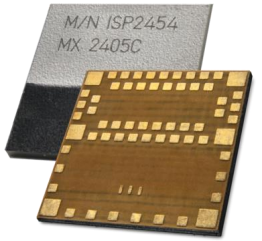


ISP2454 Solutions/Upgrade

- ISP2454
  - Faster more capable processor – M33 vs M4, double clock speed (128Mhz vs. 64Mhz)
  - Increased Flash over any nRF52 – 1.5MB
  - RAM at top end of nRF52 series 256KB
  - Digital Key / Keyless Entry (Channel Sounding) – if it works!!

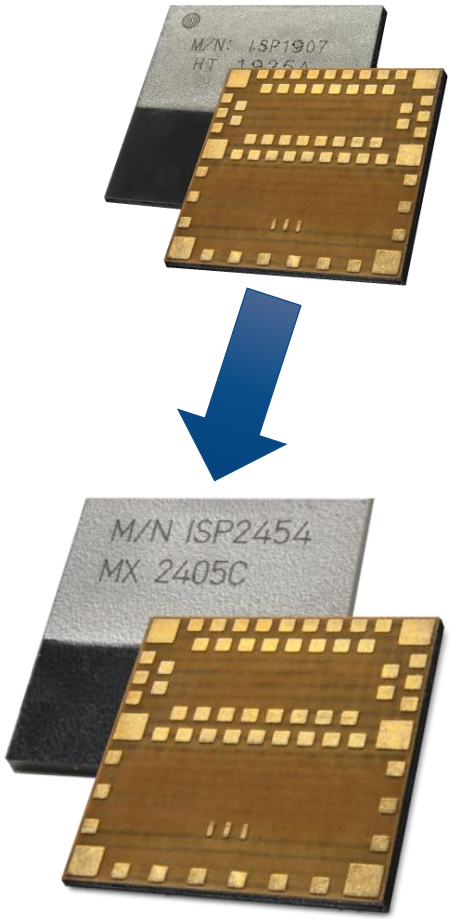


- What's missing ?
  - Doesn't match the I/O count of the top end nRF52 product
  - Doesn't have a USB (some nRF52 do)



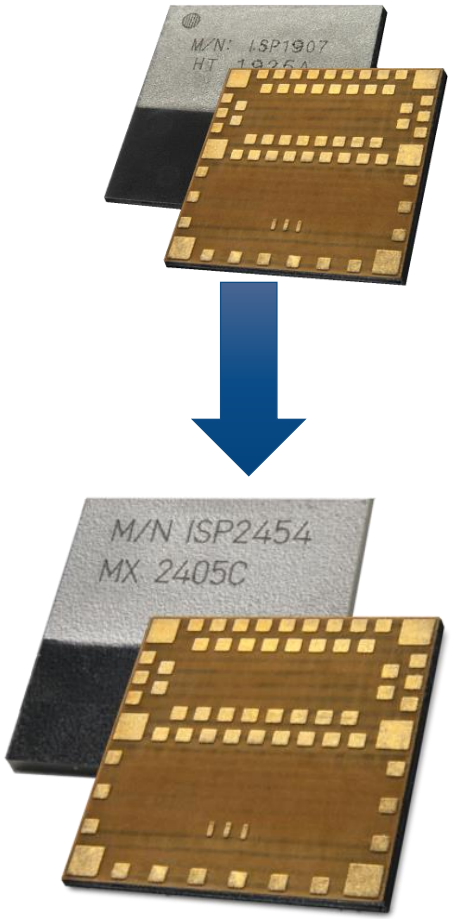
ISP2454 Migration from nRF52 based modules

- ISP2454
  - Same Footprint (8x8x1mm)
  - Same pinout (except “extra I/Os” of ISP1807-LR(nRF52840)
  - Place on board and replace!
- Issues:
  - If Soft Device used, need to migrate to Zephyr/nRF Connect
  - There may be some limitations in GPIO mapping (details to be confirmed) – some small layout changes may be required.



