

# TagoreTech Driving the Shift Beyond PIN Diodes

RF GaN in Tactical & Drone Communications



**RF SUMMIT  
FINLAND**

Pasi Tikka | RF Summit Finland | March 10

# Tagore company profile

## Business

- **Pioneer in ultra-low leakage GaN** switches
- **Integrated controllers & power** for customer ease-of-use
- Technology roadmap to render **PIN diodes obsolete** below 6 GHz by 2026
- Expanding to X- and Ku-band during 2026
- Complementary portfolio of PAs & LNAs

## Business

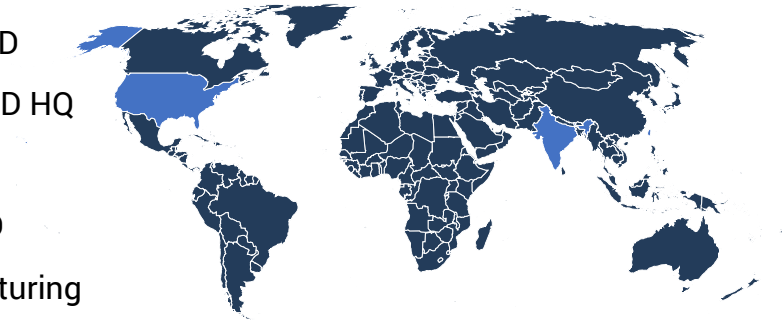
- **Highly differentiated** product offerings
- **Well-positioned** for SWaP trends in RF multi-markets
- **Key enabler** for Software Defined Radios
- **New applications** in Tunable Filters, addressing rapidly expanding drone market

## Customers

- In production with **100+ customers**
  - Defense
  - Public Safety
  - Industrial
  - Telecom

## Locations

- Chicago, IL, USA, HQ, R&D
- Phoenix, AZ, USA, PA R&D HQ
- Kolkata, India, R&D
- Tallinn, Estonia App R&D
- Taipei, Taiwan, Manufacturing



# Tagore Product Portfolio for RF Front End

- 10W to 200W Average power
- 50W to 650W Peak power
- Independently controlled
- Low charge pump noise

**RF Switch**  
SP2T, SP4T  
SP6T...

- 0.5 & 1ohm, 125V Peak voltage
- Independently Controlled
- Charge Pump Bypass function
- Tunable Harmonic filters & Antenna matching

