AirDocs (Documents in the Air) is a middleware system that allows placing and retrieving objects or documents at different indoor locations **without** requiring a positioning system. It:

1. relies on WiFi/Bluetooth infrastructure existing in most homes and institutions
2. requires only a single additional server visible in the intranet, and an app that can be installed on any smartphone.
3. does not require training of, or support from a location service
4. enables many applications that involve natural placing / retrieving documents at locations

Indoor WiFi signal propagates in an irregular fashion due to multipath and shadowing caused by the building itself, furniture, and people. But at a given location, propagation to and from access points, while not predictable, is relatively stable in time and is specific to that location. The same can be said about GSM/4G propagation, as well as sound reflections from the walls - the collection of these measurements is unique to the location they are measured at. The wireless measurements (WiFi, 2G/3G/4G, Bluetooth) are monitored permanently by all smartphones as part of their normal functioning, requiring no additional gathering effort. We aggregate all these measurements into a "rich signature" for the physical location as shown in Figure at the right.

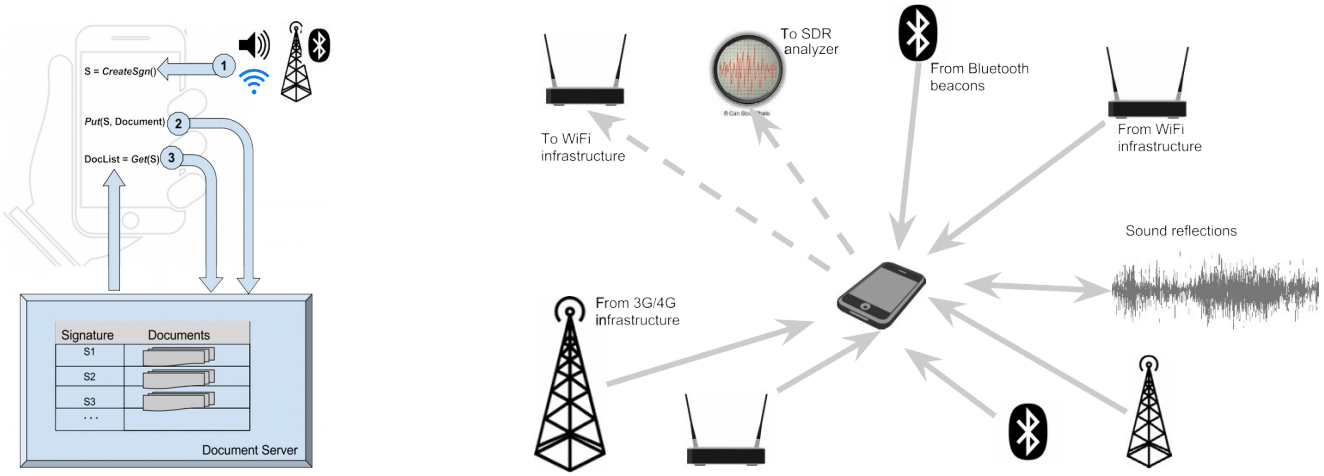

Figure left: Primitives used to create/use location specific signatures to index collection of documents associated with locations. *Put* function places a document "in the air" at a location identified by signature S. *Get* function retrieves document placed at signatures close to S.

As will be detailed later in the proposal, other sensors available on the smartphones can also be used: sound, magnetic, compass. The unique rich signatures obtained can then be used to manage a document collection without mapping them to geographical locations, but in fact obtaining an association between a document and its unique location in the building(but not cartesian position). The datastructure obtained is like a location indexed database, but without the actual positions which are expensive to obtain and maintain. The middleware will offer three main primitives to the applications:

1. S = *CreateSgn*() harvests location specific signal statistics from the phone sensors(WiFi, 3G, sound, etc) and creates a multidimensional signature that cannot be confused with any other location signature in the building;
2. *Put*(S, document) stores a document on the server associated with the signature S; The signature is created by a phone, but the indexing of the signatures and the document storage happen on a server in the intranet (or Internet).
3. *Get*(S) - a phone harvests its current signature, and asks the server for a list of documents that have "close" signatures, meaning documents that have been stored at the same location. The server searches in signature space, and real geographical coordinates are never stored.

What is achieved is a form of augmented reality with the users having the illusion of the documents being spread in the physical environment, only visible at certain locations. Leaving a document "in the air" allows for a natural way to use it as a wireless post-it for museums explanations, maps & directions in airports and malls, lab door announcements, restaurant menus, etc. The purpose of *AirDocs* project is to experiment with rich signatures (creation, maintenance, classification), searches in signature space, implement a proof of concept for the middleware, and several Android applications that would usually require location: wireless post-it, graffiti, guided navigation. Full blown applications will have to consider institution specific document policies (their maximum size and life length), security(who can create documents), scalability, and an appropriate human interface to facilitate production and consumption of spatial data.