



Offre n°2025-08578

## PhD Position F/M Modular compilation of real-time programs

*Le descriptif de l'offre ci-dessous est en Anglais*

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

### A propos du centre ou de la direction fonctionnelle

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region. For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

### Contexte et atouts du poste

The PhD student will be part of the [SyCoMoRES team](#) of Inria Lille & CRISTAL lab, which currently hosts 3 fellow PhD students and one postdoc. Lille is a city close to Brussels, Paris & London, easily reachable by train, with a large student population and a number of cultural places & events.

PhD students are appointed for a duration of 3 years. We plan to organize weekly research meetings with the PhD student.

### Mission confiée

A real-time system controls a physical device in its environment, at a rate adapted to the device evolution. This requires not only to compute correct values, but also to compute values at the right time. Real-time systems can be found in several industrial domains, such as automotive, aeronautics, nuclear plants or automated production lines.

Many ERTS are of critical nature; a malfunction may damage properties or even put human lives in danger. So as to ensure the safety of ERTS, a wide range of formal techniques have been proposed to support their design, implementation and validation. Unfortunately, one of the main drawbacks of formal methods is their poor scalability, thus limiting their applicability to complex modern ERTS. A classical approach to reduce complexity is the component-based approach. First, the system is decomposed into smaller components, each developed and analyzed in isolation. Then, the components are integrated together, and a simpler analysis is performed at the integration level.

In the current industrial practice for the development of ERTS, timing requirements are specified and analyzed only at the global level, when assembling all components. Thus, timing analysis suffers from the scalability issues mentioned previously.

The objective of the thesis is to contribute to a framework for the component-based development of real-time systems, by focusing on modular compilation.

The system will be programmed with the synchronous data-flow language Prelude, which was specifically designed for the development of critical ERTS. The language already contains constructs to structure a program as a hierarchical set of components. However, the Prelude compiler flattens the program before translating it into a non-hierarchical set of concurrent threads implemented in C.

The applicant we will study the compilation of a Prelude program into C modules structured with a hierarchy similar to that of the source program. They will define a notion of real-time interface for modules, which will expose the temporal characteristics necessary to compose modules together. The compiler will target execution with a Real-Time Operating System equipped with a hierarchical scheduler. In this scheduling model, each module is assigned a partition of the system resources and its sub-modules are executed by a local scheduler. Top-level modules are executed by a global scheduler. Particular care will go into ensuring that the semantics of the Prelude program is preserved by the

compilation, especially regarding the temporal characteristics of the module interfaces.

## Principales activités

The following activities will be carried out during the thesis:

- Bibliographic research
- Proposing solutions for the identified research directions
- Writing research papers on the thesis results
- Teaching (optional)

## Compétences

Technical skills: a good background on computer science and embedded systems.

Languages: English. French is *not* required.

Other valued, appreciated: compilation, synchronous languages, real-time systems, OCaml

## Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

## Informations générales

- **Thème/Domaine** : Systèmes embarqués et temps réel  
Plateformes expérimentales logiciel (BAP E)
- **Ville** : Villeneuve d'Ascq
- **Centre Inria** : [Centre Inria de l'Université de Lille](#)
- **Date de prise de fonction souhaitée** : 2025-09-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2025-03-21

## Contacts

- **Équipe Inria** : [SYCOMORES](#)
- **Directeur de thèse** :  
Forget Julien / [julien.forget@inria.fr](mailto:julien.forget@inria.fr)

## A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

## L'essentiel pour réussir

- Curiosity;
- Enjoying intellectual stimulation and facing new challenges

**Attention:** Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

## Consignes pour postuler

### Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

**Politique de recrutement :**

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.