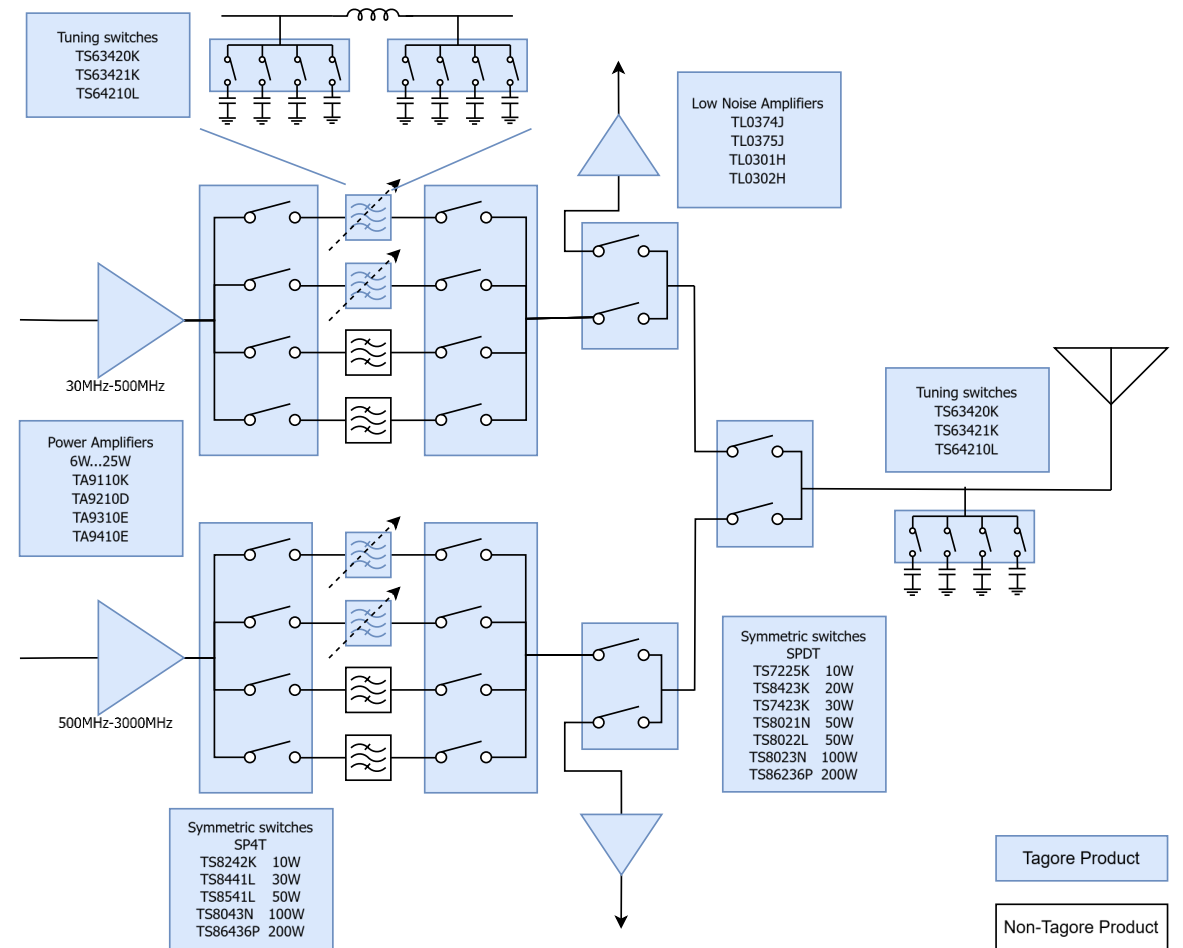
**Tuning**  
Switches

- Broadband PA's for Portable radios
- Radar driver PA's
- Broadband PA's for LMR/PMR
- Library of enablement collateral

**GaN PA's**  
2W-100+W

- Wideband Low Noise Amplifiers
- Dual Channel 2 - 5 GHz, 20W receiver FE
- Single Channel 2 - 5 GHz, 100W receiver FE
- High-linearity, low NF gain blocks

**GaAs LNAs**  
  
**GaN Blocks**



# Motivation for RF GaN switches?

Property	Si	GaAs	GaN
Energy Gap (eV)	1.11	1.43	3.4
Critical Electric Field (MV/cm)	0.3	0.5	3.5
Charge Density (# x $10^{13}/\text{cm}^2$ )	0.3	0.3	1
Thermal Conductivity (W/cm/K)	1.5	0.5	1.5
Mobility ( $\text{cm}^2/\text{V/s}$ )	1350	8000	1500
Saturation Velocity ( $\times 10^7 \text{ cm/V}$ )	1	1.4	2.7

Higher Voltage  
& Better Linearity

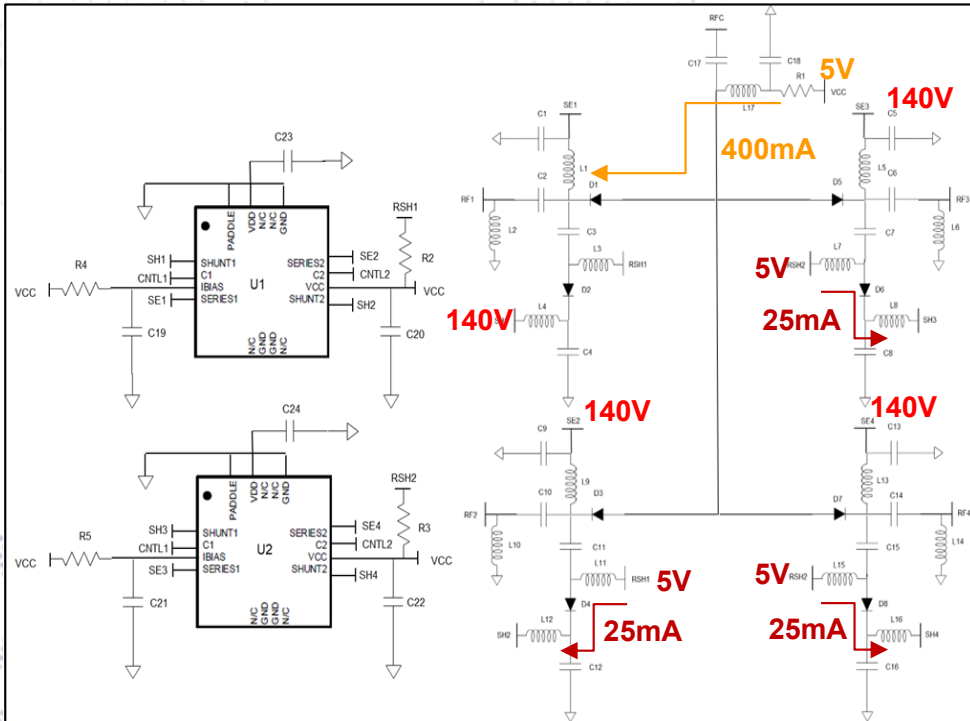
Lower  $RDS_{ON}$ , Higher Power  
& Frequency

