« Le GaN dans les systèmes militaires »

« GaN in military systems »

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Summary

- DGA presentation
- History
- GaN Advantages
- GaN necessary improvements
- GaN Circuits
- Substrates and Epitaxy
- European industrial base
- Military applications & Market
- Conclusion

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DGA : OUR MISSIONS

WWW.IXARM.COM

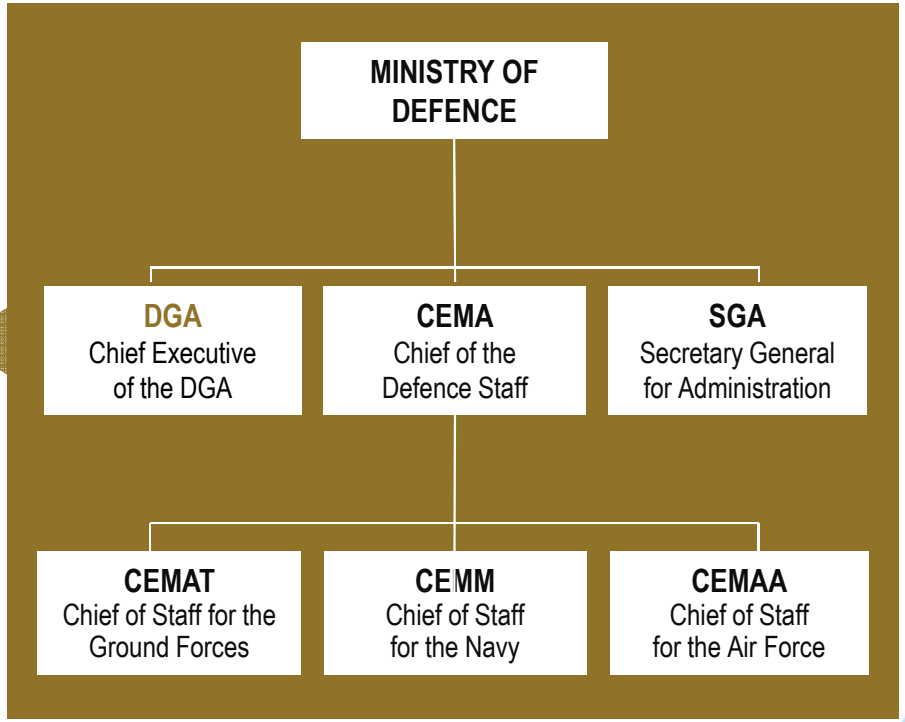
DEFENCE PROCUREMENT AGENCY

Equipping the Armed Forces

Preparing the future of Defence systems

Promoting Defence equipment exports

At the core of the Ministry of Defence



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Components activities at DGA

- Part of Technical Directorate
- All Electronic and opto-electronics components
- 40 persons in Bagneux (South of Paris) and Bruz (near Rennes)
- 13 persons working on microwave components and systems
- Expertise, technology analysis and RF characterisation

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GaN History at DGA

- Late 1990's GaN break-through is detected by DGA
- 2001 : First DGA contract to research labs launched
- 2003 : First military European conference (MoD's, Industry and research Labs) in Stockholm
  - MoDs convinced that they need to support the development of GaN microwave technology to make it available in Europe, without access restriction
- 2005 : Biggest EDA project (Korrigan) on components funded by 7 European MoD's is started
- 2006 : UMS started industrialisation
- 2011 : UMS GH50 technology qualified

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GaN advantages versus GaAs

- Firstly : transistors power density
  - Higher power T/R for radars
  - Higher power for jamming
  - Smaller circuits: lowering of the €/W cost
- Wide band capability for Electronic Warfare
- Robustness
  - LNA without limiter in radar antennas
  - Radiations
- Higher operating Tj

GaN necessary improvements

- HPA X band MMIC current capability
  - GaAs ~20mm² 10W PAE 40%
  - GaN ~20mm² >20W PAE 50%
- Without PAE improvement, the potential of this technology can't be exploited due to thermal constraints
- PAE and packaging with high thermal dissipation capability are still to be improved
- TJ 225°C qualification

GaN Circuits – next step

- T/R module with GaN / w/o GaAs
  - Robust LNA
    - NF ~ GaAs LNA
    - High linearity
    - >40dBm without damage
    - Recovery time !!!
  - Driver
- Other circuits
  - Power switches
  - Mixer (Higher compression point)
  - …

Substrates and Epitaxy (1/2)

- SiC substrates
  - Cristal compatibility with GaN
  - Good thermal propriety
  - But expensive compared to Si
  - Up to now one source (US) is delivering the majority of the 4 inches quality substrates
  - → MoDs support to have an European alternative : EDA MANGA project

- Si substrates
  - Not chosen in a first step :
    - Lower epitaxy quality
    - Thermal constraints for L to Ku band power devices
  - Solution for lower power devices at higher frequencies assuming the lossy lines issue is solved.

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Substrates and Epitaxy (2/2)

- Epitaxy
  - A European substrates provider won't be sufficient without a European Epitaxy provider to guarantee the availability of the GaN technology material for military application
  - After Korrigan the main technical approach exhibiting good result was MOCVD
  - European MoDs have the objective to make this European source emerging

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European Industrial Base

- Substrates
  - Norstel (Sw), SiCrystal (Ge)
- Epitaxy
  - IQE (UK), EpiGaN (B), Classic (Sw)
- GaN process
  - Ommic (Fr), Selex SI (It), UMS (Fr/Ge)

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GaN Military Applications

- The main applications are those which need high power in a small volume
  - Active antennas radar
  - Jamming
  - Seeker
  - Telecom
  - Military Frequency band : VHF, UHF, L to Ka
- SATCOM
  - A growing need waiting for European technology
  - Common Space and military need
  - Ka band

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GaN Military Market

- Deployment of GaN in progress for all the military applications in all the frequency bands
- Nevertheless European military market will not be large enough to feed the GaN suppliers
- ESA in phase with MoDs on the need
  - Regular meetings and workshops with ESA allow the alignment of both ESA and MoDs strategy
- Still waiting for the volume Telecom market

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Conclusion

- Strong effort from MoDs to develop GaN technology in Europe
  - Technology now available
  - Material availability to be achieved
- Thermal constraints still to be mitigated (PAE, Tj, packaging)
- Ka-band technology is the next step
- After HPA, need for LNA, Mixer….

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