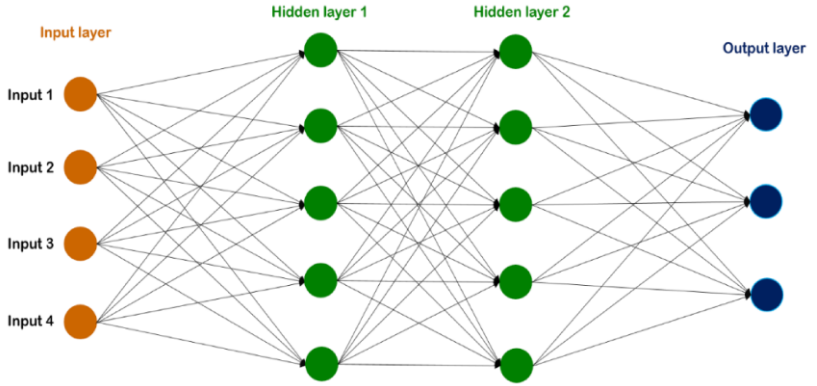
Applications for ISP2454 /Reasons to upgrade

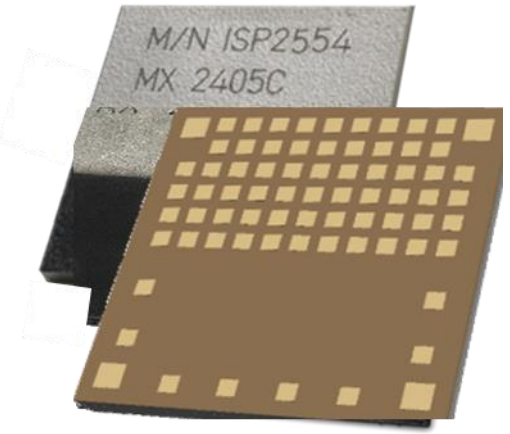
- Lower cost (to be confirmed)
- Improve battery life
- Add OTA upgrade capability on board
- Add higher level of security – PSA level 3. Secure Key Storage unit, TrustZone
- Add support for advanced stacks – Thread/Matter etc – require significant Flash/RAM
- Increase responsiveness
- Better ADC resolution (14 bit vs. 12 bit 4x improvement)



Applications for ISP2554-HU

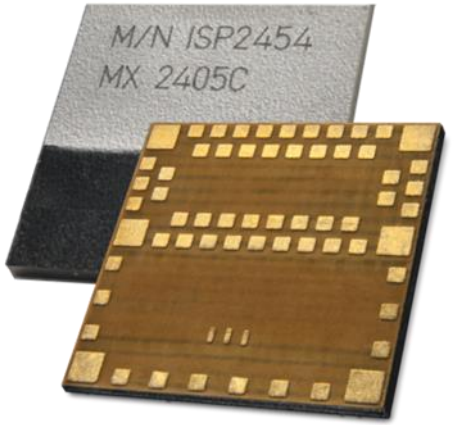
- Replace multiple devices with one – Separate host micro, extra memory, security system etc
- New interfaces – high speed USB, CAN Bus. Non-Automotive grade vehicles (scooters/electric bikes)
- Machine Learning – can load ML models onto device
  - “Computing at the Edge”
  - Improve Latency, reduce data traffic etc
  - Voice commands/image recognition
- Intensive computational tasks – 320Mhz processor capability
- Flexibility with Radio/Application – separate cores for each function