- Properties that helps to make superior Power Amplifiers applies to High Power Switches
- Why most of the companies are looking only Power Amplifiers?
  - Power amplifier market is 10x compared to high power switch market
  - Switch market dominated by public safety, defense, medical whereas Power Amplifier market dominated by Telecom

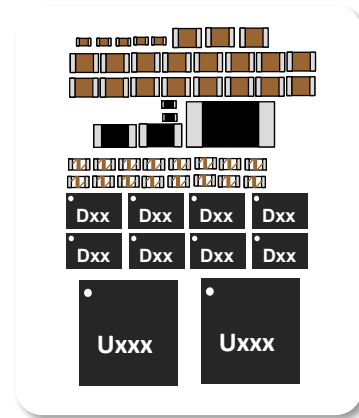
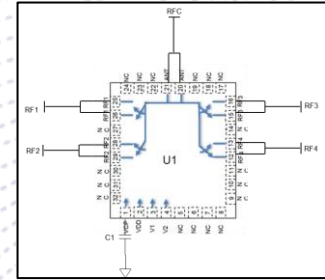
# Unique RF GaN technology – comparison to PIN diodes

Replacing Apollo era PIN diodes with integrated GaN RF switches

## 100W SP4T pin diode switch solution



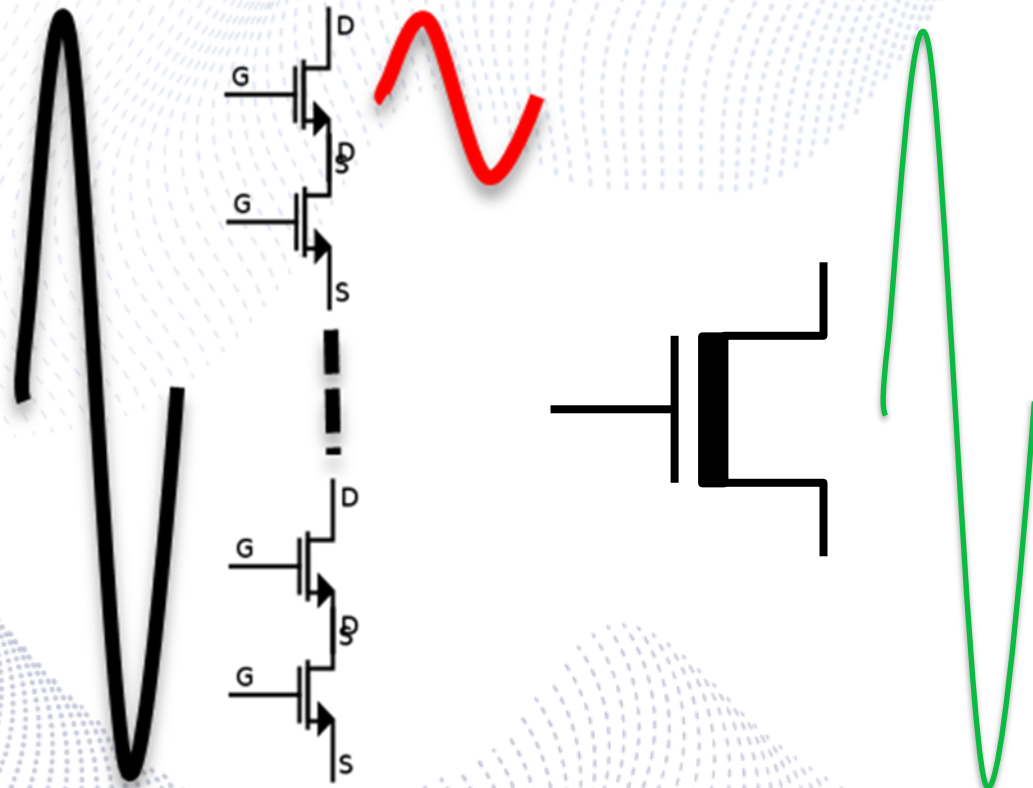
55 vs 2 components  
275mm<sup>2</sup> vs 25.5mm<sup>2</sup>  
2500mW vs 0.6mW  
10% longer battery life



