2019-01920 - PhD Position F/M On the benefits of QUIC and application layer FEC for mobile cellular terminals

Type de contrat : CDD ou Mobilité IT
Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Docteurant

A propos du centre ou de la direction fonctionnelle

The PhD will take place as a CIFRE (Convention industrielle de formation par la recherche) between the ENENSYS SME (https://www.enensys.com/), leader in broadcast and telecom systems, and the Inria public research institute (https://www.inria.fr/). ENENSYS (previously Expway) and Inria (and more specifically Vincent Roca) have been working together for 14 years in a very fruitful manner, recently in the context of a joint Innovation Laboratory, LEELCO, on low latency robust communications.

The PhD will be hired by the ENENSYS company but will be located at the Inria research center, either in Grenoble - Montbonnot (preferred solution) or in Lyon (Campus de la Doua).

Mission confiée

Scientific context of the PhD

Application level forward erasure codes (or FEC) – meant to recover from packet losses caused by congestion or bad transmission conditions – are now well established as one of the key reliability technics for multicast/broadcast data flows. This is the case for massively scalable file delivery services (e.g., with the FLUTE/ALC or Route protocols), or real-time content delivery services (e.g., with the FECFRAME protocol, or DASH streaming, or mission critical systems used by emergency teams in-the-field). The 3GPP MBMS (and other related standardization bodies) have specified these FEC and protocol solutions, taking advantage of IETF standards, and various successful deployments have been done worldwide, e.g., in 4G cellular networks.

Recently, the known limitations of TCP – in particular for Web content delivery through HTTPS – have led to the specification of a new transport protocol under the impulsion of Google, QUIC. A major and highly dynamic standardization activity has begun, performed in the context of the IETF QUIC Working Group. The main goals of this protocol are manifold: improving flexibility (e.g., by defining several reliability models or multiplexing facilities), improving performances (e.g., by multiplexing several independent streams in a single connection, thereby limiting the head-of-line blocking of TCP while providing a lightweight mechanism), improving security and confidentiality (e.g., the traffic is systematically encrypted – it’s mandatory –, leveraging on the latest TLS 13 protocol), making protocol ossification impossible (i.e., middleboxes are no longer in position to look into and modify packet headers since QUIC Header is encrypted and integrity protected). Other improvements are also under study, like for instance the addition of a datagram service, of multi-path capabilities, or multicast delivery.

In parallel, a lot of work has been carried out on sliding window FEC codes, that proved to further improve robustness with respect to more traditional block codes (e.g., Reed-Solomon, LDPC, RaptorQ codes) in situations where real-time requirements are unavoidable. These codes (for instance RLC codes whose IETF standardization is almost finalized), that are specially crafted for the packet loss channel (also known as the erasure channel), are good candidates for QUIC.

Principales activités

Subject proposal

Among the potential improvements of QUIC, the IRTF “Coding for Efficient Network Communications Research Group” (NWCRG), co-chaired by one of this PhD advisors, is working on the addition of FEC in QUIC. We believe (and experiments start to prove) that an appropriate usage of FEC coding can help in improving QUIC behavior in various situations without negatively impacting congestion control nor other essential features any transport protocol should ensure.

The proposed PhD work will focus on mobile communications for cellular terminals rather than generic Internet. In this context, several features of the associated use-cases may be useful in further improving the QUIC protocol and offering gains over existing solutions. The goal of this PhD is to assess if and how QUIC could help in these use-cases, considering unicast, broadcast and/or multi-path communication scenarios.

In addition to more theoretical aspects, this PhD proposal naturally includes a lot of practical work, namely playing with and improving QUIC and FEC implementations, benchmarking in various simulation environments, monitoring standardization activity. Potentially, new mechanisms could be proposed and standardized within IETF and/or 3GPP.

Contacts - advisors

Any person potentially interested should contact both:

- Vincent Roca, PhD/HDR, Inria research institute, France, roca@inria.fr, https://www.inria.fr/people/vincent-roca/
- Christophe Burdinat, engineer, ENENSYS, France, burdinst@enensys.com

Please contact the two persons simultaneously. More information will be provided on demand.

References

Informations générales

- Thème/Domaine : Réseaux et télécommunications
- Système & réseaux (BAP E)
- Ville : Montbonnot
- Centre Inria : CRI Grenoble - Rhône-Alpes
- Date de prise de fonction souhaitée : 2019-10-01
- Durée de contrat : 3 ans
- Date limite pour postuler : 2019-09-15

Contacts

- Equipe Inria : PRIVATICS
- Directeur de thèse : Roca Vincent / vincent.roca@inria.fr

A propos d’Inria

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l’interface d’autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 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

Why should you apply?

It's a PhD: this is never easy, from times to times it is stressful, but you will be rewarded for all your efforts. In particular, since the work takes place in relationship with a French SME, this work may help shaping new services, with potentially worldwide deployments: having concrete impacts can be highly rewarding for a PhD.

If you are curious, motivated, interested by working a multicultural environment, at the boundary between the academic and private domains, if you are not reluctant to dig into complex technical documents that describe protocols and techniques nor academic research papers, if coding in C/C++/Python or something else is a pleasure for you, if you are fascinated by Internet and want to actively contribute to its evolution, then let's have a talk together!

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.

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

Compétences

Candidate’s profile

The PhD candidate should preferably have a previous experience in 2 of the following 3 areas:

- Transport layer networking and congestion management;
- Forward error/erasure correction;
- Access technology (broadband, mobile or satellite).