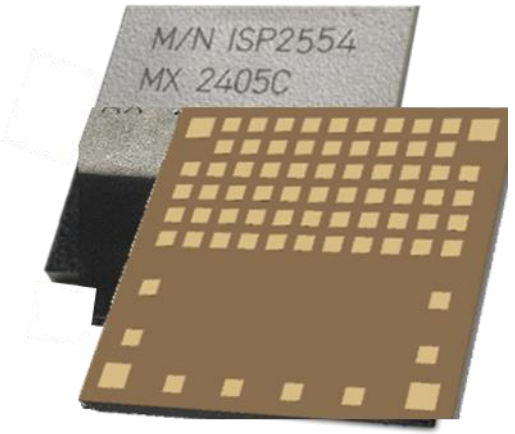


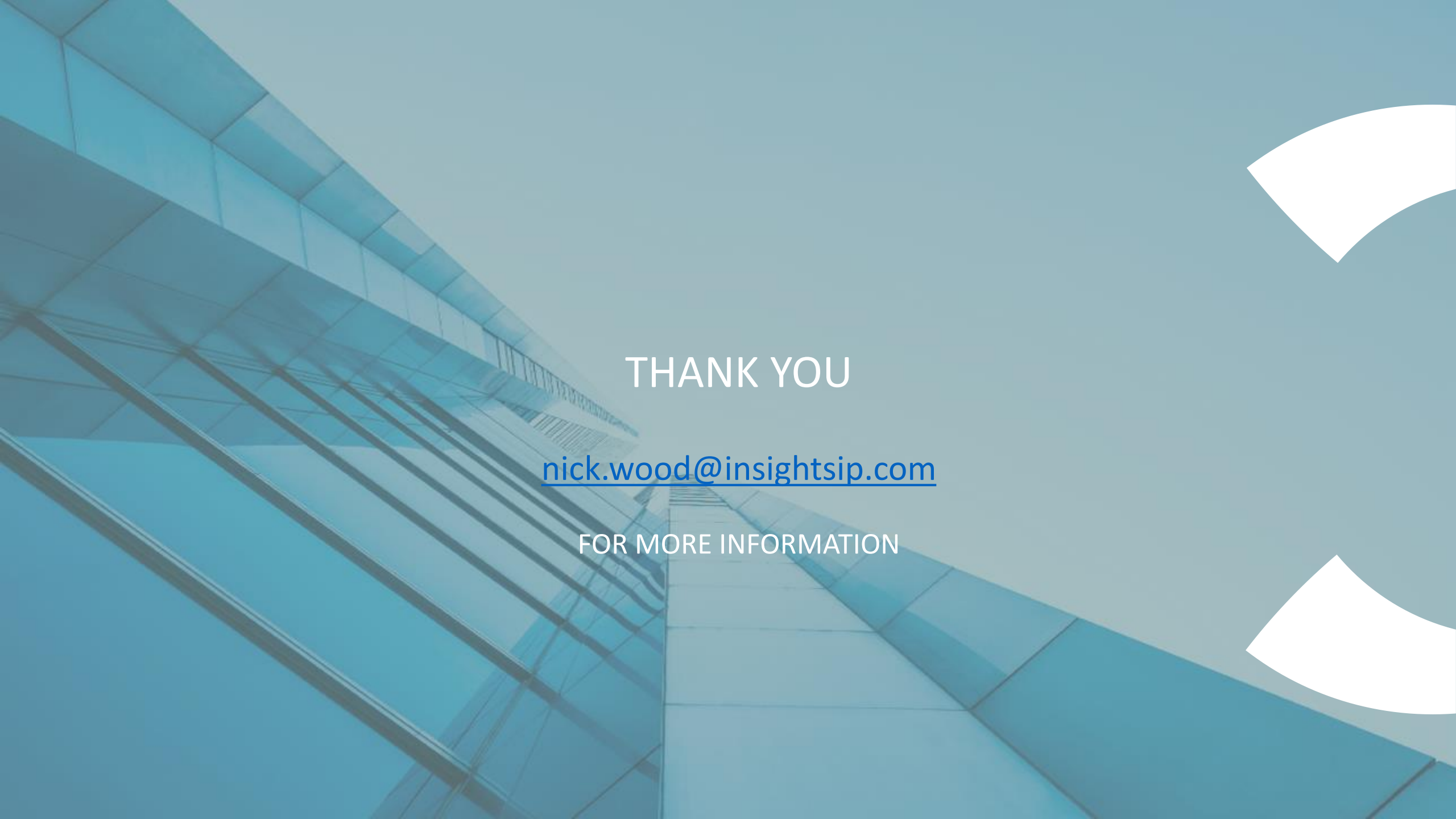


Conclusions

- New generation devices offer a wide range of capabilities – from “better mousetrap” to cutting edge next generation capabilities
- ISP modules support new generations with pin compatible offer for the L series, easy upgrade, product refresh
- More products to follow in due course to fill in gaps and complete the range







THANK YOU

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FOR MORE INFORMATION