10x smaller

Drastic reduction in Component count, Power, and Design time

# Comparison to SOI for high power / high voltage switches

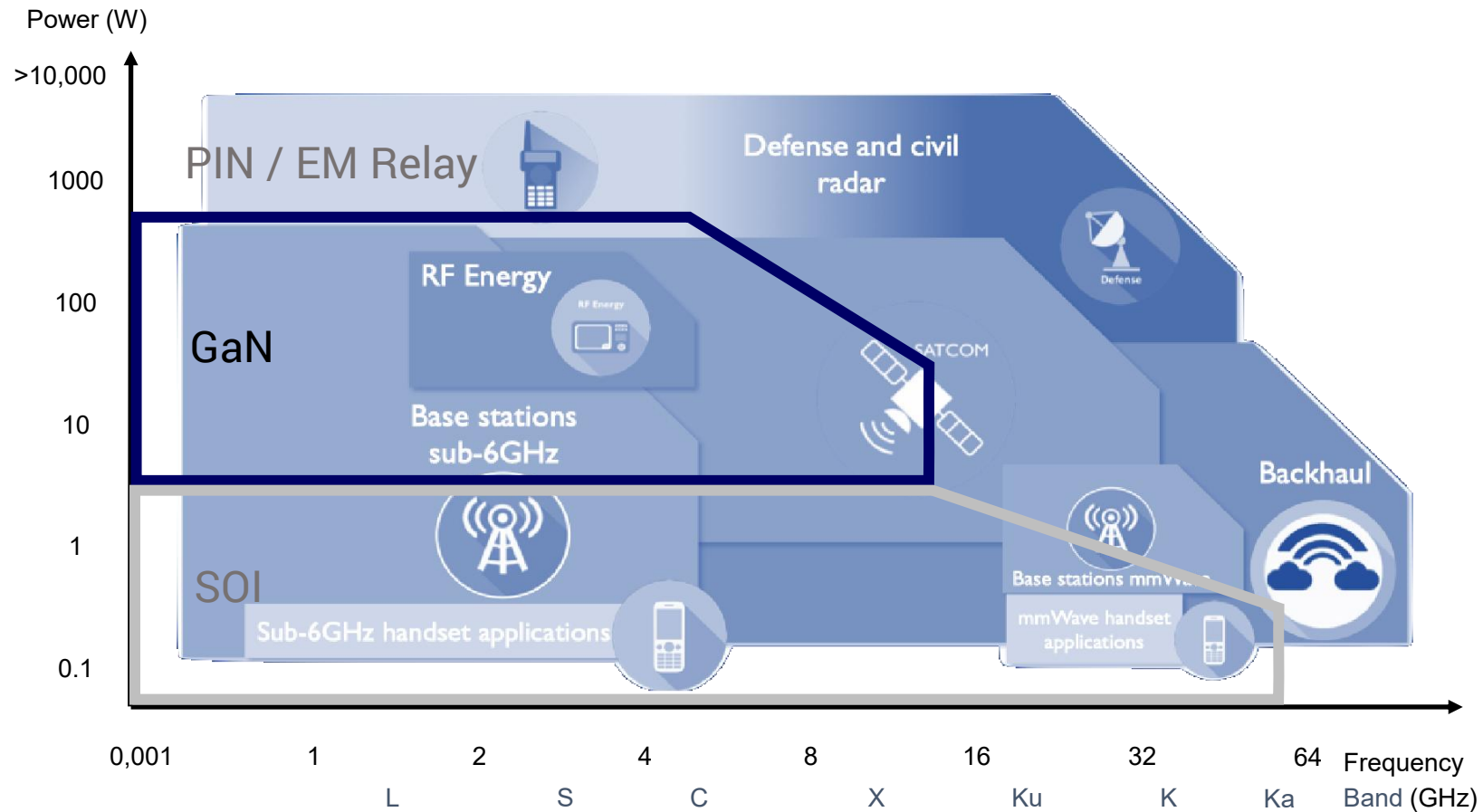


SOI/SOS

GaN

- Higher GaN BV eliminate stacking
  - Lower device capacitance
  - Lower substrate parasitic
  - Lower IL
  - Smaller die
- SOI/SOS requires large stack
  - N stack  $\rightarrow$   $N^2$  increase in FET periphery
  - Higher device capacitance
  - Higher substrate parasitic
- GaN is superior above 5W or 50V applications

# Tagore GaN RF Switch technology



## Higher Power applications

- From 5W CW
- To 500W+ Pulse
- Upto 200V RF Voltage

## Extended Frequency Coverage

- 1MHz to Ku Band

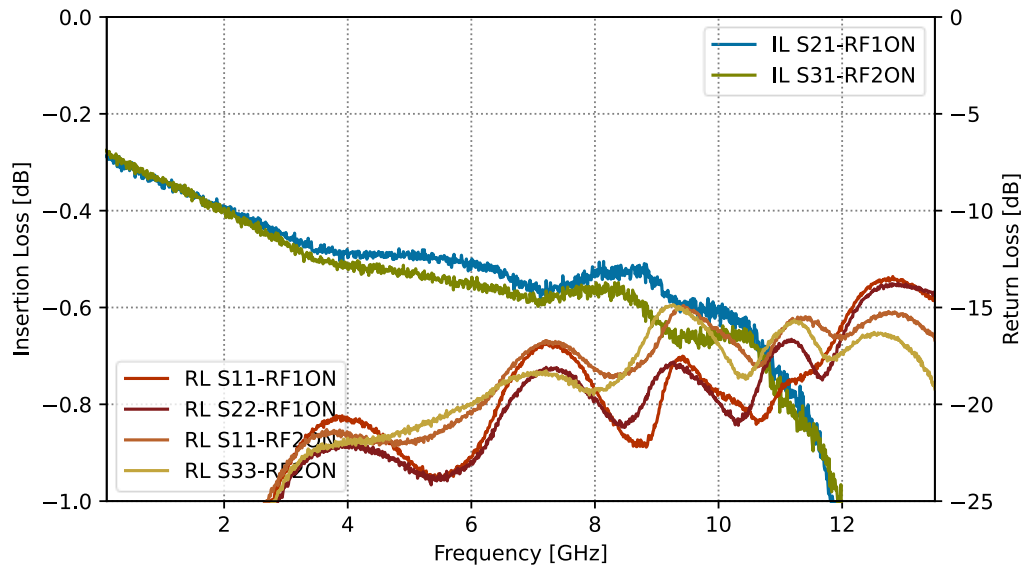
## Application Focus

- Tactical radios
- Drone Datalinks
- Jamming
- Telecom
- Phased Array Radar
- Public safety

## Extensive technology development program with Finnish RF industry involvements

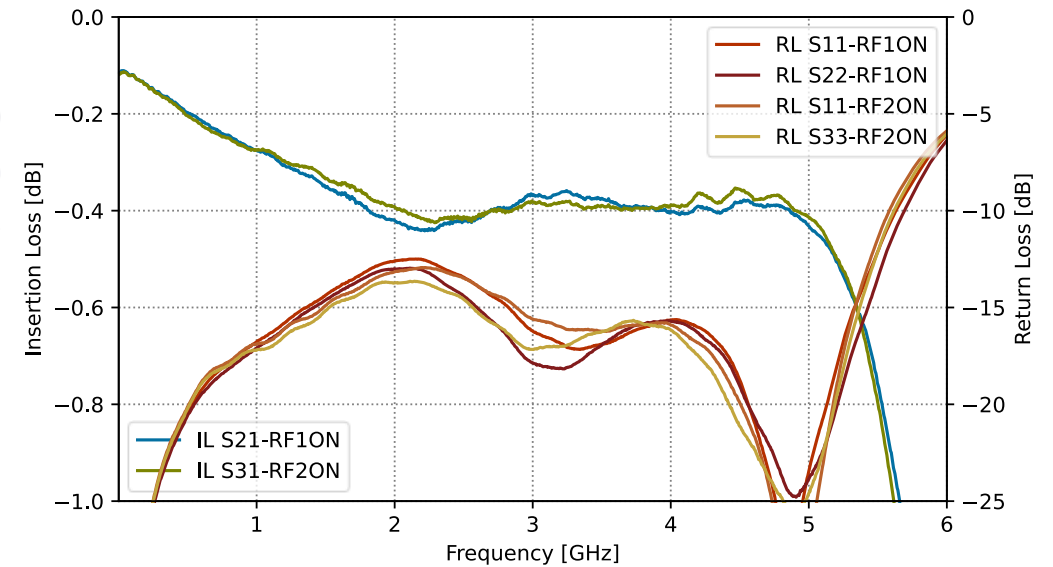
- 6 Finnish companies
- 3 Estonian companies

# Examples of RF GaN switch products



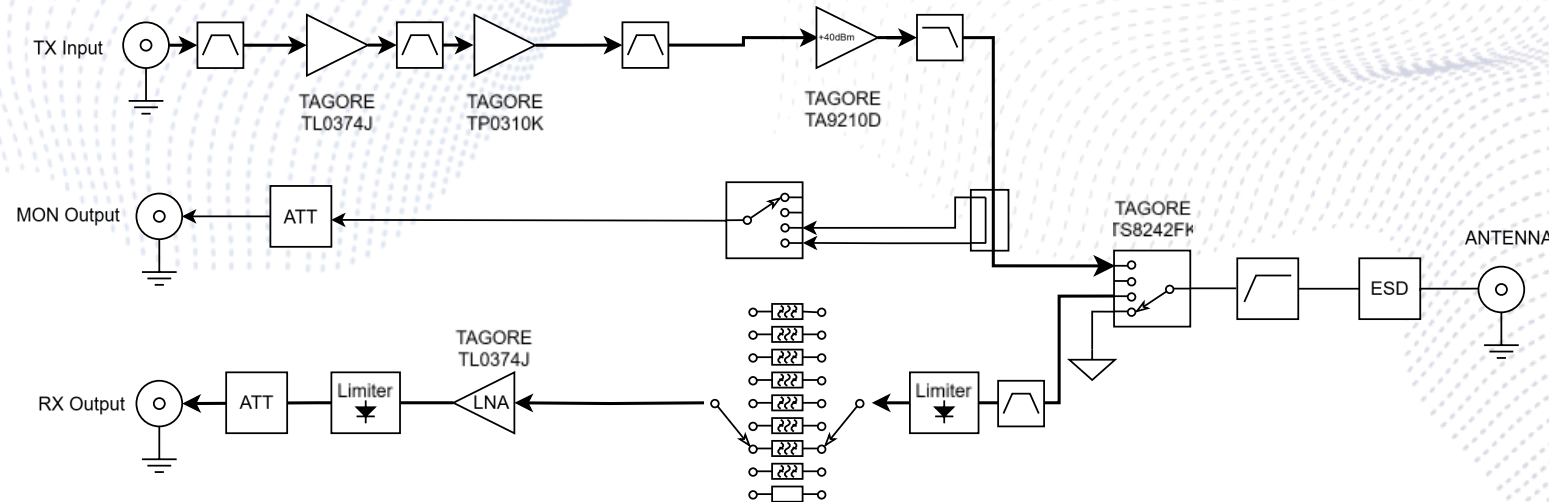
## X-band $10W_{avg} / 30W_p$

- No additional components compared to other GaN solutions
- Isolation more than 30dB at X-band
- 50...80 ns switching time
- $3.0 \times 3.0 \text{ mm}^2$  package



## NATO IV band $100W_{avg} / 250W_p$

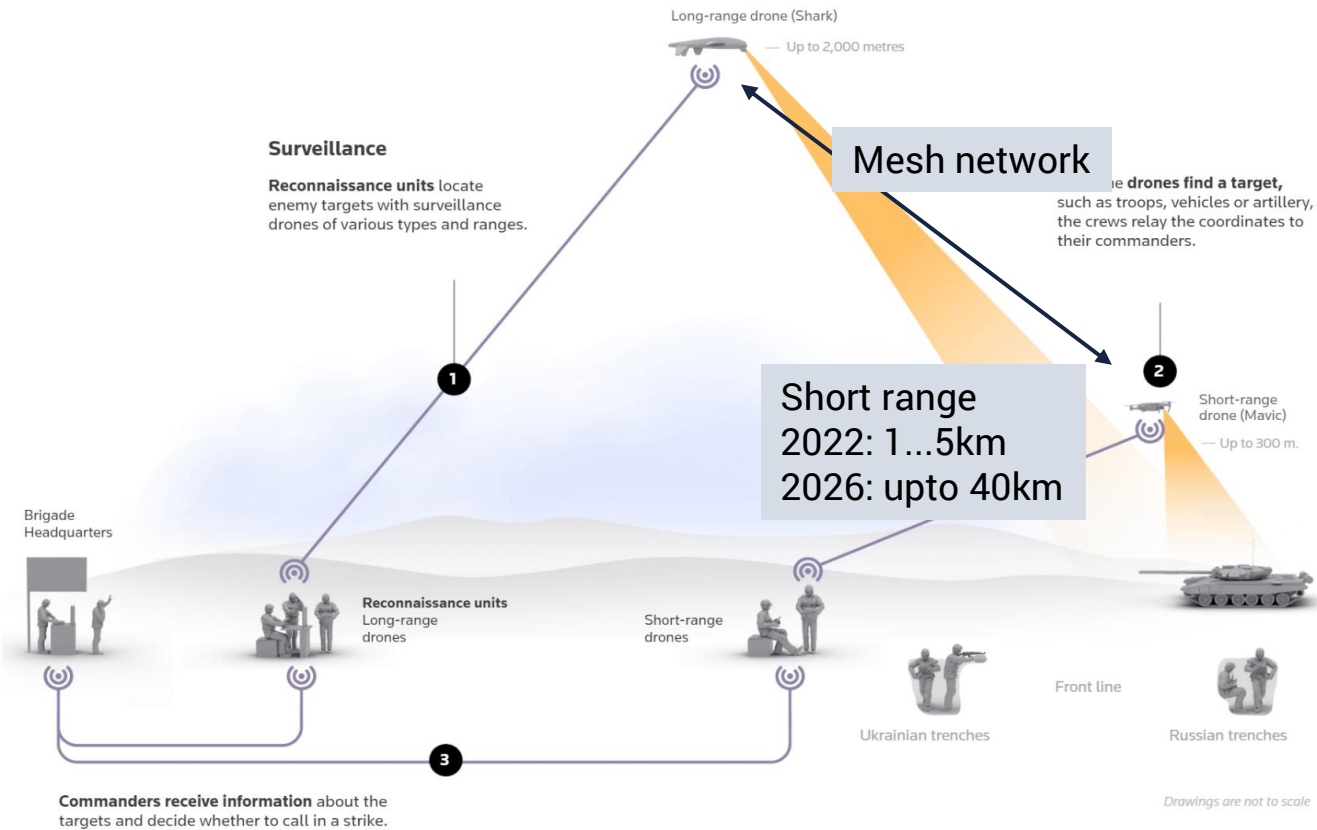
- Fully integrated solution
- Isolation better than 20dB at 5GHz
- 12 us switching time
- $5.0 \times 5.0 \text{ mm}^2$  package



## Tagore RF Front End for Drone Datalinks

- Tagore is developing reference design for drone datalinks
- Compatible with most SDR cards
- Ready to start testing with SDR
- Final stage  $P_{1dB} = 10W$
- Applicable RF power  $\sim 5W$ , with utilizing DPD
- Will be announced at IMS 2026

# Current battle field – grey zone up to 40km



12dB more power means four times the distance or 50...75% closer to jammer (AI with Camera)  
20dB means 10x distance or 70...90% closer to jammer (AI with Camera)  
Difference between 25dBm and 45dBm

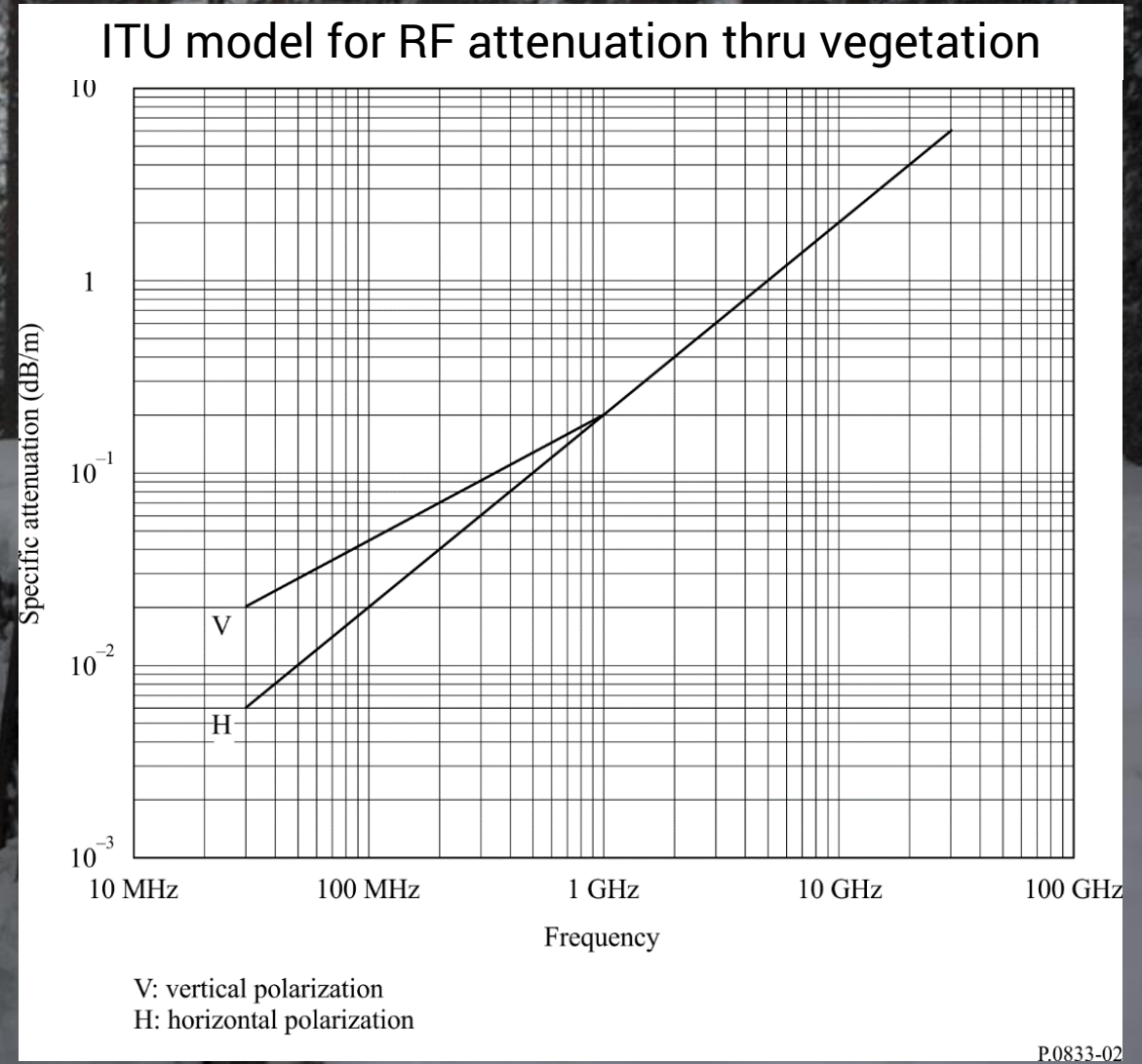
# Suomi elää metsästä – Finland lives in forest

- Finland has always taken advantage of forest
- Economical advantage – material for shelter, paper, pulp, export
- Defending independency – Battle of Raatteentie 40k enemies vs. 600 defenders
- Unique feature of Finnish nature

How is this linked to RF?

# RF propagation in forest

- RF Propagation in forest, high attenuation,
- Revival of HF, VHF, and UHF frequencies for datalinks, especially below 1 GHz but in open space upto 10 GHz
- VHF, UHF, SHF last Finnish Academic literature from year 2004
- Recent year academic focus have been at 100GHz area



# Summary

Drone warfare has revived 1 MHz – 10 GHz frequency bands with >5W RF powers

Tagore has developed RF GaN technology as key enabler for tactical and datalink communications at HF, VHF, upto X-band frequencies, targeting 5W and higher

Application development in Estonia

Close co-operation with Finnish industry

Question to Finnish Academia and Finnish Industry in RF field:

Do we have proper research and technology development focus to ensure working drone datalinks in Finnish Forest?